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Make the Repair Job a Thorough One

During periods of freight car shortage demands are so insistent that it becomes the first duty of all concerned to do everything possible to assist in improving the utilization of the existing rolling stock. The incentive is a real one when it is remembered that at such times a car not used represents an average revenue loss of about $6 for each idle day. It is a startling fact that freight cars spend about 20 per cent of their time on repair tracks or in traveling to and from such tracks. This is the point where the attention of the mechanical departments of the railroads must be concentrated if they are to do their share toward improving conditions. As a car leaving the repair track means one more car available for traffic, at times of urgent demand for cars there is a strong temptation to do just enough work to turn a car back into service again. The general car situation has been but little improved, however, if at an early date that same car is obliged to make another trip to a repair track and has to be again withdrawn from service for another day or so, as is usually the case even though the work may be performed in an hour or two. When the need for cars is the greatest is the time when the fullest benefit may be obtained by doing a thorough job on every car that reaches the cripple track. Not only should the work that is necessary to repair the parts whose condition caused the withdrawal of the car from service be well done, but in addition the opportunity should be utilized to repair all other parts which careful inspection shows might require attention at an early date. It is not so much the number of cars which are turned out that really counts as the number of cars which are in a condition to stay out in service and continue to earn revenue.

Utilizing Capacity of Locomotives

There seems to be a general impression among railway operating men that modern locomotives do not give as high power output in proportion to their weight nor haul as heavy loads as locomotives in use some years ago. Investigation often shows that the available power of large locomotives is not being fully used and very often trial runs show very much better performance than is attained in everyday service. A comparison of locomotive tractive force with train resistance in most cases would indicate that heavier loads could be hauled or higher speeds made than seems possible in practice. Probably the reason that a large locomotive does not come up to expectations, even when in good condition from a mechanical standpoint, lies in the fact that it is supplied with a limited amount of fuel, often very much less than it has been designed to burn. The general proportions of locomotives are usually based on the assumption that 120 lb. of coal will be burnt per hour for each square foot of grate area. Typical modern Mikado or Pacific type locomotives usually have from 60 to 70 square feet of grate and would, therefore, require 7,200 to 8,400 lb. of coal an hour. The limit of hand firing is about 7,500 lb. an hour but the best that can be expected from the average fireman is about 6,000 lb. It is natural for the fireman to spare himself as much as possible and in every-day service the rate of firing will usually not exceed 3,000 to 4,000 lb. of coal per hour while a locomotive is running. This means that the firebox is getting less than half the amount of coal it can use and the cylinders are getting only about half the amount of steam they were designed for.

Under these conditions it would be possible to increase the power of the locomotive at a speed where the boiler is the limiting factor by as much as 40 per cent by merely increasing the fuel supply. There is a big opportunity for improving operating performance by starting a campaign among the firemen to get them to supply somewhere near the amount of coal a locomotive is intended to burn. If this cannot be done there does not seem to be any excuse for building such large hand-fired locomotives. If the locomotive was designed for the limited amount of coal which the firemen will shovel, it could be made smaller, cheaper and be easier to maintain. There is another alternative, of course, the application of mechanical stokers on all large locomotives. It is generally accepted that the application of a stoker is justified on locomotives requiring over 6,000 lb. of coal an hour. Many locomotives that far exceed these limits are still being built for hand firing. There seems little justification for providing excess capacity unless it can be utilized and the application of stokers on all large locomotives would seem to be absolutely necessary for efficient operation.

An Effective Schedule at Jackson Shops

There is no doubt that many practical railroad shop men object to schedule systems because of the clerical work involved in filling out certain forms. They fail to realize that shop schedules, to be of practical value, must consist of something far more vital than assigning a clerk to fill out forms regarding work already done. The effective shop schedule orders work and material in advance, and is an important aid in locating weak departments, speeding up operations and increasing shop output. The schedule system has already demonstrated its ability to perform these functions, and the number of forms used can be suited to the needs of individual shops. The schedule system installed at the Jackson shops of the Michigan Central, as described in this issue, has few printed forms, and yet its effective control of shop operations was one of the important factors enabling the Jackson shops to recover quickly from the strike and in a period of three months show an important increase above normal output.

The first essential of any successful schedule system is that the entire shop supervision believe in it and work for it. At Jackson, everyone from the division master mechanic and shop superintendent down to the youngest foreman is apparently an enthusiastic booster for the schedule. The reason is that the schedule system gives these men a reasonably logical method of controlling shop operations. It relieves them of many minor details, affording opportunity to concentrate on more important features of the work. In addition, it so times the work of the various departments that as a rule locomotive parts arrive at the erecting shop ready for assembling as they are needed.

It is impossible to run a shop schedule system successfully without the services of some man of reasonably high calibre, who is familiar with locomotive repair work, to fill the position of schedule supervisor. At Jackson this man is given the title of schedule foreman and made responsible not only for scheduling locomotives but also for following up work orders, trucking all material through the shops and shipping to outside points. The schedule foreman has an assistant to handle details of the work, a clerk to look out for work orders, and ten laborers provided with power tractors and trailers for moving material. The movement of material is intimately involved in a successful schedule system; knowing when various operations are to be completed, the schedule foreman is in the best position to supervise the movement to the next machine or department. Special attention is directed to the efficient power-trucking system at Jackson shops as described in the article.

Of particular interest also is the efficiency department at Jackson, composed of two machinists, two boiler makers and a blacksmith who, under the close personal direction of the assistant shop supervisor, devote their entire time to tracing delays as indicated by red marks on the schedule board, locating the weak points in various departments and strengthening them. When one department has been brought up to the standard, some other becomes the limiting factor and receives the same kind of attention. In this way there is a gradual toning up of the entire shop organization, with a decidedly favorable effect on shop output.

The Standard Box Car

A circular recently issued by the American Railway Association states that the committee on car construction of the Mechanical Division has practically completed designs for standard box cars of 40 and 50 tons capacity which will be submitted to the roads which are members of the American Railway Association for adoption. The standard car will probably be the most important technical question that will come before the next Mechanical Division meeting. Standard designs for freight cars have often been proposed before but it has not been possible to get the railroads to agree on a satisfactory type. In 1914, the American Railway Association appointed a committee to work out designs for standard box cars. A sub-committee representing the principal carbuilders was appointed and later representatives of the mechanical departments of some of the principal railroads were added to the membership. Three designs were prepared by the subcommittee and sample cars were built in 1917 but a short time later this country entered the war and the matter was not carried through to a conclusion.

When Mr. McAdoo was appointed director general of railroads, he attempted to bring about a standardization of equipment which resulted in the design of the cars built by the Railroad Administration. These were compromise designs hurriedly prepared and no one has ever proposed that they should be perpetuated as a standard of American railroads.

Since the end of federal control the Committee on Car Construction has gradually been laying the foundation for the development of the standard box cars. As a basis for the design, certain fundamental dimensions and minimum strength requirements were proposed in 1920. These were adopted by a letter ballot of the Mechanical Division and approved by the American Railway Association. The designs which the committee is now ready to submit have, no doubt, been worked out with the greatest care. It still remains to be seen whether the railroads will be able to get together on the project on which in the past they have never been able to agree. It is evident that certain advantages could be obtained by a standardization of box cars but there are difficulties in putting the scheme into practice. The standard car would certainly stop the building of inferior designs. It should bring about some reduction in the cost of building cars and should facilitate repairs on foreign lines after a sufficient number have been placed in service to justify the roads in keeping repair parts in stock. There are certain difficulties that are bound to arise from the adoption of a standard car. After the design has once been definitely standardized there will be a tendency to perpetuate it and if this is carried too far it may prevent the adoption of improved types of construction. It will also be difficult to develop a design that will not discriminate against the manufacturers of certain car appliances.

There is some question whether the railroads are ready at this time to adopt a standard car but even if the time is not ripe for a unified design, the roads should go on adopting standard dimensions and minimum requirements that will promote interchangeability of parts and facilitate the repair of cars off the home line.

The Problem of Rebuilding Locomotives

One of the perplexing problems which the railroads have had to face in recent years has been to obtain a well balanced design in rebuilt locomotives without excessive expenditures. Practically all the important modern appliances for increasing the economy of the locomotives are boiler accessories. If the boiler is rebuilt with the addition of one or more of these devices it usually has more capacity than the cylinders can use and as the railroads are anxious to get the maximum tractive force from all their motive power, it is desirable to increase the size of the cylinders. If the cylinder diameter is increased to utilize the available steam capacity, the stresses on the main rods, driving boxes and frames will be too high in most cases. This makes it necessary to provide practically an entire new set of machinery and increases the cost of rebuilding very greatly. Since the introduction of devices for utilizing the trailer or tender wheels to increase the tractive force at low speed, a new method is available for overcoming this difficulty. By applying such devices for increasing the tractive force, the capacity of the boiler at low speed can be utilized. At higher speeds the main cylinders would be able to utilize the full boiler output by running at a slightly longer cutoff. Thus from the engineering standpoint, the introduction of auxiliary devices for increasing tractive force offers new possibilities for obtaining a well balanced design in rebuilt locomotives.

Engine Terminal Machine Equipment

It would be possible, but rather unusual, to overestimate the importance of adequate modern machinery in enginehouses. In most cases the condition is reversed and the needs are underestimated to such an extent that sufficient machine equipment is not available, in proportion to the locomotives despatched, to keep motive power in good operating condition and eliminate delays. Frequently there are no machines at small terminals to perform even comparatively simple operations, such as turning, boring or shaping. As a result, locomotives must be taken out of service and sent to the back shop for slight repairs, or else held in the roundhouse while defective parts are shipped to the main shop, repaired and returned. Revenue is lost while the locomotives are out of service, and unexpected light repair jobs disorganize the schedule work in the back shop.

In enginehouses provided with machine equipment, on the other hand, some of the machines are so old, and were so old when discarded by the back shop, as to be practically useless. Many instances of machinery of this kind, which hinders more than it helps, could be cited, but one will suffice. A prominent eastern railroad purchased a new driving wheel lathe for installation at one of its back shops, the old lathe being shipped to a comparatively new enginehouse and set up. The old lathe was an obsolete model with the driving gear teeth on the face plates exposed, badly worn and having large portions of several of the teeth broken out. In fact, the lathe was in such shape that it could not be used for turning tires at all. It was occasionally used to true journals, but on the whole was more of a liability than an asset, taking valuable space in a congested enginehouse.

The lack of machinery in enginehouses is costly in three ways: Loss of revenue from delayed locomotives, cost of shipping locomotive parts to back shops for repairs, and undue interference with back shop work, increasing its cost. Enginehouse work sent to the back shop is usually marked rush and greatly interferes with the output of the back shop because schedule work must be taken from the machines, the rush enginehouse work substituted and the schedule work then set up again. Where several terminals are located near together and at some distance from the main back shop, experience has shown it a paying investment to equip one of the terminals with a small production machine shop capable of supplying the needs of that district for cylinder packing, valve packing, rod brasses and similar parts. With a few modern machines these parts can be made as accurately and cheaply at the roundhouse as at the back shop. In addition the cost of shipping is saved and the parts are available when needed in a hurry.

Locomotive Maintenance Standards

The ability of a road to handle satisfactorily the volume of traffic offered may at times depend upon the degree of perfection to which the motive power is maintained. A so-called "car shortage" is usually due only in part to an actual lack of cars. Other important contributory causes may be a lack of sufficient terminal facilities or some factors for which the mechanical department is not responsible. The mechanical department is responsible, however, if a sufficient number of the locomotives owned are not maintained in a suitable condition to operate without frequent minor running repairs. A low standard of maintenance makes it difficult to handle full tonnage trains promptly without delays on the road or to turn locomotives as quickly as they should be turned to render the maximum service in relieving traffic congestions. Conditions during recent months have greatly increased the number of locomotives needing general overhauling and the back shops have a big program ahead of them to bring the number of unserviceable locomotives down to a normal figure.

While there undoubtedly is an urgent need for many new locomotives and for a thorough and prompt overhauling of considerable existing power, the need for adherence to a high standard of maintenance and the benefits that can be obtained therefrom should not be overlooked. Even roads that in former years insisted on a relative high state of maintenance have been obliged recently to lower their standards. To such, it may hardly be necessary to call attention to the need of raising the standard as rapidly as possible. The next few months mark what is usually the most trying period of the year at locomotive terminals. Leaky boilers and poor steaming locomotives are indeed a source of trouble in severe weather. Leaky rod packings are dangerous while leaky cylinders and piston packing rings reduce the capacity of the locomotive and have a considerable effect on the fuel consumption. This is also a time of the year when more than the usual attention should be given to the condition of the front end and draft apparatus. Lack of prompt attention to slight defects or wear of mechanical details may not result in immediate and important increases in fuel consumption but if neglected will add considerably to the total eventual cost of repairs. A low standard of maintenance is never economical. Any apparent immediate savings will be far more than equalled by increased bills for fuel and by higher costs of frequent running repairs and general overhaulings.

New Books

Sampling and Analysis of Pig Iron. *By the Chemists' Committee of the United States Steel Corporation. 40 pages, 6 in. by 9 in., bound in paper. Published by the Carnegie Steel Company, Pittsburgh, Pa.*

This book describes the accepted and approved methods used by the chemists of the constituent companies of the United States Steel Corporation for the sampling and analysis of pig iron, which have been revised to include the latest practices. The work is not only authoritative, but it is also very complete. In addition to methods for determining the more common elements, the determination of titanium and of copper are described.

Production Grinding. *By F. B. Jacobs. 238 pages, 6 in. by 9 in., bound in cloth. Published by the Penton Publishing Company, Cleveland, Ohio.*

This well-arranged and carefully-printed book pertains to production grinding in the industries and contains 188 illustrations. Grinding practices in the automotive field are naturally given the most space, and the use of grinding machines in five prominent American automobile plants, for cutting and finishing repetition machine parts in large quantities, is outlined. Experience in these plants shows that both high production and accuracy can be obtained at the same time with modern grinders, a combination not found to the same degree in any other type of machine tool. While no consideration is given directly to grinding in railroad shops, the book should be read by those interested in more efficient railroad machine shop operation. Many jigs are illustrated, some of which could probably be adapted with slight changes to railroad shop use and a chapter on die grinding will have certain practical applications.

Air Brake Association Proceedings for 1922. *F. M. Nellis, Secretary, 165 Broadway, New York. 232 pages, 6 in. by 9 in. Bound in cloth.*

The twenty-ninth annual convention of the Air Brake Association took place at Atlantic City on June 19, 20 and 21, 1922, only an open meeting of the Executive Committee having been held in 1921. The papers and reports presented included the following: Wastes in Air Brake Service, a paper by Prof. S. W. Dudley; U. C. Equipment, a paper by J. C. McCune of the Manhattan Air Brake Club, and a lantern slide lecture by R. E. Miller; Air Consumption of Locomotive Auxiliary Devices, a final committee report; Triple Valve Repairs, a committee report by the Northwest Air Brake Club, and Recommended Practice, a committee report to which is added a complete copy of recommended practices with the 1922 revisions.

In addition to convention proceedings the Air Brake Association now publishes books on Maintenance of Freight Brakes; Maintenance of Steam Driven Air Compressors; Questions and Answers on No. 6 E. T. Equipment; Handling Passenger and Freight Trains; U. C. Brake Equipment; Code for Testing Air-Operated Auxiliary Locomotive Devices, and Principles and Design of Foundation Brake Rigging.

WHAT OUR READERS THINK

Comments on Designing Gondola Car

Chicago, Ill.

To the Editor:

In the article, "Method Used in Designing C. M. & St. P. Gondola Car," in the November issue of the *Railway Mechanical Engineer,* there appear to be a few arithmetical errors.

Referring to page 641, middle of first column, calculation of moment of inertia of center sill, item "Channels," quantity Ad^2 should read 1.78, not 17.8. This makes $I_z = 1108.546$, $S_t = 148.5$ and $S_b = 142$. Ratio $\frac{US}{ES}$ should read $= \frac{1}{29.4} + \frac{2.05}{142} = .048$.

Calculation near bottom of second column, page 641, should read

$$\frac{250{,}000}{29.4} + \frac{250{,}000 \times 2.05}{142} = 12{,}120 \text{ lb. per sq. in.}$$

Under heading "Body Bolster," page 642, second column, item reading "I_z of webs ———," the third quantity, 14.75, should be cubed, not squared. The summation is correct, however. Line below giving Ad^2 of flanges $0.75 \times 7.5^2 \times 4 = 169$, not 42.2. Sum of $Ad^2 = 1162$ and I_z total $= 1296.35$, instead of 1169.54 making $S_m = 159.5$. With this section modulus stress will become 10,000 lb. per sq. in. very near.

On page 643, "Side Truss," last item of p_4 should be

$$\left(\frac{1}{4} \times p_1\right) \text{not} \left(\frac{1}{4} + p_1\right)$$

while developing a large horsepower when running fast.

In calculating stresses in the diagonals a "straight line" strut formula is used when $\frac{l}{r}$ is as high as 178. The writer believes this formula should not be used when $\frac{l}{r}$ exceeds 120. However, your correspondent has apparently taken l as actual length instead of "equivalent length" which would be one-half actual length when ends are fixed. His intention is apparently to cover this factor by limiting stress to 14,000 lb. per sq. in. It is doubtful whether the method taken gives fair values of the stresses. Certainly member D.E. showing such a wide difference of 3,900 lb. per sq. in. "allowable" and 13,700 lb. per sq. in. "actual" should hardly be passed without further investigation by one of the more exact strut formulas.

The same remark applies to the top chord. The calculation of bending moment due to outward pressure of load is not given, but the writer would be inclined to doubt that a stress of 20,000 lb. per sq. in. on top angle is reduced to 7,630 lb. per sq. in. by the mere application of a wood plank in its weakest direction for bending. The resultant pressure on the side of the car acting at two-thirds the depth from the top can be shown to be

$$P = \frac{1}{2} w D^2 \tan^2 \left(45 - \frac{1}{2} h\right)$$

where w = weight of material per cubic foot (sand = 100 lb.)
D = total depth of load (say 5 ft. 0 in.)
h = angle of repose of material (sand 40 deg.)

Placing in the appropriate values, we find P = 272 lb.

Therefore, reaction at top angle $= \frac{272}{3} = 91$ lb. per linear foot of car side. Added to this we have a pressure due to centrifugal force when passing around curves at high speed. Assuming an 8-deg. curve and a speed of 40 m.p.h., the well-known formula for centrifugal force gives a pressure of 15.1 lb. per sq. ft., or 75.5 lb. per linear foot of car side.

This load is evenly distributed; therefore, reaction at top angle $= \frac{75.5}{2} = 37.75$ lb.

Total reaction at top angle $= 37.75 + 91 = 128.75$ lb. Bending moment taken over 15 ft. length.

$$M = \frac{128.75 \times 15 \times 15 \times 12}{12} = 29{,}000 \text{ in.-lb.}$$

It now remains to distribute the stress created by this bending moment between the wood and steel. The deflection produced is obviously the same for both members and is in general cases expressed by

$$d = \frac{Wl^3}{nEI}$$

where d = deflection in inches.
W = total load in pounds.
l = length of beam in inches.
E = modulus of elasticity.
I = moment of inertia of section.
n = factor depending upon method of loading and support.

The deflection for the wood may be written $d_w = \frac{W_w l^3}{nE_w I_w}$

and for the steel $d_s = \frac{W_s l^3}{nE_s I_s}$

and from conditions $\frac{W_w l^3}{nE_w I_w} = \frac{W_s l^3}{nE_s I_s}$

l^3 and n are common to both and may be omitted giving $\frac{W_w}{E_w I_w} = \frac{W_s}{E_s I_s}$

Taking $E_w = 1{,}700{,}000$ lb. per sq. in. for LL yellow pine
$E_s = 27{,}000{,}000$ lb. per sq. in. for steel
$I_w = 9.48$
$E_s = 4.05$
we obtain $6.78\ W_w = W_s$

That is to say the total load W is shared between the wood and steel in the ratio of 1 to 6.78. Seeing that the bending moments taken by the wood and steel are proportional to the loads, we can say that the wood takes

$$\frac{29{,}000}{1 + 6.78} = 3{,}720 \text{ in.-lb.}$$

and the steel $= 3.720 \times 6.78 = 25{,}280$ in.-lb.
Section modulus of the wood = 7.97
Section modulus of the steel = 1.56

Therefore, stress on wood = 467 lb. per sq. in. and on the steel = 16,200 lb. per sq. in.

The angle also carries a thrust of 36,600 lb. as a truss member tending to buckle it in same direction as side loading.

The bending moment of 25,280 in.-lb. on the angle is equivalent to an end thrust T multiplied by the deflection.

If, therefore, the deflection due to side pressure is calculated, and also the equivalent end thrust, to which is added the thrust of the truss framing, the section may be treated as a column with the new loading.

$$\text{Deflection in this case} = \frac{WL^3}{EI} \times \frac{5}{384}$$

$$d = \frac{1,930 \times 180^3}{27,000,000 \times 4.05} \times \frac{5}{384} = 1.34 \text{ in.}$$

End thrust $= \frac{25,280}{1.34} = 18,900$ lb. to be added to 36,600, making 55,500 lb. Using strut formula, allowable stress $= 16,000 - 70 \frac{l}{r}$

$$f_a = 16,000 - 70 \times \frac{15 \times 12}{2 \times 1.01}$$
$$= 9,700 \text{ per sq. in.}$$

Area = 4 sq. in. Therefore, allowable load = 38,800 lb. Actual load = 55,500 lb.

This would seem to show that the top angle is rather highly stressed, but this maximum would only occur when car, loaded with perhaps the heaviest type of material (sand), passes around a curve at high speed. Also the side posts have some influence in supporting the 15-ft. length of angle and therefore the above calculated bending moment may be higher than would actually occur. For these reasons the section 5 in. by 3½ in. by ½ in. angle is probably about right, although 5 in. by 5 in. might be better.

The large number of cars with badly bulging sides that are to be seen in service is sufficient evidence of the importance of obtaining the best possible design of side construction.

H. J. Coventry.

Note—Slide rule was used in all calculations.

Note: In addition to the points mentioned above, attention is called to the fact that in the table on page 641 giving the meaning of the symbols, the items S_b *and* S_t *should be transposed.*

Advantages of Three-Cylinder Locomotives

Ashford, Kent, England.

To the Editor:

As one who has made a close study of three-cylinder locomotives during the past 15 years, I have read with the greatest interest the article in the November issue of the *Railway Mechanical Engineer* dealing with the Characteristics of Three-Cylinder Locomotives. The conclusions arrived at exactly agree with those given in a paper which the writer read before the Institution of Locomotive Engineers (London) in 1918.

While Mr. Meineke has made out a good case for the use of three cylinders, there are yet other advantages which he has not touched upon. For instance, the reciprocating masses of each set of parts are only about 70 per cent of a corresponding two-cylinder engine, and further, it is sufficient to balance, say 50 per cent, instead of 66 per cent. The balance weights are therefore much lighter, and not only so, but their positions are such that the weights on the right and left-hand sides are about 180 deg. apart. As a consequence, there is little or no variation in adhesion when running fast, because when one weight tends to lift the left-hand wheel, that on the right-hand side acts downwards. In the two-cylinder engine the weights are 90 deg. apart and their combined effect is to alternately augment and diminish the adhesion of the pair of wheels. This variation in adhesion in conjunction with the more irregular turning moment makes the two-cylinder engine more liable to slipping while developing a large horsepower when running at relatively high speeds.

As far as the longitudinal forces are concerned, the three-cylinder is self-balanced, and it is only necessary to consider the effect of the couples which tend to rotate the engine in a horizontal plane and possibly it may be found that no balancing for the reciprocating weights is necessary.

The dynamometer car records show that the drawbar pull is much steadier than in a corresponding two-cylinder engine.

Owing to the smaller piston loads and the fact that the inside piston partly opposes the thrust of the outside, the wear on driving boxes is reduced, there is less shock in the reversals of steam loads and, moreover, there is a larger bearing area available for carrying loads. As a consequence, wear is reduced generally.

It is found possible in British practice to accelerate trains from rest or to work slowly up a heavy grade with full throttle and maximum cut-off without undue disturbance to the fire due to the six light exhaust beats per revolution of the wheels. It is also found practicable, owing to the excellent balancing, to run heavy passenger trains at 70 miles per hour with 68-in. driving wheels. Hence three-cylinder locomotives can be said to possess a large degree of flexibility in working as they are not only eminently suited for pulling heavy loads, but also for fast running.

One of the problems in the design of three-cylinder engines is the question of the inside valve gear. After some study of this subject in 1908 the writer devised a means of operating the inside valve from the outside gears by the use of rockers. About the same time H. S. Vincent of New York also devised a somewhat similar arrangement, and this was described by J. Snowden Bell in the Proceedings of the American Master Mechanics' Association, Vol. XLVI, 1913. Since then the same principle has been discovered in Germany and put into practical use. On the other hand, the North Eastern Railway (England) prefers three complete sets of link motion, a total of six eccentrics on the driving axle. Locomotives built by Borsig in Berlin have an independent Walschaert gear inside the frame, driven from an additional return crank on the outside through a rocker. An independent gear gives a more nearly correct result, but it is often difficult to apply. The resulting motion from the combination of the two outside gears is not an exact reproduction of the primary gears, but it is sufficiently near for practical purposes. If the primaries were pure harmonies, the inside valve would also have a harmonic motion. As it is, the primary valve gear gives a periodic motion compounded principally of a harmonic and a small octave at a phase of 90 deg. and twice the frequency. When the two outer gears are combined, the resulting motion is influenced by these small octaves, but not sufficiently to matter, even in full gear of 75 per cent. As a maximum of 66 per cent cut-off is all that is necessary in three-cylinder engines, the small irregularities of motion are diminished and at 25 per cent there is little or no difference to be detected.

The design of the cylinders has advanced considerably and steam and exhaust passages are simple and direct while joints under steam pressure are avoided. Some recent designs are suitable for either plate or bar framing.

The crank axle is reduced to its simplest form. In some cases it is forged and the webs slotted out, as is usual in British practice. In another form the axle is bent to shape. A third way is to build up the axle. This enables special steels to be used for the construction, and any part that may break in service can be replaced without scrapping the whole axle. Again, the bearing surface of the crank pin is more effective due to the absence of round corners on the journal; and the crank webs can be prolonged so as to form balance weights. In this way the whole of the revolving parts are balanced in their own plane, thereby relieving the axle of bending stresses due to centrifugal force. The balance weights in the wheels are correspondingly reduced.

The first railway to adopt extensively the use of three high-pressure cylinders in conjunction with a superheater was the North Eastern of England. This practice was followed some two or three years later by the Prussian State Railways in Germany. Since then a large number of these engines have been built in Europe.

It remains to be proved whether the three-cylinder locomotive is adapted to American conditions. The 15 per cent greater cylinder capacity offers an alternative to the booster, or in conjunction with that device an even greater hauling capacity.

H. Holcroft.

Economy of Balanced Compound Locomotives

Dallas, Tex.

To the Editor:

When efforts are made to prevent avoidable waste in locomotive operation, the possibilities of a properly designed superheated balanced compound, over an equally well-designed superheated simple engine for certain classes of service, should receive consideration. Heavy high-speed passenger and fast freight service offer the best field for this type. By a properly designed compound I mean one having separate valves and an independent cut-off for the low-pressure cylinders. This is essential if the best results are to be obtained. It is generally contended that the compound locomotive is too complicated and that the upkeep is too high. While it must be admitted that there are more parts to the compound, the fact that the driving stresses are distributed through four sets of gears instead of two results in considerably less wear and tear on the machine as a whole and a greater mileage between shoppings.

In the following table, which was published by a large western road in the days when compounds were used considerably and which shows results obtained over a period of 15 months, it will be seen that there was practically no difference in the cost of repairs between the compound and the simple locomotives:

Locomotive	Locomotive miles	Gross ton-miles	Repairs per locomotive-mile	Repairs per 1,000 gross ton miles
Compound A	56.886	42,146,900	$.0161	$.0217
Compound B	60,234	49,070,628	$.0154	$.0182
Compound C	54,497	42,404,236	$.0154	$.0198
Compound D	51,248	40,544,366	$.0121	$.0153
Simole 507	52,915	31,400,344	$.0166	$.0280
Simple 520	63,234	38,163,393	$.0120	$.0198
Simple 566	52,738	34,612,835	$.0184	$.0284

Another objection raised against the compound is that it cannot be built to develop the same power as the modern simple engine. This is true as regards the largest modern freight locomotives, but for passenger service it is possible to build a Pacific type locomotive with 21 in. by 33 in. by 28 in. cylinders, 200 lb. boiler pressure and 72-in. wheels which would develop 44,000 lb. tractive force. This is equal to the average simple Pacific type, and as such locomotives are often used for fast freight service, this objection will not hold good as far as these two classes of service are concerned. A freight engine having 22 in. by 34 in. by 32 in. cylinders, 225 lb. boiler pressure and 63-in. drivers would develop 69,000 lb. tractive force, which is equal to the best Mikado. Both the above sets of figures can be increased at starting by admitting live steam to the low pressure cylinders if necessary.

At high speeds the compound will deliver more power than a simple engine owing to the better cylinder action resulting from the later cut-off reducing wire-drawing of the steam to a minimum, and also the increased range of expansion, while at low speeds on grades it is less liable to slip and stall owing to the more even torque on the crankpins. They are smoother running machines due to the perfect mechanical balance and to the less varied mean effective pressure in the cylinders. This is an advantage both to the machine itself and the track, especially where light steel is used and the roadbed is not the best.

In the following table is given the results of tests carried out on the Paris, Lyons & Mediterranean Railway in France between a superheated simple and a superheated compound locomotive. The only difference in these two engines is that due to the double expansion of steam in the compound and two extra sets of valve gears for the low pressure cylinders.

The cylinder dimensions of the compound are 17.1 in. by 25.7 in. by 25.7 in.

Weight of trains	Mean consumption per indicated horsepower hour—simple		Mean consumption per indicated horsepower hour—compound	
	Water	Coal	Water	Coal
278 tons	19.07 lb.	3.1 lb.	14.21 lb.	2.35 lb.
	19.58 lb.	3.49 lb.	14.56 lb.	2.37 lb.
487 tons	21.49 lb.	3.23 lb.	14.12 lb.	2.35 lb.
	20.59 lb.	3.3 lb.	14.8 lb.	2.13 lb.
646 tons			13.53 lb.	2.05 lb.
			14.2 lb.	2.06 lb.

The above tests were made on the 95-mile division between Laroche and Dijon, which is nearly all up hill, at speeds ranging between 55 and 65 miles an hour. Two tests were run with each load to avoid the possibility of error and it will be seen that the results agree very closely. The maximum horsepower indicated by the compound was 2,425 and for the simple, 2,051. As a result of these tests, which were borne out by the every-day performance of the compounds, 91 simple engines were converted to compound.

The decreased water consumption of the compound means longer runs without stopping for water, resulting in less wear and tear on equipment due to starting and stopping heavy trains, and also a saving in the fuel necessary to work heavy trains up to speed. The time between washout periods can also be lengthened.

In designing a compound engine it is necessary to have separate valves and valve gear for each set of cylinders so that the cut-off to the low-pressure cylinders can be later than to the high pressure. This is especially advisable at high speeds when it is necessary to have a large port area to handle the large volume of low pressure steam quickly.

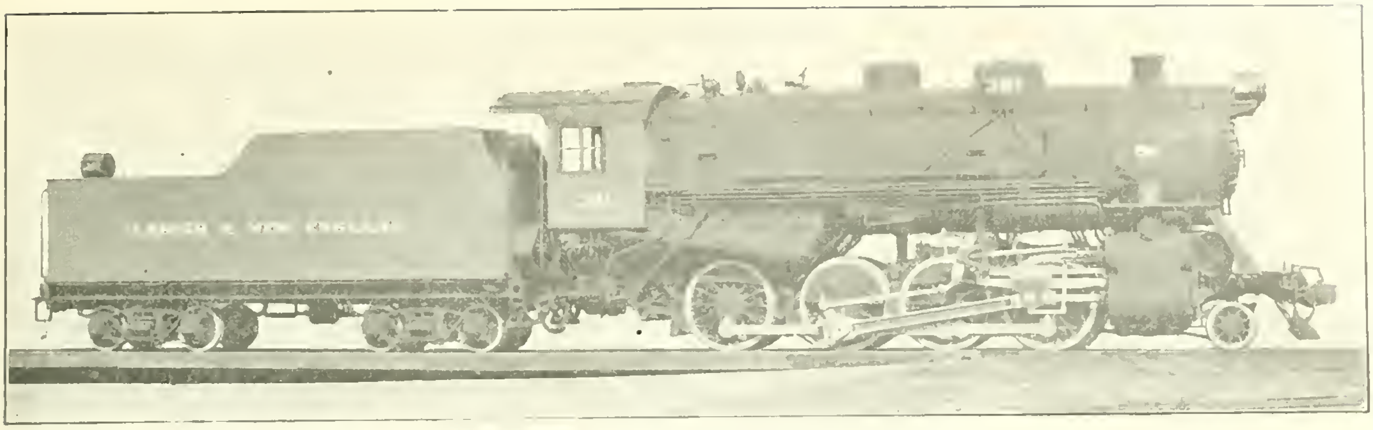
The Walschaert valve gear can easily be arranged for independent cut-off to both cylinders, by setting both links side by side and working them by one eccentric rod. The crosshead arms are set one on each side of the low-pressure crosshead and connected to both combination levers, and an indirect rocker arm is used to transmit the motion to the high-pressure valves between the frames. This system has practically all the gearing outside the frames where it is readily accessible for repairs and oiling.

The high-pressure exhaust should be led to a common chamber from which it passes to the low-pressure steam chests. This is an advantage in certain classes of breakdowns, as it is possible to use three cylinders to bring the train in. This chamber should be connected to a pressure gage in the cab which will act as a guide to the engineer in adjusting the low-pressure cut-off.

Since the modern locomotive is becoming a regular power plant on wheels, with its superheater, feedwater heater, mechanical stoker and booster, why not adopt double-expansion where operating conditions are suitable when it will give 25 per cent and 35 per cent economy in fuel and water respectively? Where a number of such engines are used on a division, their operation should show a good profit on the added investment involved in their construction and upkeep.

P. D. Anderson.

A Motor or other part of electrical equipment is desired to do its work at a certain voltage and should not be expected to do its work properly unless this voltage is maintained within reasonable limits. Low voltage means a heavy current in the winding, which overheats the wiring, tending to destroy the insulation. Too high a voltage is also dangerous, as the spacing between parts has not been arranged for higher pressure and arcs are often caused which break down the insulation with resultant serious damage.—Bureau of Mines.



Consolidation Locomotive Weighing 301,500 lb. and Having a Tractive Force of 68,200 lb.

Powerful Consolidation Locomotive for L. & N. E.

Unusually Heavy Weight and High Tractive Force with Well-Proportioned Boiler Are Special Features of This Design

COMPARATIVELY few locomotives of the 2-8-0 type have been built during recent years for use on American railways. While this was a popular type of freight locomotive for a long period, it has largely been superseded by the Mikado type because of the increased depth of firebox and length of boiler barrel, with correspondingly increased boiler capacity, which can be obtained when a trailing truck is added. However, the Consolidation locomotive is still a highly desirable type where high tractive force combined with low total weight is the important factor as it is where heavy trains, moved at slow speeds, comprise the bulk of the traffic. By careful designing, a boiler of sufficient capacity can be obtained for such service if road clearance does not impose too many restrictions.

Conditions on the Lehigh & New England are especially suited to the operation of Consolidation type locomotives. Most of the traffic is drag freight. Since the road is close to the coal mining section fuel is relatively cheap. The vertical clearance of 15 ft. 8½ in. gives room above the driving wheels for a boiler of large diameter with a deep throat sheet. The bulk of the power is of the Consolidation type and in adding to the number of its locomotives it was decided to adhere to the same type, but to increase the capacity over that of the older locomotives, which had 208,000 lb. on the drivers.

The four Consolidation type locomotives built by the American Locomotive Company which this road has placed in service recently are excellent examples of well-designed engines to meet special conditions. Weighing 301,500 lb. with 279,000 lb. on the drivers, they are the heaviest Consolidation locomotives ever constructed. The previous record for size with this type was made by the locomotives built by the Baldwin Locomotive Works for the Western Maryland and described in the *Railway Mechanical Engineer,* July, 1921. In several particulars the weights and dimensions are the same for the two designs. Both have 27-in. by 32-in. cylinders, 61-in. drivers, 17-ft. 6-in. driving wheel base, and a rated tractive force of 68,200 lb. The Lehigh & New England locomotives have boilers with a larger grate area and more heating surface, which is reflected in the increase of 6,600 lb. in weight.

The height from the rail to the center of the boiler is 10 ft. 4 in. and to the top of the stack is 15 ft. 8½ in. The firebox is 126⅛ in. long by 96¼ in. wide, while the height from the bottom of the foundation ring to the crown sheet is 83½ in. at the front and 57¼ in. at the back, which gives a fair firebox volume and sufficient space for the application of a brick arch. There are 301 2-in. tubes and 50 5⅜-in. flues. The total evaporative heating surface is 3,666 sq. ft., of which 271 sq. ft. is in the firebox. The superheater has 901

DIMENSIONS, WEIGHTS AND PROPORTIONS

Type	2-8-0
Service	Drag. freight
Cylinders, diameter and stroke	27 in. by 32 in.
Valves, kind and size	Piston — 14 in.
Maximum travel	7 in.
Outside lap	1 3/16 in.
Exhaust clearance	0 in.
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	279,000 lb.
On front truck	22,500 lb.
Total engine	301,500 lb.
Tender	184,100 lb.
Wheel bases:	
Driving	17 ft. 6 in.
Total engine	26 ft. 11 in.
Total engine and tender	65 ft. 2 in.
Driving wheels, diameter outside tires	61 in.
Boiler:	
Type	Straight top
Steam pressure	210 lb.
Fuel, kind	Soft coal
Diameter, first ring, inside	88 in.
Firebox, length and width	126⅛ in. by 96¼ in.
Height to crown sheet, back	57¼ in.
Height to crown sheet, front	83½ in.
Tubes, number and diameter	301 — 2 in.
Flues, number and diameter	50 — 5⅜ in.
Tubes and flues, length	15 ft.
Grate area	84.3 sq. ft.
Heating surfaces:	
Firebox, including arch tubes	271 sq. ft.
Tubes	2,349 sq. ft.
Flues	1,046 sq. ft.
Total evaporative	3,666 sq. ft.
Superheating	901 sq. ft.
Comb. evaporative and superheating	4,567 sq. ft.
Tender:	
Water capacity	10,000 gal.
Coal capacity	16 tons
General data, estimated:	
Rated tractive force, 85 per cent	68,200 lb.
Cylinder horsepower	2,755 hp.
Boiler horsepower	2,420 hp.
Speed at 1,000 ft. piston speed	34 m.p.h.
Steam required per hour	5,730 lb.
Boiler, evaporative capacity per hour	5,030 lb.
Coal required per hour, total	8,950 lb.
Coal, rate per sq. ft. grate per hour	106 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine	92.6 per cent
Weight on drivers ÷ tractive force	4.08 lb.
Total weight engine ÷ tractive force	4.42
Total weight engine ÷ cylinder horsepower	109.4 lb.
Total weight engine ÷ boiler horsepower	124.5 lb.

Boiler proportions:

Boiler horsepower ÷ cylinder horsepower	87.9 per cent
Comb. heating surface ÷ cylinder horsepower	1.66
Tractive force ÷ comb. heating surface	14.93
Tractive force × dia. drivers ÷ comb. heating surface	.911
Cylinder horsepower ÷ grate area	32.7
Firebox heating surface ÷ grate area	3.21
Firebox heating surface ÷ evap. heating surface	7.4
Superheating surface ÷ evap. heating surface	24.6

sq. ft. heating surface. The rated boiler capacity is 2,420 hp., or 88 per cent of the cylinder power, which is 2,755 hp., a proportion which has been found to be ample for the conditions under which these locomotives are operated.

Of the total weight of the locomotive 92.6 per cent is on the drivers and available for adhesion, whereas with the typical Mikado locomotive the weight on the drivers is nearer 75 per cent. The factor of adhesion is 4.08. The possibilities of excellent use of the weight by a Consolidation type is shown by the fact that the total weight is only 109.4 lb. per cylinder horsepower and 4.42 lb. per pound of rated tractive force, figures that can scarcely be equalled by a locomotive of the 2-8-2 type.

Two of these locomotives are hauling coal trains of 3,500 gross tons from Lansford to Pen Argyl, a distance of 54 miles, part of which is up a 0.5 per cent grade, at a speed of approximately 20 m. p. h. Two others are running out of Pen Argyl and handling 690 gross tons up a 2.75 per cent grade without difficulty. While no test runs have been made, it has been observed that these locomotives are free steamers, of ample boiler capacity and consume a conservative amount of fuel.

The leading dimensions, weight distributions and proportions of these locomotives are given in the table.

The Insulation of Boilers and Heated Surfaces

By Wm. N. Allman

In the insulation of locomotive boilers the one very important feature is to conserve the heat and thereby reduce the loss by radiation to a minimum. The value of such insulation is therefore a matter of importance.

The unit of heat is a B. t. u. There is no insulation that is 100 per cent efficient, but the real object of insulation is to prevent to the highest degree the flow of heat to the outside surrounding air from the boiler surface. The conductivity of the material determines the rate of flow with a given difference in temperature. A smaller number of heat units (B. t. u.) will flow through an insulating material with a low than one with a high conductivity.

The efficiency of an insulating material is expressed by a percentage which represents the per cent saving which would be realized by insulating the boiler with such a material over what would be lost if the surface were left bare. The efficiency is then obtained by subtracting the heat loss of the insulated surface from the heat loss of the uninsulated or bare surface, and dividing the result by the heat loss from the bare surface. Expressed as a formula, this would be as follows:

$$E = \frac{U - I}{U}$$

where U = Heat loss in B. t. u.—bare surface
I = Heat loss in B. t. u.—insulated surface
E = Efficiency of insulation

In Table I the figures represent the loss in B. t. u. which would be expected with bare or uninsulated surfaces for temperatures ranging from 0 to 500 deg. F.

Table II represents the efficiencies of an 85 per cent magnesia boiler lagging in thicknesses from 1 in. to 3 in. It is highly important that material thick enough be applied in order to secure the best results. Another important feature is to cover every square foot of exposed surface. By this is meant the firebox area as well as the shell of the boiler. While a number of railroads have not adopted the practice of covering the exposed area of the outside firebox sheets, it is a mistake to allow them to go uninsulated when it is considered that there is an enormous heat loss which may be saved.

By referring to the figures contained in Table III, it can be readily seen what this loss amounts to in the course of a year.

TABLE III

Steam pressure gage	Steam temperature	Difference between temperature of steam and surrounding air F.	Loss per sq. ft. per hr. (B.t.u.)	Waste of coal lb. per sq. ft. per year based on 300 days of 10 hrs. each	Number of sq. ft. of surface that wastes a ton of coal in one year
0	212	142	334.0	77.0	26.00
10	240	170	425.0	98.0	20.40
25	267	197	522.5	120.6	16.58
50	298	228	644.0	149.0	13.42
75	320	250	737.5	170.2	11.75
100	338	268	820.0	189.2	10.57
150	366	296	960.0	221.6	9.02
200	388	318	1,079.0	249.0	8.03
250	406	336	1,184.0	273.2	7.32

(Temperature of surrounding air 70 deg. F.)

Note:—Above figures based on coal having an average heat value of 13,000 B.t.u.

To determine the amount of heat saved by the application of 85 per cent magnesia lagging, we may consider a locomotive boiler carrying a boiler pressure of 200 lb. per sq. in., the corresponding temperature being 388 deg. F. Assuming an outside temperature of 70 deg. F., we obtain a difference in temperature of 318 deg. F. Referring to Table I, the loss under these conditions would be 1,079.0 B. t. u. per hour per sq. ft., and for coal having an average thermal content of 13,000 B. t. u. this would equal a waste of 249.0 lb. of fuel as shown in fourth column of Table III for each square foot of surface per year under the conditions as shown; namely, 300 days of 10 hrs. each.

By the application of 85 per cent magnesia sectional lagging with its high insulating value, the major portion of this loss may be saved and converted into useful work, and by referring to Table II the following efficiencies are obtained by interpolation:

	Efficiency	Lb. coal saved per sq. ft. per year
1½ in. thick lagging	91.43 per cent	227.6
2 in. thick lagging	93.33 per cent	232.4
2½ in. thick lagging	94.57 per cent	235.5
3 in. thick lagging	95.40 per cent	237.5

This shows that even the thinnest insulation will show a large saving by preventing the escape of heat from the surfaces.

TABLE I.

	50 deg.	100 deg.	150 deg.	200 deg.	250 deg.	300 deg.	350 deg.	400 deg.	450 deg.	500 deg.
B.t.u. per square foot per hour	97.5	215.2	360.0	533.0	737.8	978.0	1,269.4	1,614.0	2,050.6	2,590.0

TABLE II

Thickness of insulation	Temperature difference between hot surface and surrounding air									
	50 deg.	100 deg.	150 deg.	200 deg.	250 deg.	300 deg.	350 deg.	400 deg.	450 deg.	500 deg.
	Per Cent Efficiencies									
1 in.	80.80	82.36	83.90	85.25	86.48	87.60	88.70	89.64	90.56	91.48
1½ in.	86.25	87.40	88.53	89.49	90.37	91.16	91.94	92.65	93.32	93.97
2 in.	89.32	90.16	91.08	91.85	92.53	93.12	93.71	94.27	94.80	95.31
2½ in.	91.19	91.95	92.69	93.32	93.87	94.38	94.87	95.31	95.73	96.14
3 in.	92.55	93.22	93.83	94.37	94.82	95.25	95.67	96.06	96.40	96.75

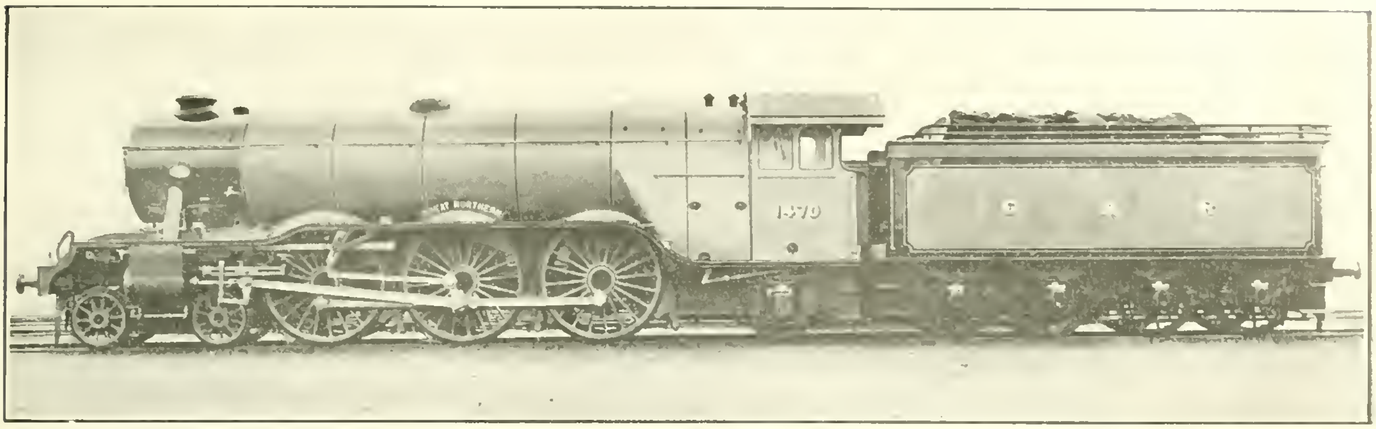


Fig. 8—Great Northern, Three-cylinder, 4-6-2 Type Express Passenger Locomotive

Recent Tendencies In British Locomotive Practice

Part II

Pacific Type Locomotives for Great Northern and North Eastern Are of the Three-Cylinder Type; Great Western Uses Four Cylinders

By E. C. Poultney

FOR many years 4-6-0 type express locomotives have been used by most railways where the demands of the traffic required greater capacity than could be obtained by four coupled engines. The 4-6-0 and 4-4-2 engines described by the writer in the *Railway Mechanical Engineer* for November, 1916, are still representative of the leading examples in service; in fact, with the exception of some two-cylinder 4-6-0 engines and the new three-cylinder engine of the same wheel arrangement built for the Caledonian and certain large 4-6-0 locomotives having four cylinders and others having two, put into traffic on the Great Central and London & South Western, no passenger engines of what may be called a new design have been built for some years.

The Atlantic type has been used to a limited extent by some railways, thus the Great Central and Great Western both gave the type a trial by building engines of the 4-6-0 and 4-4-2 type, with the same boiler design on each, but subsequent locomotives for maximum power on each of these lines have been of the 4-6-0 type; on the other hand, the North Eastern, the first line to build 4-6-0 express engines, gave them up in favor of the Atlantic type about 1903, and the Great Northern commenced to build Atlantics in 1898 and have continued to use this type up to the appearance of the Pacifics, the first of which has just been constructed.

Development of the Pacific Type

Recently some interesting developments have occurred and these take the form of two new designs of Pacific type locomotives, the first of this type to be placed on a British line since "The Great Bear" was built at Swindon in 1908 for the Great Western. The new engines are for the Great Northern and North Eastern. Both these railways have for many years used 4-4-2 engines for express passenger traffic. The North Eastern at one time used 4-6-0 engines, but gave them up for Atlantics about 15 years ago, and the Great Northern has never used the 4-6-0 design.

The Great Northern 4-6-2 type locomotive, Fig. 8 and Fig. 9, was built at the Doncaster shops to the designs of H. N. Gresley, who kindly provided the photographs.

The Atlantic engines, the last of which was built 11 years ago, although of relatively low tractive force, have in consequence of their considerable boiler capacity done excellent work on the Great Northern but the increasing weight of the trains has necessitated the introduction of locomotives of a greater tractive force.

The boiler of the Great Northern engine is the largest which has so far been used in British practice, and in its dimensions practically reaches the permissible limits of the comparatively small loading gage of British railways. The barrel portion is composed of two sections, a taper length coming next the fire-box, and a parallel section forward to the smoke box. A single plate is used for each, that is, the barrel is formed from two plates only. The diameter of the tapered length where it joins the fire-box is 77 in., and forward where it joins the front portion it is 69 in. and the length is 19 ft.

A wide fire-box of the round top design is used, and the back head slopes forward from the foundation ring as in American practice. The fire-box casing is 78 in. in diameter at the front, and tapers to 73 in. at the back; the casing is 9 ft. 5½ in. long, and at the bottom the length is 6 ft. 8 in., with a width of 7 ft. 9 in. The internal fire-box is of a design not before used in English practice, and as will be seen from Fig. 10, it resembles the design now common in American locomotives. By extending the box forward into the barrel section capacious proportions have been obtained and the tubes have been kept to a moderate length, the distance between the tube sheets being 19 ft.

There are 168 tubes 2¼ in. and 32 flues 5¼ in. in diameter, and the ratio between the inside diameter of the tubes and the length between the tube sheets is 1 to 114. The tubes comprising the units of the Robinson superheater are 1½ in. outside diameter. The fire-box is of copper, and the tubes are solid drawn steel. The center line of the boiler is unusually high, being 9 ft. 4½ in. from the rails. The height to the top of the stack is 13 ft. 4 in.

Turning now to the engines, these are of Mr. Gresley's standard three-cylinder type, that is to say, they follow **in**

DIMENSIONS, WEIGHTS AND PROPORTIONS OF RECENT BRITISH LOCOMOTIVES

	1	2	3	4	5	6	7	8	9	10	11
Railroad	Great Central	North Eastern	Caledonian	North British	Great Western	Great Eastern	Great Eastern	Great Northern	Great Northern	North Eastern	Great Western
Type of locomotive	4-6-0	4-6-0	4-6-0	4-4-2	2-8-0	4-6-0	0-6-0	2-6-0	4-6-2	4-6-2	4-6-2
Service	Fast freight	Fast freight	Express	Express	Fast freight	Express	Freight	Fast freight	Express	Express	Express
Cylinders, number of	4	3	3	2	2	2	2	3	3	3	4
Cylinders, diameter and stroke, in.	16 by 26	18½ by 26	18½ by 26	21 by 28	19 by 30	20 by 28	20 by 28	18½ by 26	20 by 26	19 by 26	15 by 26
Valve gear	Stephenson	Stephenson	Walschaert	Stephenson	Stephenson	Stephenson	Stephenson	Walschaert	Walschaert	Stephenson	Walschaert
Valves, kind and size	Piston	8¾ in. piston	8 in. piston	Piston	Piston	10 in. piston	10 in. piston	8 in. piston	8 in. piston	8¾ in. piston	8 in. piston
Weights in working order:											
On drivers, lb.	131,000	131,500	134,500	89,600	164,400	97,600	122,700	134,400	134,400	134,400	134,000
On front truck, lb.	47,000	46,600	47,000	39,500	19,300	46,000	....	26,400	38,200	42,600	44,000
On trailing truck, lb.	....	....	....	42,700	....	....	....	....	34,500	40,300	39,000
Total engine, lb.	178,000	174,100	181,500	171,800	183,700	143,600	122,700	160,800	207,100	217,300	217,000
Tender, lb.	108,000	103,000	94,500	102,700	89,600	83,400	85,300	96,500	126,100	103,100	....
Wheel bases:											
Driving, ft. and in.	14-5	13-6	15-0	7-3	20-0	14-0	18-10	16-3	14-6	15-0	14-0
Total engine, ft. and in.	28-3	27-8	28-8	27-9½	29-3	28-6	18-10	25-2	35-9	37-2	34-6
Total engine and tender, ft. and in.	52-9½	52-5⅞	54-0½	53-1½	56-9¾	48-3	....	48-0¼	60-10⅝	61-11¾	....
Wheels, diameter outside tires:											
Driving, in.	68	68	73	81	68	78	59	68	80	80	80½
Front truck, in.	42	37¼	42	42	38	39	....	38	38	37¼	38
Trailing truck, in.	....	....	....	51	....	....	....	....	44	45¼	44
Boiler:											
Steam pressure, lb. per sq. in.	180	180	180	180	225	180	180	180	180	200	225
Diameter, first ring outside, in.	63½	66	67½	66	66	60	60	72	69	72	66
Firebox, length and width, in.	93-40⅛	108-47	111 long	....	110⅜-62⅜ to 38⅝	102-49½	102-49½	....	....	....	96-78
Tubes, number and diameter, in.	116-2¼	102-2	203-2	141-2	218-2	187-1¾	187-1¾	217-1¾	168-2¼	118-2¼	141-2½
Flues, number and diameter, in.	28-5¼	24-5¼	24-5	24-5	18-5⅛	21-5¼	21-5¼	32-5¼	32-5¼	24-5¼	21-4¾
Tubes and flues, length, ft. and in.	17-7⅜	16-2⅝	16-0	15-4¾	15-2½	12-10	12-10	11-11⅞	19-0	21-0	22-7
Tubes spacing	....	1¼	29/32	....	¾	19/32	19/32	11/16	¾	....	13/16
Flue spacing	....	1⅛	1	....	1⅛	13/16	13/16	1	1	....	1⅛
Air inlet through grates, sq. ft.	8.75	6.5	6.8	18.7	13.05	12.85	12.85	8.1	11.1	....	18
Air inlet through ash pans, sq. ft.	4.9	5.2	3.4	3.15	....	5.8	4.4	3.55	5.85	....	....
Grate area, sq. ft.	26	27	28.5	28.5	30.3	26.5	26.5	28	41.25	41	41.8
Heating surfaces:											
Firebox, sq. ft.	163	166	170	185	170	144	144	182	215	211	182
Tubes, sq. ft.	1,203	866	1,700	1,136	1,702	1,099	1,099	1,232	1,889	1,518	2,084
Flues, sq. ft.	678	532	500	483	360	366	366	487	836	693	589
Total evaporative, sq. ft.	2,044	1,564	2,370	1,804	2,232	1,609	1,609	1,901	2,940	2,422	2,855
Superheating, sq. ft.	343	530	270	385	324	286	286	407	525	696	545
Comb. evap. and superheating, sq. ft.	2,387	2,094	2,640	2,189	2,556	1,895	1,895	2,308	3,455	3,118	3,400
Tender:											
Water capacity, Imp. gal.	4,000	4,125	4,500	4,240	3,500	3,700	3,500	3,500	5,000	4,125	3,500
Fuel capacity, lb.	13,440	11,770	12,500	15,700	11,000	8,960	11,200	14,580	11,200	12,310	13,440
Wheels, number and size, in.	6-52	6-45¼	6-48	6-	6-	6-49	6-	6-50	8-50	6-45¼	8-
General data, estimated:											
Rated tractive force, 85 per cent	29,950	30,030	28,000	23,400	30,600	22,000	29,040	30,030	29,835	29,920	27,800
Cylinder horsepower (Cole)	1,660	1,665	1,665	1,430	1,460	1,295	1,295	1,665	1,945	1,950	1,825
Boiler horsepower (Cole)	....	1,195	1,573	....	1,460	1,095	1,095	1,405	1,842	....	1,640
Speed at 1,000 ft. piston speed	46.7	46.7	50.1	51.5	40.5	49.7	37.7	46.7	54.8	54.8	55.2
Steam required per hour	34,590	34,610	34,610	29,750	30,400	27,000	27,000	34,610	40,400	40,600	39,100
Boiler, evaporative capacity per hr.	....	24,920	32,705	....	30,490	22,780	22,780	29,240	38,275	....	34,100
Coal required per hour, total	5,390	5,400	5,400	4,640	4,760	4,220	4,220	5,420	6,440	6,350	5,960
Coal, rate per sq. ft. grate per hour	207	200	190	163	157	159	159	193	153	155	143
Weight proportions:											
Weight on drivers ÷ tractive force	4.45	4.34	4.80	3.83	5.37	4.43	4.23	4.43	4.53	4.49	4.83
Weight on drivers ÷ total weight engine	73.6	75.4	74.1	52.5	89.5	67.9	100	83.6	64.9	62.0	62.5
Total weight engine ÷ cylinder horsepower	107.1	104.6	109.0	119.3	125.7	110.7	94.7	96.6	106.0	111.2	117.9
Total weight engine ÷ boiler horsepower	....	145.6	115.3	120.1	125.7	131.1	112.1	114.5	112.4	....	126.2
Total weight engine ÷ comb. heating surface	74.6	82.7	68.6	78.5	71.9	75.7	64.7	69.5	60.0	69.7	75.3
Boiler proportions:											
Boiler horsepower ÷ cylinder horsepower	....	72.0	94.6	....	100	84.6	84.6	84.5	94.8	....	87.3
Comb. heating surface ÷ cylinder horsepower	1.44	1.28	1.58	1.53	1.68	1.46	1.46	1.38	1.77	1.58	1.86
Tractive force ÷ comb. heating surface	12.5	14.2	10.6	10.7	12.4	11.6	15.3	13.0	8.65	9.60	8.17
Tractive force × diam. drivers ÷ comb. heat. surf.	852	980	775	870	850	906	905	885	690	767	667
Cylinder horsepower ÷ grate area	63.8	61.6	58.3	50.1	48.6	48.9	48.9	59.4	47.2	47.6	43.6
Firebox heating surface ÷ grate area	6.27	6.38	5.96	6.48	5.58	5.43	5.43	6.50	5.22	5.13	4.36
Grate air inlet ÷ grate area	34	24	24	65	43	48	48	29	27	....	43
Firebox heating surface ÷ evap. heating surface	7.97	10.60	7.17	10.25	7.95	8.95	8.95	9.55	7.31	8.71	6.37
Superheat. surface ÷ evap. heating surface	16.7	21.0	11.4	21.3	15.15	17.7	17.7	21.35	17.9	28.7	19.1

detail design those used for the 2-6-0 and 2-8-0 locomotives, but the cylinders are each 20 in. in diameter as against 18½ in. for the other engines, while the stroke is the same, viz., 26 in.

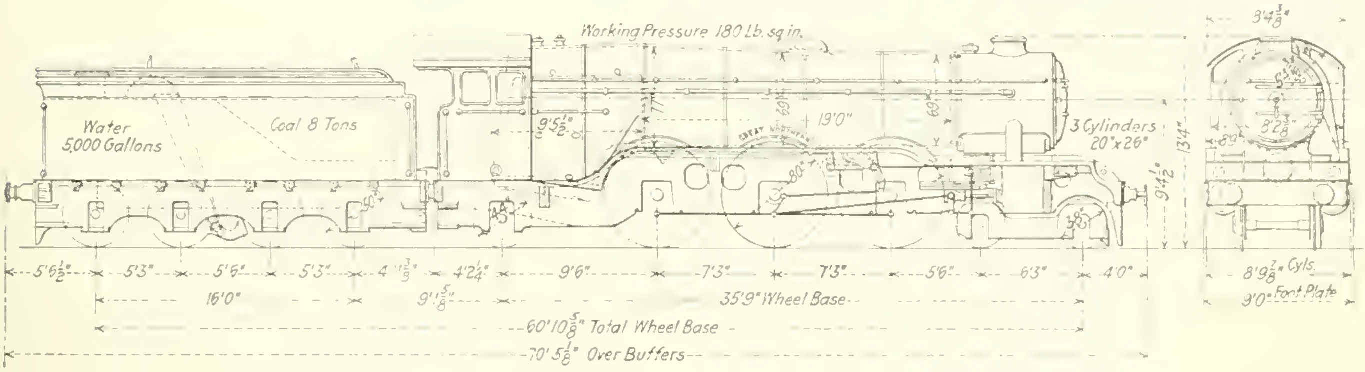


Fig. 9—Diagram of Three-cylinder Pacific Type Locomotive, Great Northern Railway

The piston valves have a diameter of 8 in. and are operated by two sets of Walschaert gear applied to the outside motion, and the valve for the center cylinder is operated by the combined movement of the two sets of valve motion as in the case of the 2-6-0 engines already described.

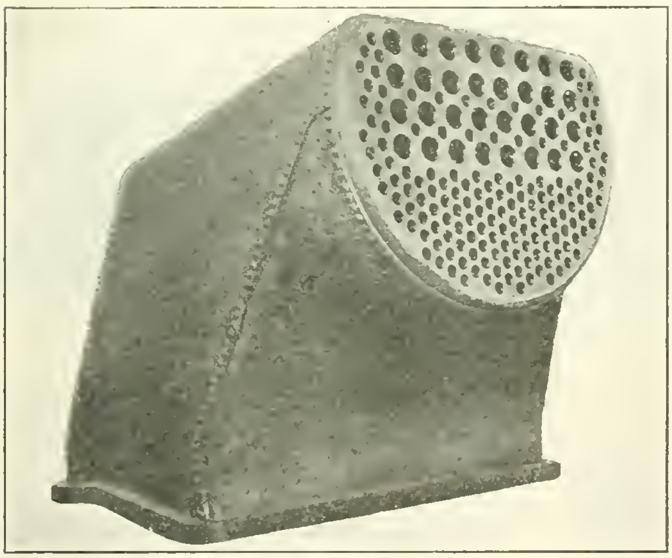


Fig. 10—Firebox of Great Northern Pacific Type Locomotive

The inside cylinder is placed over the trailing wheels of the leading truck, and arranged with its center line inclined at 1 in 8 to clear the leading axle so that the drive is, like in the 2-6-0 engines, all through the center coupled wheels. The crank pins are at 120 degs.

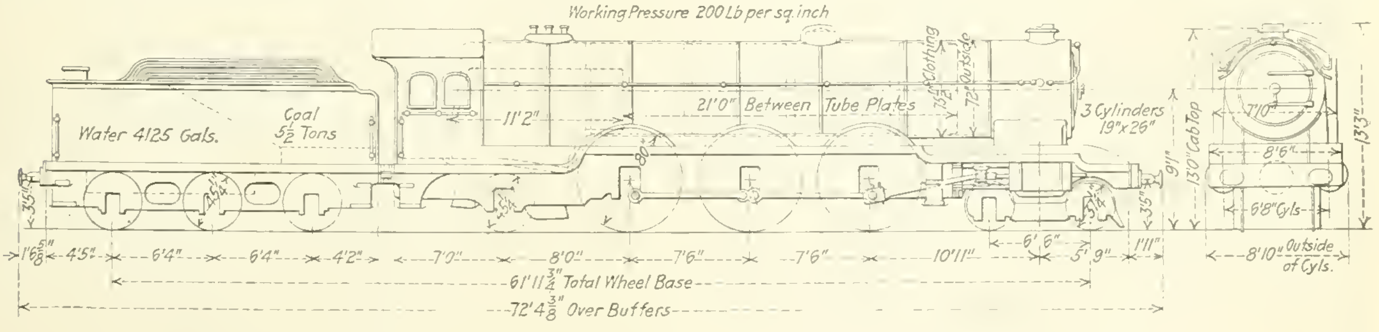


Fig. 11—Diagram of Three-Cylinder Pacific Type Locomotive, North Eastern Railway

The main, side and piston rods, the latter hollow, are made of nickel-chrome steel, as are also the piston heads and the crossheads of light design which are carried in three-bar guides.

The pins for the return cranks of the valve gear are fitted with ball bearings, and the long transverse lever forming part of the gear for the inside cylinder valve is pivoted on a roller bearing.

Laminated springs of 42 in. centers carry the weight on the leading and trailing coupled axles, and the driving boxes are fitted with helical springs.

The trailing truck axle is fitted with special axle boxes allowing a radial movement of 2½ in. each way; this, together with the flexibility furnished by the leading truck, enables the engines to negotiate 22 deg. curves.

The tender is of unusual design, as it is carried on four axles, and these are not in the form of trucks. It has a capacity of 5,000 gal. of water and 8 tons of coal, and is fitted with a water scoop.

The fittings include two injectors (the one on the left hand side being of the exhaust steam pattern), screw reversing gear, steam sanders and a pyrometer. Wakefield's mechanical lubricators are fitted, one for the cylinders and valves, and another for lubricating the journals of the coupled axles. The automatic vacuum brake is used.

The total weight of the engine only in working trim is 206,000 lb., and of this 134,400 lb., or 65 per cent, is carried on the coupled axles. The engine weight per square foot of evaporative heating surface is 70.6 lb., and per square foot of total heating surface, boiler and superheater, 60 lb.

The North Eastern Pacific engines, Fig. 11, have three cylinders and in conformity with Sir V. Raven's usual practice they are all made in one casting, and the drive is taken by the leading coupled axle. To obtain sufficient length for the three connecting rods, the distance between the cylinder and driving axle centers is 10 ft. 11 in., and this, combined with the liberal distance between the centers of the coupled axles, which is 7 ft. 6 in. as against 7 ft. 3 in. for the Great Northern Pacifics, makes the total engine wheel base very long, namely, 37 ft. 2 in., which length is reflected in the length of the boiler, which has tubes no less than 21 ft. long.

The fire-box is of considerable size, and is extended forward into the barrel portion of the boiler, the length from outside the back head at the foundation ring to the fire-box tube sheet being 11 ft. 2 in. The barrel is in four sections, butt jointed, and its center line is 9 ft. 1 in. above the rails. The diameter is 72 in. over the plates. There are 118 tubes 2¼ in., and 24 flues 5¼ in. diameter. The working steam pressure is 200 lb., which, with three 19 in. by 26 in. cylinders and 80 in. drivers, gives a rated tractive force of 29,920 lb.

Piston valves distribute the steam, and are operated by three sets of link motion, all six eccentrics being mounted on the single throw crank axle. The trailing axle is fitted with radial boxes, permitting a 3½ in. movement.

The engines have six-wheeled, self-trimming tenders which are fitted with water pick-up apparatus and carry 5½ tons of coal and 4,125 gal. of water, and weigh when full 103,100 lb. The Westinghouse brake acts on the engine and tender, and an ejector is fitted for working the automatic vacuum brake on the train when required.

The Great Western locomotive "The Great Bear," Fig. 12, was placed in traffic in 1908, and when built was much the largest locomotive ever used on a British railway. The engine also was the first Pacific type tender engine built, and remained the sole British representative of this type till the Great Northern engine left the Doncaster shops in May of the present year. In designing "The Great Bear" G. J. Churchward adhered closely to the practice followed in the four-cylinder engines of the 4-6-0 type, the chief difference being in the boiler, which is much larger and has a wide fire-box equipped with arch tubes. The four cylinders are 15 in. by 26 in., and those between the frames are placed well forward to allow sufficient length for the main rods which drive the leading wheels through a crank axle. The outside cylinders drive the middle axle, and each has an 8-in. piston valve of the inside admission type. Those for the outside cylinders receive their motion from the Walschaert gear fitted to the adjacent set of inside motion, thus two sets of valve motion work all four valves. The adjacent valve spindles are coupled together by being linked to horizontal levers. A strong box casting supports the main frames between the outside cylinders, and also serves to carry the expansion links and reversing shaft. Wheel and screw reversing gear is used. The inside main rods have open ends with the brasses held by a gib and cotter, and those for the outside rods have solid bushed ends.

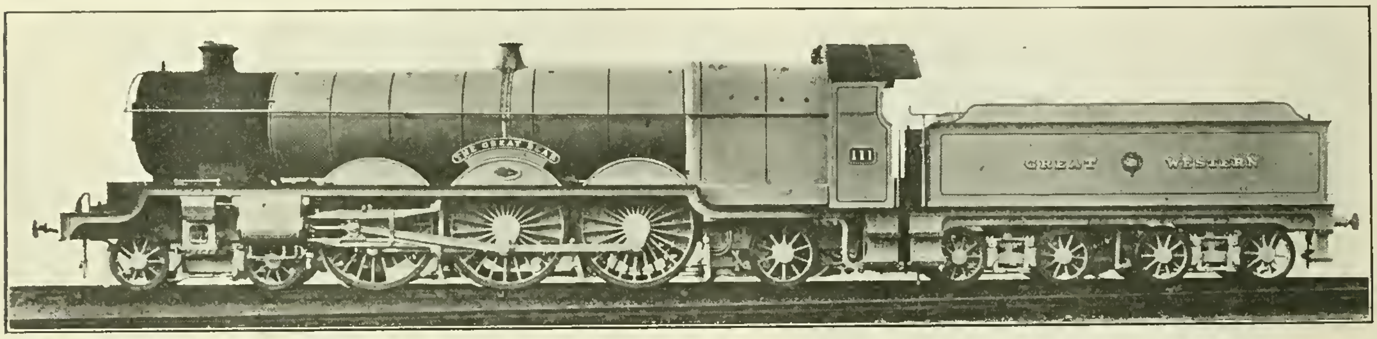


Fig. 12—Great Western, Four-cylinder, 4-6-2 Type Express Passenger Locomotive

The coupled wheels are 80½ in. diameter, and underhung laminated springs are used. Equalizing gear is provided, all the coupled axle springs being connected, those for the rear coupled axle being connected with the springs for the radial box of the trailing truck.

For convenience in making comparisons, the principal dimensions, weights and proportions of the various locomotives have been arranged in the accompanying table.

Results of Flange Lubrication*

Let us assume that we have before us a section of a locomotive driver wheel tire that has the flange and tread in perfect contour. By removing 1/32 in. from the throat of the flange, 1/16 in. metal would have to be removed from the tread of the wheel to restore the countour, or ⅛ in. from throat eqauls ¼ in. from tread. On many roads this represents considerable mileage lost. If this expense could be eliminated, the cost of maintenance per locomotive mile would be greatly reduced.

An extensive test was made with and without flange lubrication on one of the larger roads covering a period of two years, the first year with and the second year without flange lubricators. The locomotives equipped were run over the same section of the line and everything was directly comparable. It was established on this test when using flange lubrication that the flange wear on the driving wheel tires was reduced 72 per cent, while the wear on the rail per 100,000 gross tons was reduced about 87 per cent. The cost of driving wheel tires per 10,000 miles was decreased 29 per cent, engine truck wheels 42 per cent, and tender truck wheels 49 per cent, with flange lubrication.

In Figs. 1 and 2 it will be seen that without flange lubrication the flange wear was excessive in relation to the tread wear, and that flange lubrication decreased the flange wear, thus allowing the tread wear in a number of cases to be the condemning factor. The mileage made for the flange wear shown is about four times that made without lubrication.

Fig. 3 gives comparative rail wear at the same location and over the same period of time with and without flange lubrication. It will be noted that the wear on the rail with lubrication was about 17 per cent of that on the ones without lubrication. The derailments on a portion of this line over which the above tests were made showed a decided decrease when flange lubrication was used. From actual records taken without flange lubrication, it was found that 80 per cent of the rolled steel wheels under cars and tenders were removed for flange wear.

On the Norfolk & Western without flange lubrication, the front tires of a locomotive averaged 16,000 miles, whereas when equipped with a flange lubricator, they averaged 33,000 miles, or an increase of 106 per cent. The St. Louis-San Francisco showed a net saving of $84.03 per year per consolidated locomotive. The Southern (Queen & Crescent) increased the mileage between turning tires from 23,000 miles before using lubrication to 44,000 miles after using lubrication on the flanges. On Pacific type locomotives the mileage was increased from 40,000 to 92,000 miles.

On a 2-8-0 Southern Pacific locomotive the life of the driving tires was increased 375 per cent when equipped with flange lubricators, the tender truck wheels 436 per cent and rail wear on curves greatly reduced. This test was conducted where the ruling grade is 3.8 per cent and maximum curve over 10 deg.

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*Abstract of report at Traveling Engineers' Association convention, Chicago, November, 1922.

The wide range of opinions of the effectiveness of the flange oiler to prevent flange wear indicates that there are certain divisions and certain railroads where their application is justified and where results show a real saving. However, the tractive effort with relation to weight on drivers on certain classes of modern superheater locomotives has been reduced to a point where the application of a flange oiler would result in a waste of fuel caused by locomotives slipping, greater than the saving effected by the use of a flange oiler. With the proper flange lubricator, using a heavy asphaltum oil, the flange wear on the locomotive, tender and cars and the rail wear will be sufficiently checked to warrant the use of flange lubricators, but no matter what flange lubricator is used, it must be maintained and receive the co-operation of everybody concerned.

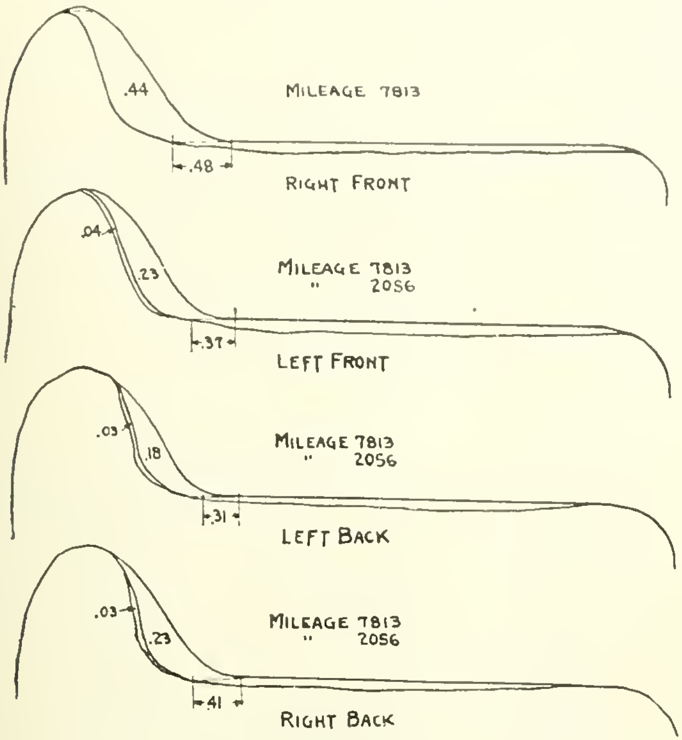


Fig. 1—Excessive Flange Wear on Locomotive Without Flange Lubrication

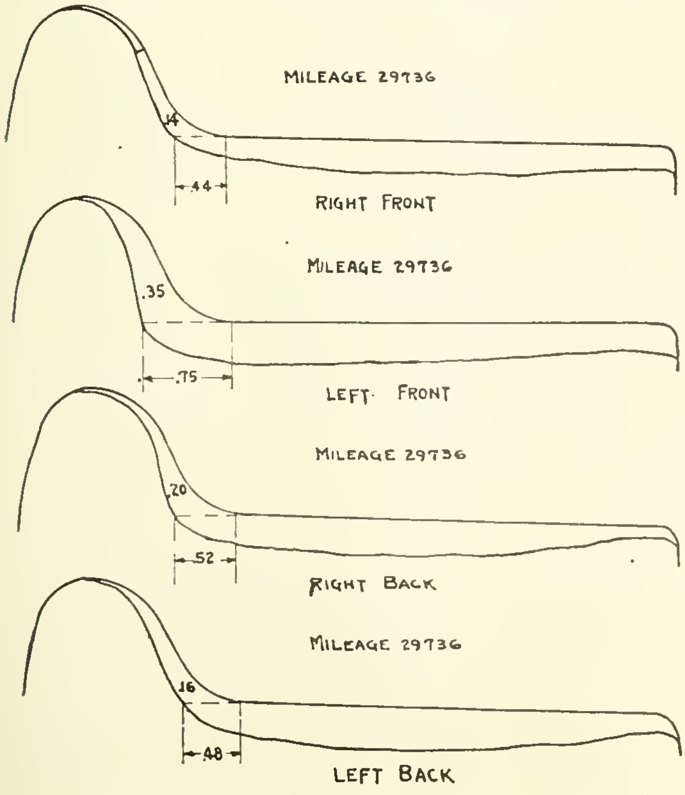
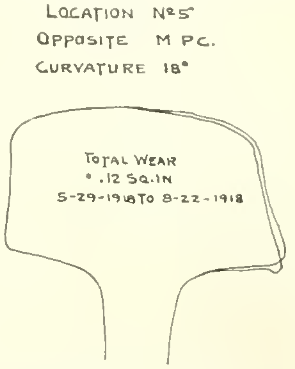


Fig. 2.—Character of the Tire Wear After Lubrication of Flanges Was Adopted

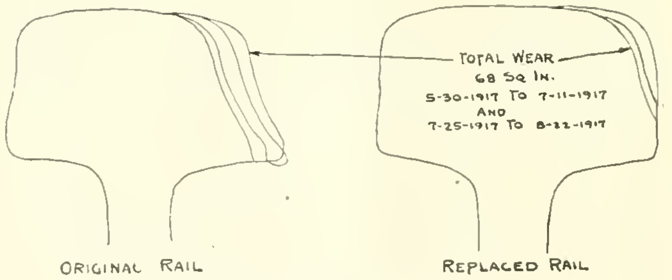
The report was signed by N. Suhrie (Pennsylvania), chairman; J. D. Heyburn (St. L.-S. F.); J. E. Ingling (Erie); P. J. Miller (N. Y. C.), and W. J. Fee (G. T.).

Discussion

From the expression of the members who recounted their experiences with flange oilers, it is evident that wherever operating conditions tend to cause flange wear in excess of tread wear the service of flange oilers is beneficial. Not only do they reduce the flange wear so that even under most difficult conditions the tires will go for tread wear, but they reduce rail wear on curves and have a noticeable effect in reducing the amount of fuel burned. In almost every case mentioned the greatest difficulty which is encountered in insuring satisfactory service is to secure proper application of the nozzles for the delivery of the oil to the flanges and sufficient attention to maintain them in correct alinement. Where this detail is not attended to oil frequently gets on the tread, where it causes slipping and reduces the effectiveness of the brake action. Several railroads confine the care of flange oilers to one man at each terminal, giving him additional duties such as oiling the spring rigging, in order to fully utilize his time. The tendency in the development of the oiler is to make it automatic and keep it in operation continuously. To this there is some objection on the part of enginemen, who claim that flange lubrication when combined with white frost, fog or drizzling rain, adds to the slipperiness of the rail, and feel that under such conditions they should be permitted to shut off the oiler.



WITH FLANGE LUBRICATOR



WITHOUT FLANGE LUBRICATOR

Fig. 3—Effect of Flange Lubrication on Rail Wear

Fan Draft for Locomotives Discussed by A.S.M.E.

Proposed Construction Would Permit Application of Additional Equipment for Saving Fuel

THREE widely different phases of locomotive design formed the topics of the papers presented at the Railroad Session of the annual meeting of the American Society of Mechanical Engineers held in New York on December 6. An extremely technical discussion of Stresses in Locomotive Frames was presented by R. E. Eksergian of the Baldwin Locomotive Works. George H. Hartman gave an analytical discussion of valves and valve gears in a paper entitled "Steam Distribution in the Locomotive," and Frans H. C. Coppus brought out the advantages that might be derived by securing the draft in a locomotive through the use of turbine-driven fans in a paper on Mechanical Drafting of Locomotives. An abstract of Mr. Coppus' paper, which is especially noteworthy because of the possibility of effecting large fuel savings by the method which he proposes, is given below.

The Mechanical Drafting of Locomotives

By Frans H. C. Coppus

GENERALLY speaking, it is a simpler task to incorporate extensive improvements into the design of a new locomotive than to apply them to one already in operation. Though the author would be the last person to discourage the development of the locomotive along radical lines that would require a total reconstruction or rearrangement of the present locomotive power plant, he believes that more can be accomplished for the immediate future by adding to the existing locomotive equipment which is standard, in principle at least, in stationary and marine practice, and which does not necessitate extensive or costly alterations. The existing locomotives, 68,000 in this country alone, represent such a large investment that no matter how efficient a new locomotive may be built, it is out of the question to relegate them to the scrap heap, and they will be with us for many years to come.

In the treatment of this subject the author has therefore limited himself to the existing locomotive. The supporting data employed are based on modern steam locomotives equipped with superheater and brick arch and fed by means of a live-steam injector.

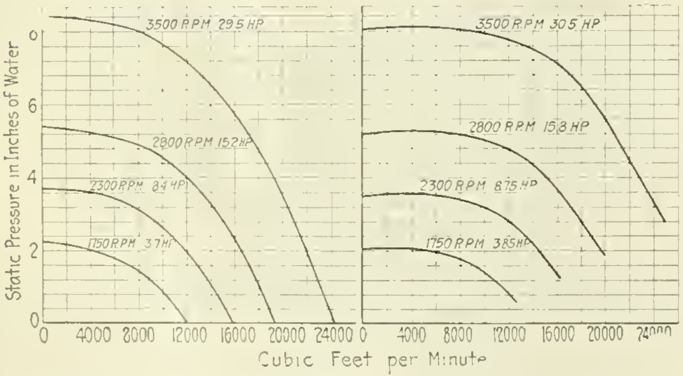


Fig. 1 Fig. 2

Fig. 1—Performance Curves of Vano Blower with 22-in. Diameter Diffuser Outlet.

Fig. 2—Performance Curves of Vano Blower with 30-in. Diameter Diffuser Outlet.

History of Locomotive Drafting

An interesting outline of the early history of locomotive drafting is contained in a paper on Locomotive Drafting and its Relation to Fuel Economy, by H. B. MacFarland, presented at the 1912 convention of the International Railway Fuel Association. The following quotations bearing on the subject are taken from this paper:

> It is stated, on very good authority, that the exhaust steam from the cylinders was first turned into the chimney by Trevithick in 1803. . . . . He turned the exhaust steam into the chimney as the most convenient way of dispensing with it. Throughout the development of the locomotive to its present high service standard, this method of producing draft has been the only successful one for locomotive service.
>
> Various arrangements and apparatus have been experimented with in an endeavor to secure some method equally as good, but up to the present time nothing has been accomplished which has proven entirely successful.
>
> About the year 1835 Segiun, the inventor of the multitubular boiler, experimented with an induced-draft system, using a fan in the front end. His experiments, however, did not meet with success, owing to his inability to secure a fan of sufficient capacity to properly handle the volume of gases.
>
> Despite the recognized loss of power in the exhaust jet, no serious attempt has yet been made to produce a draft on the fire by other means than the use of the exhaust jet to generate steam to meet the locomotive's demand. All experimental work has been confined to modifications of the general arrangement for utilizing the exhaust jet.

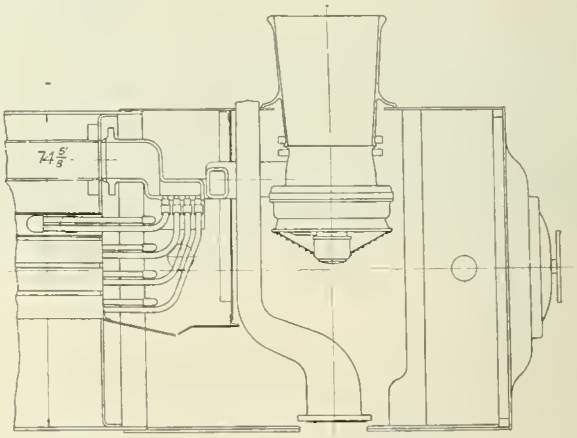


Fig. 3—Modified Standard Front End with Induced Draft Fan

The use of the exhaust steam for drafting the locomotive makes the locomotive power plant differ in principle from the marine or stationary power plant. In the latter the boiler is an independent unit, while in the former the boiler and the engine are interdependent, inasmuch as the exhaust of the engine creates the draft for the boiler and the shutting down of the engine renders the boiler inoperative. Separate the two by substituting mechanical draft for the exhaust jet and there is no reason why the locomotive power plant cannot be fitted out with the devices which have been responsible for the low cost of power generated in marine and stationary power plants. The problem is one of successful adaptation with reliability and moderate maintenance cost, within the present limitations of clearances and other conditions under which the locomotive must operate.

The logical course of development would be as follows: I, mechanical induced draft; II, undergrate forced draft; III, condensing the exhaust steam; IV, pumping the hot water from the tender through a waste-gas heater into the boiler; V, operating condensing.

Mechanical Induced Draft

About ten years ago extensive experiments with mechanical induced draft were made on the Atchison, Topeka & Santa Fe, but they met with the same fate as those made by Segiun in 1835 and for exactly the same reason: "the inability to secure a fan of sufficient capacity to properly handle the volume of gases." This statement, however, is not exactly correct. It has always been possible to secure a fan of sufficient capacity, but the difficulty has been to secure a fan with sufficient capacity to do the work economically and at the same time small enough to be applicable to a locomotive within the limitations of clearances.

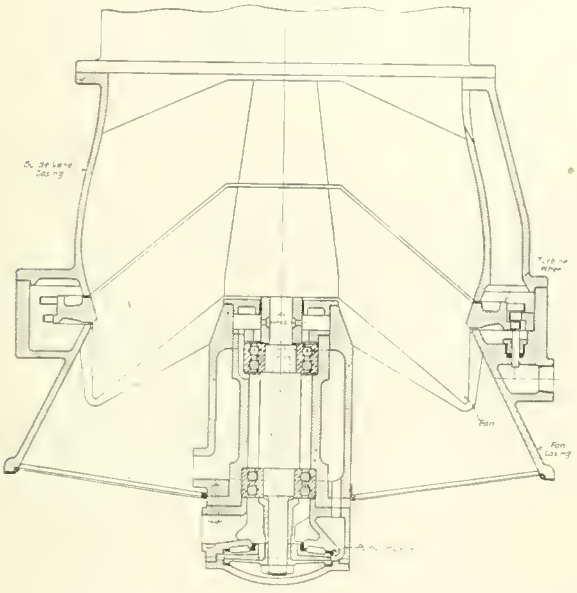


Fig. 4—Sectional View of Locomotive Induced Draft Fan

It is doubtful if a fan without the introduction of an intensifying element can be built to overcome this difficulty. Only recently this new element has been brought out. It takes the form of stationary guide vanes held in a casing. The current of air leaving the propeller is radially subdivided by the individual vanes and taken up without shock. These guide vanes, which have a curvature increasing in the direction of the rotation of the propeller, concentrate the air current and give it a further acceleration, so that a large part of the pressure is produced and a large part of the end thrust taken up by them. This new fan or blower is very much smaller than a multi-blade centrifugal fan of the same capacity, both of commercial construction. Because of this fact the former can be made applicable to the locomotive and the latter not.

Due to the fact that this blower has a much larger air delivery than any other fan of the same diameter and that, therefore, the dynamic pressure of the air is very high, the use of a diffuser which transforms the dynamic pressure into static pressure is absolutely essential. The longer the diffuser, the higher the static efficiency. The effect of the diffuser is plainly shown by the curves of Figs. 1 and 2.

Fig. 3 shows the smokebox of a modern locomotive fitted out with a blower in the stack and the exhaust pipe and nozzle displaced by a plain exhaust pipe discharging the exhaust steam into the atmosphere. It will be noticed that the guide-vane casing takes the place of the lower part of the stack, and it may be of interest to mention here that the size of the stack was exactly that of the diffuser of a 20-in. fan which has the proper capacity for this particular engine —a 26-in. by 28-in. Pacific type.

A modification of the fan is necessary in order that it may function properly as an induced-draft blower for locomotives, keeping in mind especially, simplicity of construction; low maintenance cost and assurance that the bearings are kept cool and well lubricated at all times, as the success of the whole scheme hinges not only on the capability of the blower to create the desired draft in the smokebox, but also to stand up under it.

Fig. 4 shows a cross-section of the induced-draft blower. The turbine is located on the periphery of the fan, and therefore takes up little space. The exhaust is discharged with the gases. There is no need of trying to reclaim this exhaust, as there is an oversupply of exhaust steam. The fan shaft carries on its extreme end the impeller of an oil pump which has a manifold purpose. The fan revolving at a high speed, in this particular case about 3,000 r. p. m., creates considerable back pressure, to which is added the weight of the rotating parts. No bearing will stand up under this end thrust at this speed and other means must therefore be adopted to take care of it. The end thrust created by the pump impeller is made use of to counteract the end thrust of the fan. By restricting the pump discharge to the cooling chamber, the end thrust of the pump impeller may be made anything desired, so that the vertical blower shaft may be made to float. The oil then passes upward over half of the cooling chamber, downward over the other half, and out of the smokebox into a cooling coil back to the pump inlet. The shaft is hollow and oil is forced through it and out through a small hole into a chamber over the upper ball bearing, whence it passes through the two bearings and then back to the pump.

One of the outstanding advantages of the use of an induced-draft fan instead of the exhaust jet for drafting the locomotive is the reduction of the back pressure in the cylinders. Prior to the experiments of the Atchison, Topeka and Santa Fe, a series of indicator cards taken from actual road tests of representative locomotives in various classes of service were prepared showing the initial pressure, mean effective pressure, back pressure, and indicated horsepower, and in addition the added mean effective pressure and indicated horsepower which could be obtained by reducing the back pressure to 4 lb. These showed increases in indicated horsepower ranging from 18 to 30 per cent for simple locomotives and an average of 53 per cent for a mallet compound.

The author understands that since these tests were made the exhaust nozzles have been opened up considerably so that the back pressures have been greatly reduced. With this in mind, and also the fact that the back pressures vary so widely for different classes of engines, road, and service conditions, not to mention the enormous differences in back-pressure horsepower due to different speeds, it would be idle to estimate what saving in fuel would result from drafting locomotives mechanically due to reduction in back pressure. However, the field seems broad and the prospects bright for enormous savings along this line.

If the only effect of drafting locomotives mechanically was the elimination of the back pressure on the pistons, this would in itself be sufficient to deserve the keenest interest of those responsible for the economical operation of locomotives, but the subject embraces a great many other questions and vitally affects many features in connection with the economical generation and use of steam. Mechanical drafting gives the locomotive a degree of flexibility which it does not now possess. The steam pressure may be picked up at will or allowed to drop, regardless of the amount of work the engine is doing.

This flexibility of draft makes it unnecessary to favor the engine at any time. The practice of favoring the engine on hills, often no doubt unavoidable under the present method of drafting, is not only wrong from the point of efficiency but cannot help but result in leaky tubes, increasing maintenance cost, and in shortening the life of the boiler.

The advantages of mechanical induced draft mentioned above largely relate to economy in the use of steam after it is once generated. In addition thereto mechanical draft has a strong bearing directly upon fuel economy and will greatly increase the overall boiler efficiency.

The heat loss due to combustible in cinders, estimated anywhere from 5 to 20 per cent depending largely on the class of service, is generally classed among the "unavoidable losses." With a fan the constant flow of air through the fuel bed, while gradually changing in intensity, will not tear the fire, and this loss can be practically entirely eliminated.

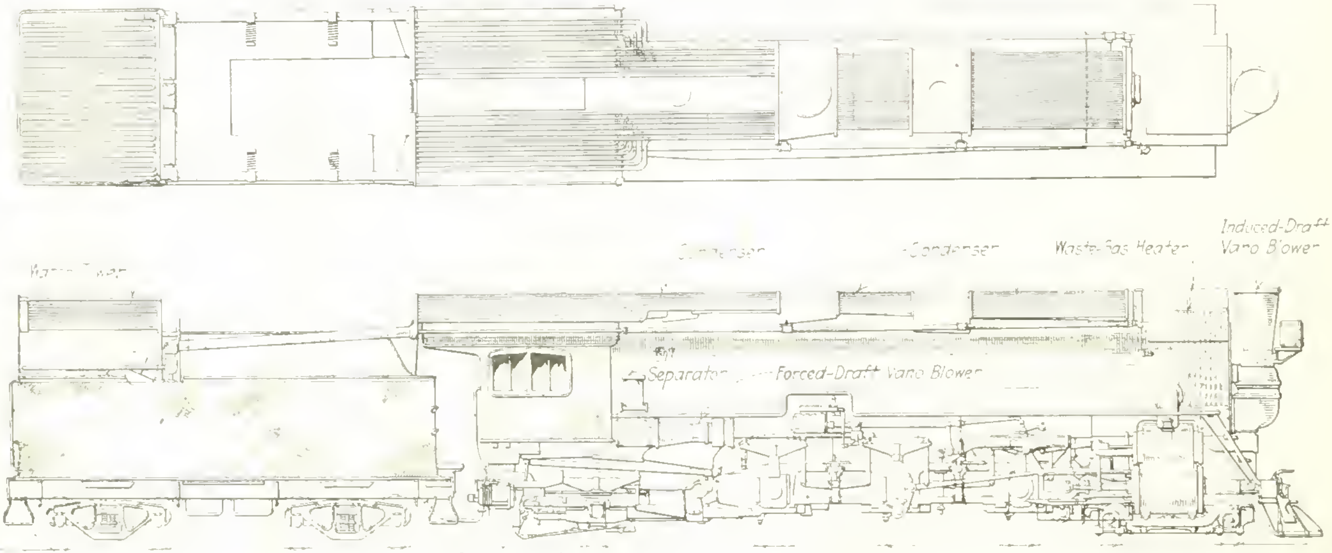


Fig. 5—Proposed General Arrangement of Locomotive with Induced and Forced Draft, Centrifugal Boiler Feed Pump and Steam Condensing Apparatus

Undergrate Forced Draft

To put the ashpan of a locomotive under pressure might prove impractical for several reasons: First, it would be difficult to keep the ashpan even fairly tight; second, there would be danger of setting fires; third, it would decrease the capacity of the pan as there should be ample air space between the ashes and the grate. To overcome this difficulty the author has constructed a grate with hollow bars taking the air from a wind box to which the forced-draft blower is connected.

The forced-draft blower is of the same general construction as the induced-draft blower. It operates, however, in a horizontal position with no excessive end thrust and handles cold air. Therefore, the special lubrication, end-thrust balancing, and cooling features are unnecessary.

While it is not impossible to operate a forced-draft blower in conjunction with an exhaust jet, it is much simpler and better to connect it up to an induced-draft fan. It will be plain that if the forced-draft blower was working alone the combustion chamber would be put under pressure and the gases and flames would leak out through the fire door. If, on the other hand, only the induced-draft blower was working, conditions would be very much the same as they are with the present practice. Between these two extreme conditions the speed of the two blowers could be so adjusted—and after once adjusted, maintained—that there would be an atmospheric pressure condition in the combustion chamber, if carried to a nicety. This is very common practice with stationary and marine boilers. With the fire door open there would be no inrush of cold air nor any outward leaking of flames or gases. Such a condition is called "balanced draft." It can be effected only by the use of a forced-draft blower in conjunction with an induced-draft blower, jet blower, or stack. While in a locomotive boiler there is no boiler setting through which air can filter in, the draft over the fire is so much stronger than in stationary practice and the fire door (on hand-fired coal burners) opened so much oftener, that even greater economies than in stationary practice should result from balanced draft.

With forced draft there is no reason why cheaper grades of fuel could not be utilized, which will not only result in economy in the cost of fuel, but also in the cost of handling and storage of coal. The air space in the grates may also be very small so that no fuel will be lost in the ashpan, and at the same time the grate will let sufficient air through on account of the air being delivered under pressure.

The forced-draft blower creates sufficient pressure to force the air through the fuel bed, leaving only the drawing of the gases through the boiler tubes to the induced-draft blower, and the latter may, therefore, be smaller or may be run at a lower speed than if used alone. For these various reasons it is easier and more efficient to use a balanced-draft system than merely induced draft.

Condensing the Exhaust Steam

When the locomotive is drafted mechanically all of the exhaust steam is available for whatever use can be made of it. Heretofore a small part of the exhaust steam has been used to heat the feedwater. This practice has been quite common in Europe but has been only recently successfully carried out on this continent and to only a very limited extent, less than one per cent of American locomotives being thus equipped. The exhaust-steam feedwater heaters have been constructed on the principle of imparting to the water the maximum amount of heat with the minimum amount of exhaust steam because the latter was needed to draft the locomotive. With mechanical draft, the more steam used for heating the feedwater the better, as the more water will be saved. Railroad men fully appreciate the economy in time and fuel due to the saving of water, especially in freight service, and incidentally the not negligible economy in boiler repairs in bad-water districts.

The exhaust steam, or as much of it as can be condensed, may be passed through a condenser on top of the locomotive running all the way back to the tender (see Fig. 5). The remainder may be allowed to pass to the air free for the time being. Such an arrangement affords a large cooling surface and the amount of water which can be saved without even attempting to run the engine condensing will be much larger than the amount saved by merely heating the feedwater by means of an efficient heater. The cooling surface may be made more effective by directing over it a current of air created by the speed of the locomotive with or without the assistance of the undergrate-draft blower. It is a simple matter to encase the condenser, provide it with louvers to catch the air, and connect it to the blower inlet by means of a duct. This would have the additional advantage of reclaiming part of the latent heat of the exhaust and supplying the fuel bed with preheated air. A cooling tower located on the back of the tender would further assist materially in condensing the exhaust.

Pumping the Hot Water from the Tender Through a Waste-Gas Heater Into the Boiler

It needs no explanation that with all the exhaust steam available it will be a simple matter to keep the water in the tender at any temperature desired up to the boiling point. This would convert the tender practically into an open heater. Many of the carbonates would be precipitated and most of the dissolved oxygen removed. Instead of the injector a boiler-feed pump, preferably of the centrifugal type, installed in duplicate, will feed the water through a waste-gas heater into the boiler. The pumps will be located under the cab of the locomotive, so that there will be a sufficient head of water from the tender. Waste-gas heaters have been so far a distinct failure largely on account of the prerequisite that the heater should not interfere with the draft, because if it does the economy derived from its use would be nullified by an increase in back pressure. On account of the limited space available in the smokebox, the heating surface was comparatively small and facilities for examination, cleaning, and overhauling were for the most part lacking. The author has constructed a waste-gas heater which can be placed in the front end with slight alterations thereto, and which has a heating surface of over 1,000 sq. ft. By extending the front end this heating surface could be increased if necessary.

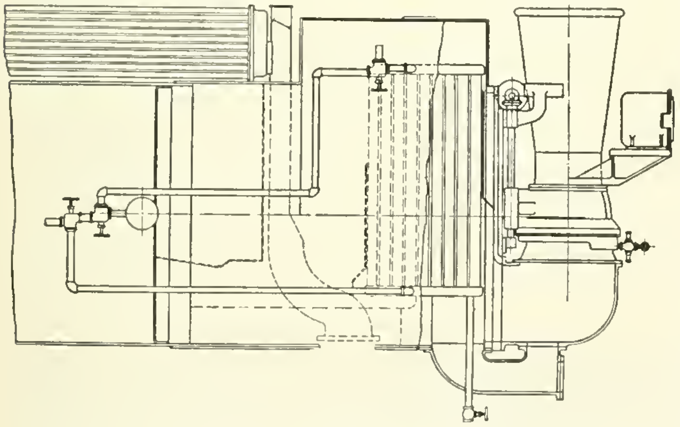


Fig. 6—Modified Front End, Equipped with Induced Draft Fan and Feed-Water Heater

From the point of efficiency it may be considered that at the present time the water is put in locomotive boilers at an average temperature of 60 deg. F. the year round. Although the injector, which is almost exclusively used on locomotives for feeding the boiler, imparts the heat of the live steam to the water, this is accomplished at a loss of heat.

If, instead of an injector, a pump is used the exhaust steam and the waste gases—which comprise the two largest items of waste energy in present locomotive operation—can heat the water from 60 deg. to 300 deg. With an absolute steam pressure of 200 lb. this is an undisputed saving in fuel of a little over 20 per cent, and the feedwater entering the boiler at a higher temperature by 150 deg. will reduce the viscosity and promote the circulation of the water and will have a very beneficial effect upon the cost of maintenance and the life of the boiler, as unequal stresses would be practically entirely eliminated.

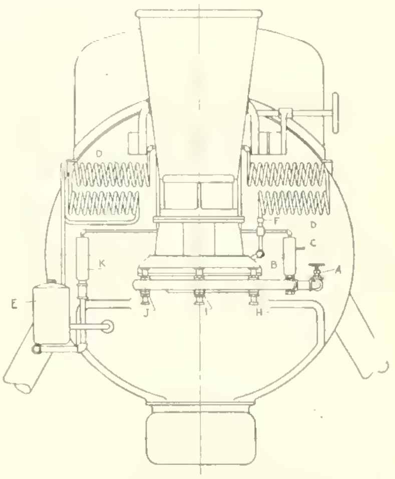


Fig. 7—Front of Locomotive Showing Induced Draft Fan and Controlling Apparatus

Operating Condensing

Mechanical drafting of locomotives makes it possible to run locomotives condensing. It can be accomplished without material change in their construction outside of an enlarged and modified tender. This, however, will come later after the steam consumption of the locomotive has been made as small as possible, which will, in itself, make condensing operation easier.

General Arrangement

Fig. 3 shows the induced-draft blower located in the stack. This is naturally the logical first step in the development of an induced-draft system for a locomotive, but a blower in such a position is not readily accessible. Practical considerations led the author to place the blower outside of the smokebox. A diagram showing the general arrangement of exhaust pipe, waste-gas heater, and induced-draft blower is shown in Fig. 6 and will need no further explanation.

Fig. 7 shows a front view of the locomotive. Means are therefore provided whereby the guide-vane casing can be quickly separated from the fan casing, giving access to both the fan and the guide vanes for cleaning.

It will be plain that it is absolutely necessary to have and maintain a fixed relation between the pressure at the grate bars caused by the forced-draft blower and the draft at the front end caused by the induced-draft blower. The steam supply to the induced-draft blower may be taken direct from the steam dome and preferably run through a simple superheating coil in the smokebox extending through the smokebox front into a throttle valve *A*, Fig. 7. Between the throttle valve and the steam chamber of the blower is placed a regulator *B* provided with a lever *C*. When the blower is not in operation this valve is closed, but by pulling down lever *C* the valve is opened, admitting steam to the chamber and starting the blower. The oil pump at the end of the blower shaft circulates the oil through a series of cooling coils *D* into a vented oil reservoir *E*, from which it flows back by gravity into the pump. The oil before it enters the cooling coils passes through a choke *F*, which puts the oil between the discharge end of the pump and this choke under any desired pressure. To this pressure system is connected a pipe communicating with diaphragm regulator *B*. Therefore, when lever *C* is pulled down, not only is the blower started, but as soon as it comes up to speed the oil pressure which acts against the diaphragm keeps the regulator valve open. If there is no oil pressure, then the moment the operator takes his hand off the lever the valve closes again. Therefore the blower cannot be started nor continue to operate unless there is sufficient oil in the reservoir *E* to supply the pump. This is a fool-proof arrangement against neglect or accident.

The first nozzle which has been supplied with steam is not sufficient to more than run the blower at a speed which will just keep the gases out of the cab, and until valve *A* is shut off at the end of the trip the blower will operate continuously. The main power supplied to the turbine is through automatic regulating valves *H*, *I* and *J*. Suppose in starting off the steam pressure is 200 lb. The blower running at its minimum speed, the steam pressure will immediately begin to drop, and at 198 lb. it will open valve *H* and supply steam to the turbine. If the load is small this may be sufficient to bring back the steam pressure to 200 lb., when valve *H* will close again. Just as soon, however, as valve *H* does not supply sufficient steam to the turbine to keep the steam pressure around 200 lb,. the pressure will continue to drop, and at 195 lb. valve *I* will open. This may or may not be sufficient to raise the steam pressure. If it is sufficient to raise it between 195 and 198 lb., valve *I* will close and at 198 lb. valve *H* will close; but, on the other hand, if it is not sufficient and the steam pressure drops to 192 lb., valve *J* will open. At any rate the steam pressure will travel between 200 lb. and 190 lb. and the blower will be gradually slowing down and speeding up, at all times giving the required draft to maintain a pressure beteen 190 lb. and 200 lb., regardless of load conditions.

The oil pressure also controls regulator *K* and gradually opens and closes it. In other words, the higher the speed of the induced-draft blower or the higher the oil pressure, the wider the regulator is opened. This regulator controls the steam supply to the forced-draft blower and the boiler-feed pump, and also the steam supply to the stoker or oil burner, if used. The oil pressure also controls the supply of oil to an oil burner, so that whatever method for generating steam is used, the induced-draft blower not only furnishes the necessary draft but also controls the amount of fuel used and the water fed into the boiler. The boiler-feed pump is equipped with a combined excess-pressure governor and safety stop, maintaining a predetermined pressure in excess of the boiler pressure at any load from practically nothing to full capacity. Proper provision is made whereby the steam supply to the different apparatus is partly shut off when the engine is standing, or drifting, if the locomotive is equipped with a superheater, to compensate for the closing of the superheater chamber resulting in the greater part of the area through the flues being shut off and which otherwise would disturb the relation between the induced-draft blower and the other equipment controlled by the oil pressure.

Conclusion

Whatever the saving in fuel will be, due to the elimination of back pressure, the heating of the feedwater, the stopping of the waste of unburned coal through the stack and through the grate, the elimination of cold air over the fire, etc., it is going to reduce just that much the amount of coal that is being fired, or the rate of combustion, which in itself greatly increases the boiler efficiency.

A rate of combustion of 100 lb. shows a boiler efficiency of 65 per cent. Reducing this rate of combustion to 60 lb., directly and indirectly by means of mechanical drafting, which is not impossible, the corresponding boiler efficiency would be 74.2 per cent, or a saving of 9.2 per cent.

In a paper presented by John E. Muhlfeld, at the Annual Meeting of The American Society of Mechanical Engineers, December, 1919, entitled Scientific Development of the Steam Locomotive, the following heat balance is shown as representative of locomotives worked at from 25 to 35 per cent cut-off and hand-fired:

	Percent
Heat absorbed by boiler	55
Heat absorbed by superheater	10
Heat loss in smokebox gases	14
Heat loss in cinders	8
Heat loss in vapors of combustion	4
Heat loss in combustible in ash	3
Heat loss in carbon monoxide	2
Heat loss in radiation and unaccounted for	4
Total	100

Under the same conditions but with mechanical draft and the waste-gas heater as described by the author, the heat balance should be approximately as follows:

	Percent
Heat absorbed by boiler and waste-gas heater	74
Heat absorbed by superheater	10
Heat loss in smokebox gases	5
Heat loss in cinders	2
Heat loss in vapors of combustion	4
Heat loss in combustible in ash	1
Heat loss in radiation and unaccounted for	4
Total	100

It does not matter so much what can be done in laboratory tests or even in road tests, when everything is tuned up and everyone is trying to make a good showing, as what actually prevails under ordinary operating conditions, and the efficiency of any equipment which depends upon the intelligence and faithfulness of the operator must be discounted. For maximum efficiency the operation should therefore be as nearly automatic as possible, and in so far as the human element must enter into it, everything should be done to make it simple and convenient for the operator. This is an axiom which the author has kept carefully in mind in the development of the equipment described. Draft is supplied exactly as needed and when needed, and the water is fed through the waste-gas heater in the same proportion as the waste gases pass over the heating surfaces. Therefore, maximum efficiency should prevail. The fireman will have no trouble in keeping up steam pressure while holding the water level constant by simply manipulating a valve in the discharge line of the pump. The engineer can count on full steam pressure regardless of grade, load, or weather conditions, and without the power of his engine being affected by draft requirements.

In conclusion, it may be stated that mechanical drafting of locomotives is imperative for the following reasons:

a It reduces the back pressure to a minimum, effecting a saving in fuel of from 10 to 30 per cent—depending upon the amount of back pressure carried at present and the amount of vacuum produced, if any—or increasing the power of the locomotive in the same degree, especially as speed increases, therefore adding to the hauling capacity or speed of fast freight and passenger engines, producing additional revenue tonnage and also eliminating or lessening the necessity for double-heading.

b It produces an engine that is free-steaming under the most adverse conditions and with all grades of fuel, decreasing liability of delay and saving time and money now spent in changing nozzle tips and experimenting with them.

c It keeps the steam pressure constant, regardless of load, saving steam now wasted every time the safety valve pops and making it unnecessary to favor the engine at any time, thereby saving fuel, avoiding unequal stresses in the boiler and resulting in saving in maintenance cost.

d It increases the efficiency of the boiler and grate by effecting better combustion and eliminating the waste of unburned fuel through the stack and in the ashpan—and incidentally stopping the inrush of cold air every time the fire door is opened—thereby avoiding sudden cooling of crown sheet and tubes.

e It makes possible the use of cheaper grades of fuel, resulting in large economies and in simplifying the handling and storage of coal.

f It eliminates the smoke nuisance in terminals and freight yards.

g It makes it possible to condense from 25 to 95 per cent of the exhaust steam, depending upon the season of the year and the kind of condensing apparatus used, resulting in economy in the cost of water and of maintenance.

h It effects a saving in fuel of 20 per cent by making it possible to preheat the feedwater from 60 to 300 deg. F., and incidentally greatly decreases the cost of maintenance by eliminating unequal stresses caused at present by the great difference in temperatures between the lower and upper portions of the boiler.

i It reduces the rate of combustion, thereby increasing the boiler efficiency.

j It lessens the work of both engineer and fireman, thereby necessarily increasing their efficiency.

Discussion

William Elmer (Pennsylvania System) questioned the desirability of making the boiler output independent of the locomotive steam consumption. To show the great amount of air that it would be necessary to handle with a fan if locomotives were drafted mechanically, he presented figures from test plant trials of a Pacific type locomotive with 27 in. by 28 in. cylinders. This locomotive developed over 3,000 hp., evaporated 65,000 lb. of water and burned 12,000 lb. of coal an hour. The draft in the front end was as much as 18 in. of water. It is difficult to determine the amount of air required to burn each pound of coal, but J. T. Anthony states it varies from 12.7 to 8.7 lb. Assuming an average value of 10 lb. of air per pound of coal and assuming further that a locomotive consumes 10,000 lb. of fuel an hour, the fan would be required to handle 100,000 lb. of air per hour. This would amount to 1,300,000 cu. ft. per hour at atmospheric temperature, and at a temperature of 600 deg., which might be expected in the front end, the volume would be double.

Robert Rennie (American Locomotive Company) stated that a locomotive with 55 sq. ft. of grate area working at full capacity should have a fan capacity of at least 48,000 cu. ft. per min. at atmospheric pressure. Cooling the air before it is admitted to the fan would make mechanical drafting less difficult, but the additional resistance due to any appliance for recovering heat from the waste gases is a disadvantage. He considered that the method of reclaiming water from the exhaust steam would hardly be practical because of the enormous cooling surface required.

W. L. Bean (N. Y., N. H. & H.) called attention to the magnitude of the fuel problem on the railroads and pointed out the desirability of trying such designs as proposed by Mr. Coppus because of the possibility for large savings. He stated that fan efficiency and capacity had been greatly improved since the last trials of mechanical draft were conducted and urged early application of the design put forward after careful engineering investigation had been made.

Dr. W. F. M. Goss discussed mechanical drafting of locomotives by means of a turbo-exhauster. He called attention to the objection of the operation of locomotives in cities on account of the noise and smoke and outlined how these could be overcome by the turbo-exhauster. He stated that the required draft could be obtained with from 40 to 50 per cent of the existing back pressure, and in conclusion expressed the opinion that mechanical drafting had so many advantages that it is likely to come into use soon on the railroads.

R. M. Ostermann (Superheater Company) stated that if it was possible by substituting mechanical draft for nozzle draft to save all or part of the waste heat in the exhaust steam, even greater mechanical complications than proposed by Mr. Coppus would be justified. To obtain the full benefits, it would be necessary to condense the steam, but to add a condenser of sufficient capacity to the modern large locomotive seems a difficult structural matter and the effect upon power and steam economy would be hardly great enough to warrant the complication, especially since there are further thermal possibilities from higher steam pressure and temperatures that can be realized with less space and weight. Disregarding the expediency of condensing the exhaust steam, mechanical drafting assumes a different aspect. Its merits would then be confined to possible reduction of back pressure and increased evaporation per pound of fuel due to improvements in draft. It seems questionable whether much reduction in back pressure could be effected or any marked saving made by the turbine as long as the draft is depended upon to keep the front end clear of cinders. Uniform draft would probably reduce spark and cinder losses, but it could be obtained more readily by a receiver in the exhaust passage.

In closing the discussion, Mr. Coppus stated that his proposal had in some cases been misunderstood due to failure to consider all the conditions set forth in the paper. His conclusions had been based on careful study and he felt certain that they were practical.

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A Sixty-Car Coal Train on the Pittsburg & Shawmut

Every Car Loaded to Capacity—Gross Weight of Train 4,710 Tons, Pulled by Two Mikados, Each Having a Weight of 180,000 lbs. on Drivers

Human Problems of Modern Industry*

The Development of Democracy in Business Is Under Way— It Needs Wise Leadership and Direction

By Samuel O. Dunn

Editor, Railway Age

THE HISTORY of industry and of its relations to the people in the leading countries of the world during the last century, and especially during recent years, presents a strange paradox. The development of modern industry has resulted in a vast increase of production which has enabled every class to esetablish and maintain material standards of living higher than ever were attained by any but a very few in earlier times. It has also made possible reductions of the hours of labor and increase of the hours available for leisure, intellectual improvement and pleasure.

If any man whose life ended prior to a century ago, or even prior to a half century ago, had foreseen this vast increase of production, this great improvement in standards of living and reduction of hours of work, he might have anticipated that it would usher in a golden age of harmony, peace and contentment among men. Quite the contrary has been the result. There never was a time when there were bitterer quarrels or fiercer struggles in industry than within recent years.

They have been waged not only between large industries and their employees, but also between large industries and their customers. Both before and since the war the railways have been engaged almost constantly in carrying on controversies with their patrons regarding rates as well as with their employees regarding working conditions and wages. Almost every large industrial combination also has been the object of attacks in the courts.

These great struggles are being carried more and more into politics. More and more are efforts made to use legislation and government administrative bodies to settle differences arising between large industries and their employees or patrons; and when legislation and government commissions are invoked their tendency is to settle the questions submitted adversely to large industrial concerns.

Finally, growing more and more active and influential is a class of labor leaders, politicians and agitators, who are striving by propaganda, by political action, by strikes and even by violence to overthrow part or all of our existing institutions and to establish in their place institutions varying all the way from a mild form of state socialism to the "dictatorship of the proletariat" in both government and industry as it is exemplified in Russia.

Modern Industry the Cause of Social Unrest

No intelligent man would question the seriousness of some of the struggles between large industries and their employees or patrons which have occurred within recent years. There are those who are convinced that these struggles are direct and inevitable results of the development of modern industry and of the way in which many large industrial concerns have been managed and that unless important changes are made in the managements these struggles will become more frequent, more bitter and more destructive of the welfare of all concerned.

There can be no question about what has been the principal cause of the great increase of production in modern times. Until a little over a century ago there had never been any really great improvement in the physical machinery of industry. Almost all the power used in agriculture, in manufacture and in transportation had been furnished by the muscles of men and animals. It was chiefly the discovery and utilization of new sources of power, mainly steam and electricity, that made possible the development of modern industry. In order to make the best use of these new sources of power large manufacturing and transportation units were created which rapidly drove out smaller ones. Other improvements in the physical machinery of industry, such as those in means of communication, stimulated the tendency of industrial and transportation concerns to increase in size. Owing to these and other causes we have witnessed within recent years the development of concerns which are enormously larger than any which existed prior to a generation ago.

How has this great increase in the size of industrial and transportation concerns helped to create the social unrest and antagonisms which now cause so much trouble?

First, it has tended to put great power into the hands of the managers of large concerns, and it is a law of human nature that men who have great power will be tempted to abuse it to further their interests and the interests of those they represent. There is hardly a large concern in the country that has not at some time and in some ways abused its power in dealing with its employees and patrons.

Secondly, where great power is possessed, or thought to be possessed, people have a tendency to believe that it is being abused, or to fear that it will be abused even though actually it is not being abused at all and there is not the slightest intention of doing so.

The Need of Personal Contacts

The owners and managers of small concerns come into frequent contact with their employees and patrons and therefore know what kind of men they are, and the owners and managers know constantly the feeling and attitude of their employees and patrons and can act accordingly. The owners of large concerns usually are numerous stockholders who are widely scattered and hardly ever come in contact with the employees and patrons. Even the managers of large concerns come into direct contact with only a few employees and patrons. In consequence usually they are almost unknown to the thousands of people with whom indirectly they are dealing; and often they themselves know extremely little about what is in the minds of all these many thousands of people.

If, in addition, as often happens, the principal officers of a large concern deliberately refrain from making any efforts to come into contact with as many of their employees and patrons as they can, or even from making any public statements regarding affairs of the company in which the company and its employees or patrons have a common interest, you have a situation which is certain to beget a lack of mutual understanding which will tend to develop into suspicion, then into antagonism and then into great and dangerous struggles. When the employees and the public begin to suspect, dislike and attack the big concerns in any field the smaller concerns in that field are likely to become the objects of similar suspicion, dislike and attack.

There is not the slightest likelihood of any reduction of the size of industrial concerns. The most radical advocates of socialism or syndicalism or guild socialism would not favor this. On the contrary, they favor wholesale consolidations of all the concerns in each field and seizure of their ownership by the public and transfer of their management either to the government, or to the employees.

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* From a paper read before the Western Railway Club, Chicago, on November 20.

We have recently seen production seriously interfered with by two great strikes due to controversies between employers and employees. We are now seeing the production and commerce of the country limited by inadequacy of transportation. This is due partly to labor troubles but much more largely to years of government regulations based largely on public misunderstanding and prejudice. Bad human relations are tending to arrest the progress of industry.

What is "Democracy in Industry"?

The policy most persistently and persuasively advocated by the critics of the present system is that of "democracy in industry." This is their slogan, although they do not always mean the same thing by it. In fact it is used to mean everything from a mild form of government regulation to the Russian soviet scheme of complete ownership and management by the proletariat. It is absurd to call the Plumb plan and similar schemes plans for establishing "democracy in industry." The Plumb plan provides that the public shall buy the railways and turn them over to the management of those on their payroll. If the railways earn any more than interest on the investment in them, one-half of the surplus will be given to the public and one-half distributed among the employees. If a deficit is incurred the public will pay it all. There never would be any surplus, however, because those in the payroll would fix their own pay through a board selected entirely by themselves. Democracy is supposed to be the rule by the many. Where would be the democracy in an industry which was owned by 100 per cent of the people and ruled by only two per cent of them for their own benefit?

How Shall Democracy Be Attained?

However, one may not be very favorably impressed by the plans for establishing democracy in industry which are advocated by those who seek to overthrow the existing political and industrial order, and may, at the same time, believe that an increase of real democracy in industry is inevitable. In fact, there already have been some great increases of democracy in industry. Labor unions in some industries have acquired so much power that they are able at times practically to dictate their own terms. Witness the recent strike in the coal mining industry and its results. This is one form of democracy in industry, since it involves dictation by hundreds of thousands of employees to a few employers. Our policy of government regulation of railroads affords another illustration of one form of democracy in industry. It involves dictation by the many who use railway service to the comparatively few companies that render it.

The great movement for democracy in government which began generations ago has been resisted to the last extremity by the upper classes in some countries. The results in those countries, of which France in the eighteenth century and Russia in the present century afford the most striking examples, have been tremendous social upheavals in which the upper classes, and, indeed, the entire countries have been almost ruined. In England, on the other hand, the upper classes yielded step by step. Vicious class antagonisms were avoided and under conditions of democracy the property owning and more intelligent classes have succeeded in maintaining their leadership.

Does not this history hold a lesson for the present generation, which is confronted with the insistent demand for more democracy in industry? Does it not suggest to the leaders of industry the wisdom of not resisting all efforts to increase democracy in industry, but on the contrary, of furthering its development along lines which will give employees and the public a larger participation in management and control, while leaving its leadership and direction still in the possession of the comparatively few men of large ability who alone are equal to its leadership and direction?

Employers of past generations took the position—and many take the same position today—that it was their right to fix working conditions and wages in their business, and that labor could accept or go without work. Now, capital furnishes the physical machinery and selects the directing minds, but labor furnishes the manual skill and labor which operate the machinery. There never was and is not now anything unnatural or unreasonable in the desire of labor to have an equal voice with the management in settling terms and conditions of employment relationship. But, if the employees are in any real sense to deal with the management regarding these matters, they must do so through representatives chosen by themselves. This necessarily means some organization of the employees. It is doubtful whether some kind of organization of the employees of any large concern can long be prevented. The question is whether the employees of the individual concerns shall be encouraged to form organizations of their own, or whether this shall be resisted, with the almost certain ultimate result that practically all employees will become members of national labor organizations.

From the standpoint of both employers and employees, dealings between each concern and its own employees are far preferable to dealings with national labor organizations. Only agreements between each concern and its employees can adapt conditions and wages to local conditions with which they are surrounded. Personally I have no doubt that all large concerns should favor an increase of democracy in industry which will result from allowing and encouraging their employees to form organizations of their own and from dealing fairly and frankly with them.

Furthermore, it seems highly probable that most large industrial concerns would derive benefits from encouraging conferences between representatives of the employees and of the managements regarding many questions of operating efficiency. In the long run it is as much to the interest of all to have each concern efficiently operated. About 12 years ago when the record for industrial and railroad accidents was at its worst, many industries, including the railways, organized safety committees composed of officers and employees. There has been since then a remarkable reduction of fatal accidents, undoubtedly mainly due to the work of these committees. There does not seem any good reason why it would not be possible and desirable to form similar committees to bring about co-operative effort to eliminate waste and increase efficiency. There are many employees who could do valuable work on such committees and would not only make contributions toward increased efficiency but also learn some of the difficulties which the managements have to overcome in reducing waste and securing economies.

The Democracy of Ownership

There is another form of democracy in industry which should be earnestly and energetically promoted. This is the diffusion of ownership of the concern's securities among its own employees and patrons. Most large concerns, and especially railroads, are regarded by their employees and patrons as being a kind of alien institutions which exploit those who work for them and from whom they get business in order to pour profits into the coffers of a small class of rich people who do business and live at ease in or within a comparatively small radius of Wall Street. So long as the employees and patrons of a concern regard it thus it will be difficult to convince them that they have any interest in its prosperity. Some concerns have adopted successful means of getting large numbers of their employees to become stockholders.

Some of the best managed public utilities are making successful efforts to get large numbers of their customers to buy their securities and thereby establish what is called "customer-ownership." The best industrial democracy which could be established would be a democracy of ownership. Substantial difficulties would have to be overcome in securing a widespread diffusion of the securities of railways among employees and patrons, but it may be they would not be so great as now believed.

No great result is ever attained without thorough study and great effort being made to attain that result. There has been study and effort to improve human relations in modern industry but the conditions which exist show clearly that it has been far from sufficient. The principle of arbitration of all great controversies that cannot be settled by direct negotiations should be insisted upon; but the thing most needed is the adoption of methods and the creation of a spirit which will tend to prevent the development of controversies to a point where they cannot be settled except by arbitration or strikes.

The Menace of Destructive Propaganda

Without doubt one of the principal causes of bad human relations in industry is that employees and the public have been allowed by the managements to be grossly misled regarding the way in which large concerns really are managed and the profits that are made. Most men who own property and manage commercial and industrial concerns seem to have little idea of the amount, character, or real purpose of the radical literature attacking the present social and industrial order which is being disseminated throughout every country among those who work for wages. Let extensive propaganda go unchecked long enough and it will overthrow any institution. The propaganda to which I have referred, whether carried on by bolshevists, syndicalists, guild socialists, I. W. W. or parlor socialists, is intended to convince people who do not own or manage property that the present system of private ownership and management of large industries inevitably works the enrichment of the few and the impoverishment of the many. It preaches that the many, by forcing the payment of wages which industry cannot stand, or by constant strikes and violence, or by governmental action of various kinds, should indirectly or directly take over to itself the virtual ownership and the actual management of all industries.

This is supplemented by propaganda carried on among small property owners and farmers which attempts to create sentiment against the existing order by greatly exaggerating the profits made by railroads and large manufacturing and mining companies, with the object of causing regulation of their management, their rates and their prices which will help to make private ownership and private management impossible.

Even if all the problems arising from the relationship of employer and employee could be solved temporarily at least there would not long be peace in industry. The present railroad situation illustrates that. The wages of all railway employees have now undergone some, and those of certain classes substantial, reductions, and probably there would be no more serious controversies between the railways and their employees for some time if the present rates were let alone. But already there is a widespread and energetic agitation for further reductions of rates among the farmers. This is partly due to the fact that the farmers really are suffering severely from an unwholesome disparity between the prices they can get for their products and the rates and prices they have to pay for the transportation and commodities they buy, and partly to reckless propaganda which has been carried on to make them believe that while they are suffering losses the railways are guaranteed large profits. If railway rates should soon be reduced again it would be necessary for the railways to start at once to secure further reductions of wages, and then the controversies between them and their employees would begin on a large scale again.

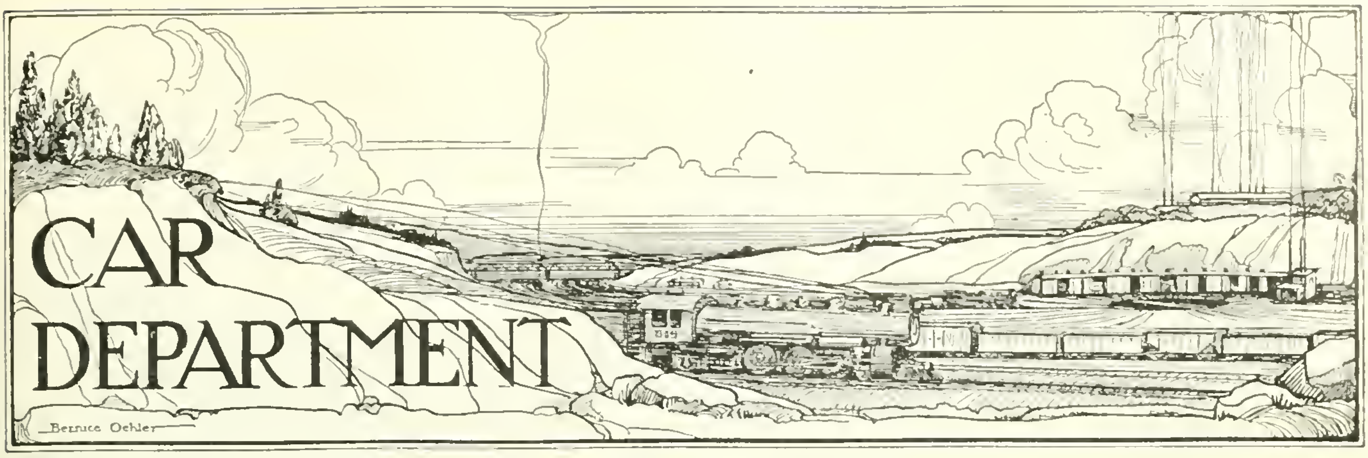
Take the Mystery Out of Big Business

There is a certain large railroad system which from every standpoint is one of the best operated and most successful in the United States. The management has tried in numerous ways to establish close relations with its employees and patrons, and has presented to them by newspaper advertising and other available means the facts about the railroad and what it is doing. It also has been especially prompt and courageous in refuting misrepresentation. When the recent shop employees' strike came this railroad, from the beginning, kept one-half of its shop employees and was one of the first to build up a 100 per cent force. Probably there is no other road which is today more popular and the object of fewer criticisms and attacks. Its management is convinced that the educational work it has carried on among employees and patrons has contributed greatly toward enabling it to maintain its shop forces, secure efficient work, handle a record-breaking business and increase its net earnings.

What the management of this railway has done, those of others can do. With respect to educational work among the employees and patrons of large concerns there are two conclusions I have reached after years of study and observation. The first is that our present system of private ownership and management of large industrial and transportation concerns cannot be permanently maintained without a better understanding and more good will being established between these concerns and their patrons and employees. The second is that the amount of educational work which must be done by such concerns among their employees and the public, if a better understanding is to be secured, must be greatly increased. There are at least a hundred politicians and labor radicals who are actively engaged in carrying on propaganda to secure the adoption of a ruinous policy of regulation and the destruction of private ownership of railroads to every man who is engaged in combating this propaganda. There are scores of radical labor organizations that constantly employ men to deliver addresses and secure publicity in every community in the country attacking private management of railroads. There are hundreds of thousands of railway employees who, under the direction of radical leaders, are everywhere carrying on propaganda against the managements of the railroads. How many of the 20,000 railroad officers make any effort to combat this propaganda?

The Esch-Cummins Transportation Act was passed to destroy the restrictive policy of railway regulation which formerly prevailed, and to establish in its place a constructive policy. Almost from the time it was enacted it became the object of the most false and misleading attacks that political and labor leaders ever carried on with respect to any piece of legislation. At the recent national election almost every important member of the National House and Senate who voted for and defended that law who was up for re-election was defeated, while almost every candidate who made his campaign largely one of attack upon that law was elected. In consequence, there is the gravest danger that the important constructive provisions of the act will be destroyed. If this should be the case the railways probably will have to look for protection to the federal courts.

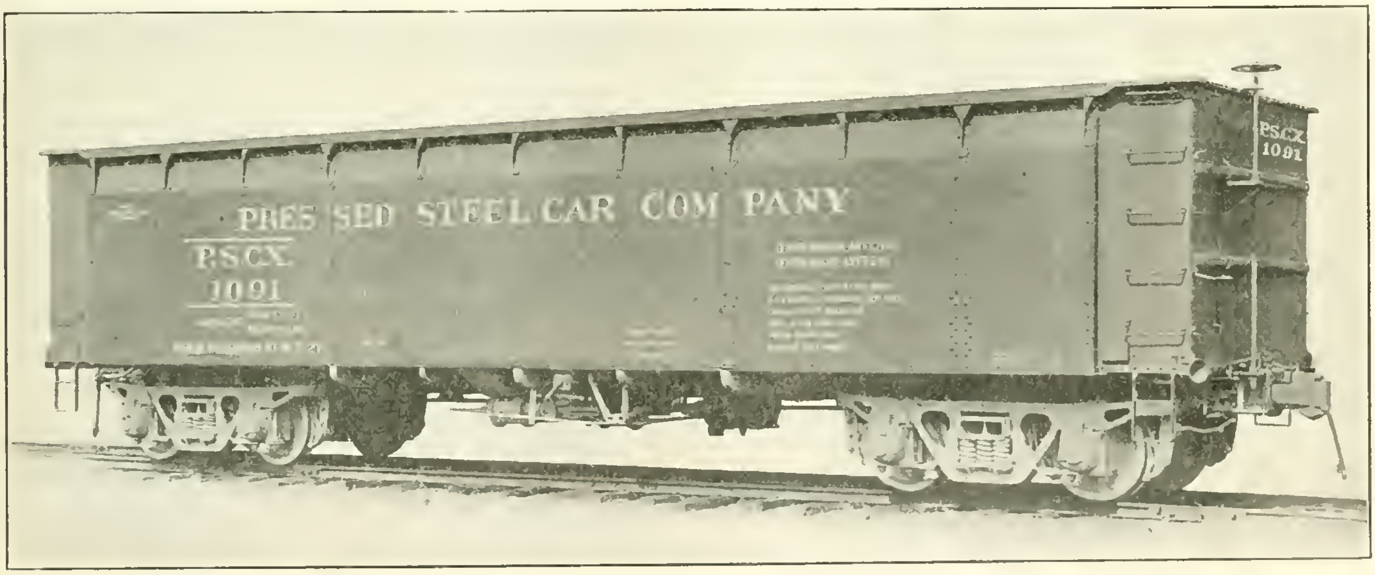
In the long run the preservation of the present industrial order will depend upon public sentiment. Whether public sentiment in regard to railroads and other large industries will be friendly or hostile, wise or unwise, constructive or destructive, will largely depend upon whether the managements of these concerns make real, persistent and intelligent efforts to solve their human problems. Big business must establish closer relations with its employees and the public and destroy popular suspicions and prejudices by taking all the mystery out of big business or it will have more serious troubles in the future than it ever has had in the past.



100-Ton Gondola Car with Four-Wheel Trucks

High Capacity Experimental Car Built by Pressed Steel Car Company Carries 77.2 Per Cent Revenue Load

ABOUT two years ago the Pressed Steel Car Company built a sample coal car which was designed especially for transporting coal to be dumped in a car dumper and with the idea of carrying the greatest amount of coal on two four-wheel trucks. The car has a stenciled capacity of 182,000 lb. or 3,212 cu. ft. When heaped with a 10 per cent overload, the capacity is 200,000 lb. or 3,703 cu. ft. As the car is always emptied in a car dumper it is not equipped with hoppers or drop doors, being of the flat-bottom, high-side gondola type. The light weight of the car, including the two four-wheel cast steel trucks, is 59,000 lb. and when loaded to capacity the wheel-load on the rail, 64,750 lb. per axle, is somewhat less than the maximum allowed for locomotives. These wheel-loads are greater than has been the general practice heretofore and on this account some doubt has been expressed as to the probability of satisfactory operation. This sample car has now been in service on the Virginian for more than a year and has a record of about 10,000 miles in coal traffic. No undue wear has so far shown up on any of the running gear or other parts, although the wear of wheels and brake shoes has, of course, been proportionately greater than on similar cars with six-wheel trucks. The car is reported to have been found satisfactory in all respects. The test shows that it is feasible and therefore more economical to use four-wheel trucks on cars of even such high capacity.

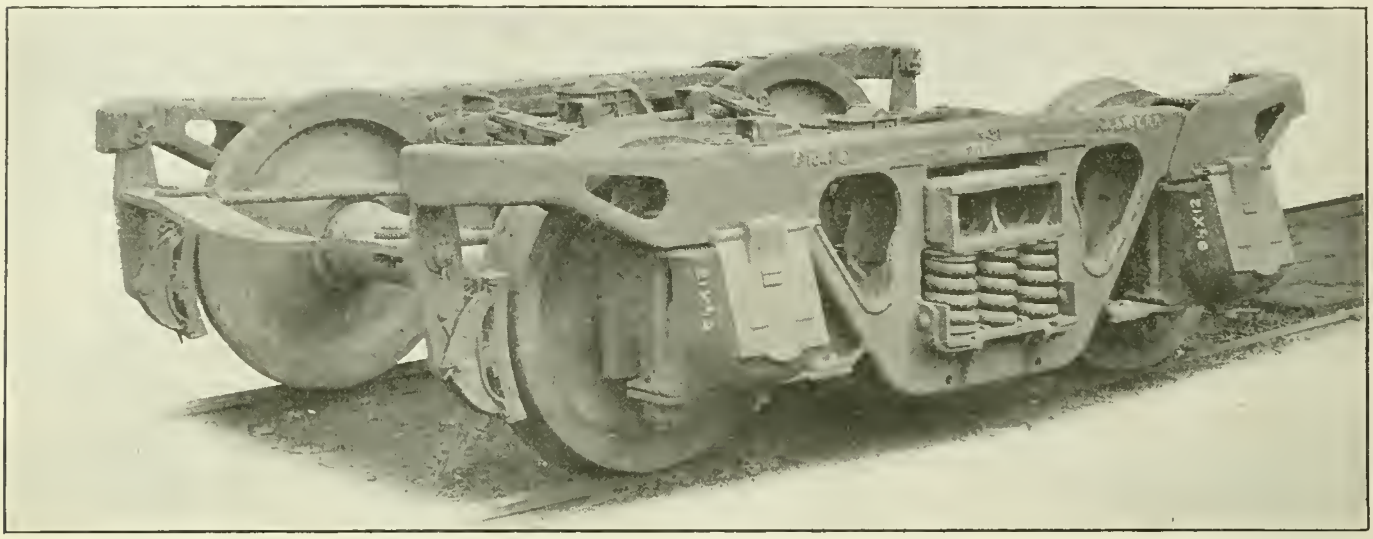


Demonstration Gondola Coal Car of 100 Tons Capacity

The car is 44 ft. 7½ in. long over striking plates and 11 ft. high from rail to top of sides. The inside dimensions of the body are: length, 43 ft. 3 in.; width, 10 ft. 1½ in., and depth, 7 ft. 5½ in.

Except for the substitution of four-wheel for six-wheel trucks, the design is practically the same as that of the 100-ton coal cars used on the Chesapeake & Ohio which were described in the *Railway Mechanical Engineer*, October, 1921. The four emergency drop doors used on the Chesapeake & Ohio cars are omitted, however. In the omission of all bottom doors on high capacity cars designed for unloading by a car dumper, this design follows the practice on the Virginian and the Norfolk & Western.

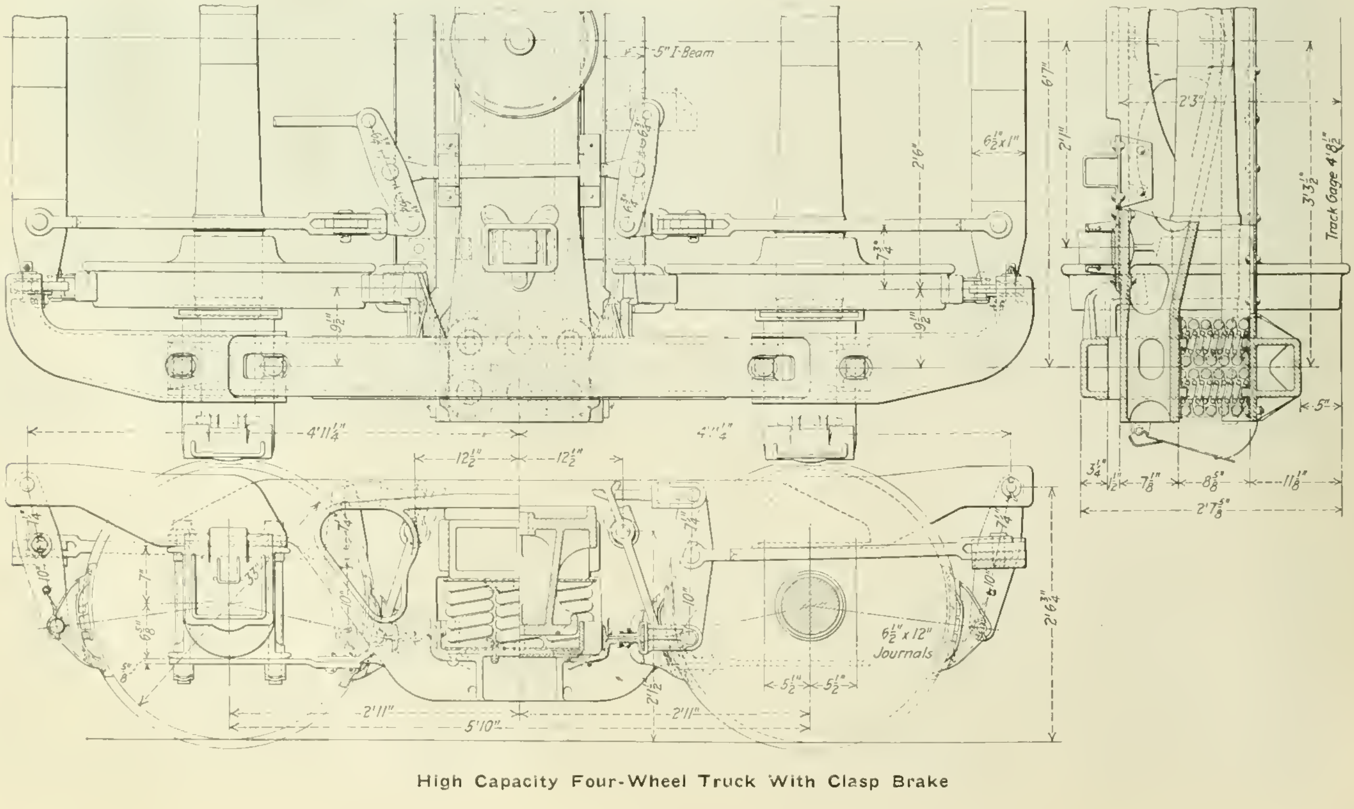
Of the light weight, 59,000 lb., the body is 35,000 lb. and the two four-wheel trucks 24,000 lb. The two six-wheel trucks used on the Chesapeake & Ohio car weighed 33,400 lb., making the light weight 68,300 lb. and the loaded weight 268,300 lb. The ratio of paying load to the total weight of the loaded car was 74.6 per cent with the Chesapeake & Ohio design. By substituting four-wheel trucks, there has resulted a saving of 9,300 lb. per car while the revenue load has been increased to 77.2 per cent of the total.



Four-Wheel Truck With Cast Steel Frame and Clasp Brake

The sides are free from outside side stakes or other projections outside the plane of the side sheets, thus giving the car a smooth straight surface and at the same time providing for the required cubic capacity in a minimum length and height. The sides are formed of ¼-in. plates, sloped in near the top at an angle of approximately 15 deg. and then flanged out, overlapping the horizontal leg of the 4 in. by 4 in. by 7/16 in. top angle to which they are riveted. With this construction the car is easily cleared of its lading when turned to the proper angle by the dumping machine. Along the bottom the sides are reinforced by 4 in. by 3½ in. by ⅜ in. angles, which angles also support the floor. Near the ends the side sheets are dropped back into the car to provide space for the ladders and grab irons inside the clearance limits, and to afford protection to ladders in car dumpers and elsewhere. The sides are braced on the inside by 11 ¼-in. gussets on each side and are tied together by two pressed steel cross ties extending from side to side near the top. The ends are composed of ¼-in. plates reinforced and stiffened by two pressed steel cross braces and a bulb angle across the top.

The center sills are 12-in. channels weighing 35 lb. per foot, spaced 12⅞ in. apart and extending from end to end of the car. They are reinforced at the bottom by 3½-in. by 3½-in. by ⅜-in. angles between the rear ends of the draft gear housings. The sills meet the A.R.A. requirements of

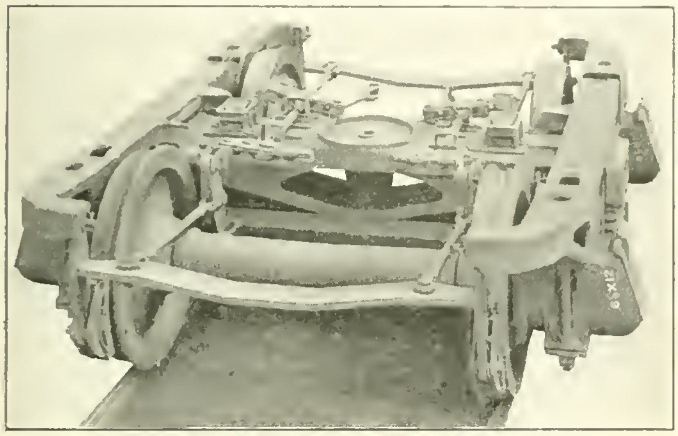


High Capacity Four-Wheel Truck With Clasp Brake

30 sq. in. area and ratio of stress to strain of .05. The center sills are reinforced at the coupler opening with a cast-steel combined striking plate and carrier iron making a substantial arrangement with no chance of the carrier iron becoming loose or the bolt being lost. There are three cross beams in the underframes between the bolsters, made of pressed steel 12 in. deep, substantially reinforced at top and bottom to transmit the load to the sides of the car.

The floor, which is flat throughout its entire surface, is made of ¼-in. plates and in addition to being supported by the sills, cross bearers, etc., is supported and braced by two pressed steel diaphragms and two 5-in. bulb angles. The body bolsters are of cast steel, 30 in. deep, in one piece, located inside the body and securely riveted to center sills, floor plates and side sheets.

The couplers are special A.R.A., type D, cast-steel, with 6-in. by 8-in. shank, 24¼ in. long with a 5¼-in. by 6-in. tail, slotted for a 6-in. by 2-in. draft key. The coupler yokes are of cast steel and the draft gear is of the Miner design, type A-18-S.


End View of Truck Showing Design of Clasp Brake

The trucks are of the standard four-wheel type with cast steel side frames of conventional design. The truck wheelbase is 5 ft. 10 in. and the distance between truck centers is 30 ft. 7½ in. The location of the springs and the method of attaching the A. R. A. standard journal boxes with tie-bars, as well as the method of spring plank arrangement, are of the usual design used on practically all modern four-wheel trucks. The cast steel side frame and truck bolster were manufactured by the Buckeye Steel Castings Company, Columbus, Ohio, and are proportioned to the heavy loads imposed.

These trucks are equipped with clasp brakes, thereby avoiding the excessive brake shoe pressures which would have been the case with single brakes for trucks of this capacity. The brake beams are formed of 5 in. I-beams weighing 10 lb. per ft.

The design of the outer brake beam support and the method of attachment to the side frame structure is worthy of special notice. As will be observed from the illustrations, the outside brake hanger bracket at each end of the side frame is a separate casting and is held in place without the use of bolts and rivets other than the bolts which connect the journal boxes with the side frame. The advantage of this construction is that these overhanging parts are separate castings and due to liability of damage in wrecks or derailments, the subsequent loss is not as much as if they were integral with the side frame. It also has added manufacturing advantages resulting in economy of production.

The truck bolsters are of typical Buckeye design with channel section top and bottom members, cylindrical center post and integral center plate. The diameter of the latter is 16 in. and width of bolster at ends is 20 in., with a depth at center of 14 in. The spring plank is of built-up channel section design, 14 in. wide at the center. The web is formed by a plate 14 in. by ¼ in., 6 ft. long, which is riveted to the 3½-in. leg of the 4 in. by 3½ in. by 7/16 in. angles which form the flanges beyond the web plate. At each end the angles are spread to a width of 20 in. to conform to the spring seat construction and width of bolster opening of the side frames to which both the vertical and the horizontal legs of the angles are secured by rivets.

Stucki side bearings with solid rolled-steel roller of 4 in. diameter are mounted on the cast steel bolsters 2 ft. 1 in. to each side of the center line. Special integrally ribbed construction inside of the bolsters is provided to carry the heavy side bearing loads.

The truck springs have a total capacity of 468,000 lb. per car when solid and consist of four nests, each containing six double-coil helical springs similar to A. R. A. Class D springs, but having outer and inner coil diameters 1-5/16 in. and 11/16 in. respectively and a free travel of only 1-½ in.

The wheels are multiple-wear rolled steel, 33 in. in diameter and of standard A. R. A. contour. Journal boxes and wedges are of cast steel. The A. R. A. axle capacity for the 6½ in. by 12 in. journals is 60,000 lb. The load on one truck, in this particular car, was considered 120,000 lb. The area of the center plate bearing surface is 190 sq. in.

The car is equipped with Westinghouse empty and load brake, schedule KDE-4-10-16, having a 4-in. take up cylinder, a 10-in. cylinder for use when the car is empty and an additional 16-in. cylinder for use when the car is loaded. The brake rigging is designed to give a 60 per cent braking ratio on the empty car and 40 per cent on the loaded car. The wheel loads are 7,375 lb. when empty and 32,375 lb. when loaded. With two shoes per wheel the nominal shoe pressures are 2,212 lb. light and 6,475 lb. loaded, which are not excessive.

Height of Standard Box Cars

THE committee on Car Construction of the Mechanical Division of the American Railway Association has practically completed designs for standard box cars of 40 and 50 tons capacity for submission at the next meeting. In the latter part of 1920 inside dimensions for box cars were adopted as follows: length, 40 ft. 6 in.; width, 8 ft. 6 in.; height (minimum), 8 ft. 6 in. With the length and width specified the maximum inside height that can be obtained within road clearances is 9 ft. 3 in. As the committee desires to show designs of cars that will meet the requirements and views of the majority of the railroads as to inside height and which can be used with a minimum of change, the American Railway Association has issued a circular requesting the member roads to vote for the height which they prefer. The circular explains that each additional inch of height above 8 ft. 6 in. will add approximately 70 lb. to the light weight of the car and will also add to the cost.

THE LAST WOODEN DINING CAR on the Pennsylvania Railroad has been replaced by a modern steel car. The new cars, when fully equipped, represent an investment of $38,000 each. If all the Pennsylvania dining cars were in operation simultaneously, 4,236 people could be served at one sitting. This company serves 3,575,500 meals annually, requiring a total force of 1,555 employees. The meals are prepared in kitchens having a floor space of 19 ft. 6 in. long and 2 ft. 6 in. wide, where a chef and three assistants prepare and cook 10,000 meals a day. Approximately 2,600,000 eggs are required every year to feed the dining patrons; also 1,500,000 lb. of fresh meat, 1,300,000 lb. of potatoes, 500,000 lb. of sugar, 5,000,000 rolls, 150,000 lb. coffee and 500,000 quarts of milk and cream.

Proceedings of Car Inspectors' and Foremen's Meeting

Tank Car Repairs—Precautions for Carding and Handling Inflammables—Car Department Apprenticeship System Discussed

A HEAVY program was carried out at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, which was held at the Hotel Sherman, Chicago, on November 9 and 10. In addition to the discussion of the changes in the interchange rules, a number of papers were read and discussed with keen interest by the large number of members in attendance, and the convention listened to a number of addresses. A list of these papers and addresses appeared with the discussion of the new interchange rules in last month's issue. Two of these papers with the discussions of them appear below. The others will appear in future issues.

Repairs and Maintenance of Tank Cars

By S. F. Beasley

Master Car Builder, Sinclair Refining Company

The manufacturer of almost every article in the United States is, in some measure, dependent upon commodities transported in tank cars. During the World War our industries were called upon to produce to the utmost, and the enormous production demanded a large increase in this class of equipment. In 1914, there were 38,000 tank cars in the United States, and subsequent to that year, the total has increased to approximately 146,000. It is evident that the major portion of this class of equipment has been built within the last eight years.

The tank car equipment of the country—in which the railroad ownership is comparatively small—is used for the transportation of liquids and solidified oils, the main portion of which is petroleum and its products. Owing to the dangerous commodities transported, the Master Car Builders' Association found it necessary to appoint a committee to govern the design of tank cars. The sole object of the Tank Car Committee of the American Railway Association is to have such cars so constructed that they afford safe transportation under ordinary railroad operating conditions. Such products as gasoline, naphtha, benzine and other highly volatile inflammable liquids must be carried in containers that are practically damage proof against everything but wrecks. The increased stringency of the requirements of the Tank Car Committee of the American Railway Association and the Bureau of Explosives have changed and have improved the previous forms of construction, and the evolution of the tank car very vividly indicates the strong desire for even greater safety.

The reports of the Bureau of Explosives show conclusively that the most dangerous, the most destructive article (from the railway standpoint) that is transported, today, is gasoline. Owing to the dangerous nature of the commodity, it became necessary for the Bureau of Explosives to assign inspectors to educate refinery employees in the proper methods of loading and placarding tank cars, and railroad employees in handling them.

Notwithstanding the fact that a thorough campaign of education has been made, the following data will show that ignorance and carelessness are still a part of the human element to be contended with:

Open Dome Accidents

Total cases reported	[illegible]
Deaths	[illegible]
Injuries	[illegible]
Cases with fatalities	[illegible]
Other cases with personal injury	[illegible]
Property loss	[illegible]

Bottom Outlet Leakage
(Last four years)

Cases	[illegible]	57 per cent [illegible] liquids
Killed	4	11 per cent of total [illegible] liquids
Injured	[illegible]	18 per cent of total [illegible] liquids
Property loss	$851,219	

Gasoline Tank Car Fires
(1913-1921 incl.)

Cases	[illegible]
Deaths	[illegible]
Injuries	[illegible]
Property loss	[illegible]

RECORD FOR 1921

Record of tank car fires in per cent of the total for explosives and all other dangerous articles

Property loss	[illegible] per cent
Deaths	[illegible] per cent
Injuries	31 per cent

Record of open dome accidents in per cent of all involving gasoline, up to 1922

Property loss	[illegible] per cent
Deaths	[illegible] per cent
Injuries	84 per cent

It can be seen from the foregoing report that the greater percentage of injuries and loss of life are due to open dome accidents, and it is to be hoped that a more thorough campaign of education will be brought about to reduce such accidents.

The question of maintaining tank cars in as nearly as possible their original first class condition is a very important one, and to that end it becomes necessary that each car, when placed at the loading racks, receive a complete and thorough inspection. In order that this inspection shall be thorough and complete, and that the necessary repairs be properly made, we have found it advisable to sub-divide and specialize the work, training men to become thoroughly acquainted with the requirements of each of the several devices used, so that they can restore them to their original first-class condition.

When tank cars are delivered to our refineries, they are given the usual general inspection. The selection of cars for loading necessitates, first, seeing that the cars are in first-class condition and, second, the suitability of the cars for the lading. There are three features of the tank car construction that must be given very close attention. These are the safety valves, the discharge valve and the dome cover. We have specially trained men whose sole duties are to inspect and repair these parts.

The most common defect existing in the discharge valve is corroded valve seats, dirt lodging under the valve seat, and corroded valve rod fastenings. The most common defects in dome covers are worn or broken threads and defective gaskets.

In testing and adjusting safety valves care should be taken to see that the valve seats are properly ground and proper adjustment made that will cause the valve to pop at 25 lb. pressure. On such cars where the safety valve dates have expired we do not simply remove the safety valves and take them to the shop for testing, but they are replaced with others that have been thoroughly tested and properly adjusted. We do not look with favor on the testing of safety valves with the weight or spring lifting device shown in the tank car specifications, for the reason that after such cars carrying inflammables have reached their destination and have been emptied, there is invariably a small amount of the liquid remaining in the car and, during the summer months, pressure is liable to be built up. The testing of the valves with a spring lifting device at such times will not give accurate results as there is too great a liability of indeterminate pressure.

The inspection of the tanks is made by men who are thoroughly familiar with this class of construction, and it is their duty to see that the tanks are thoroughly tight before cars are permitted to be loaded. All air brakes are tested before cars are delivered to the railroads for movement.

In addition to the above, we also have a man whose particular duty is to inspect and maintain draft gears and couplers. The selection and maintenance of a proper draft gear for tank cars is a matter of very much importance. In ordinary commodity carrying cars, the construction allows some flexibility between the parts and the load itself, which is of such a nature that shifting can take place, all of which relieves the car structure of much of the damaging effect of impact forces. In other words, it aids the draft gear in its work of protecting the car. The nature of the lading in tank cars makes the work of protecting the car against this damage more severe, for two reasons: First, the inability of the load to shift and thus absorb in work a part of the energy delivered in impact; second, the great seriousness of what might be considered small defects if found on an ordinary freight car. The container is rigidly attached to the underframe and, when in movement, the car is entirely empty or loaded to capacity, so that no assistance can be given the draft gear in its work of protecting the car by either the flexibility of the structure or by the shifting of the load. In ordinary commodity carrying cars, a few loose rivets may be a matter of comparatively small moment, whereas the same number of loose rivets in a tank car may be the cause of ignition and consequent loss of life and property.

The Committee on Car Construction, of the American Railway Association, has had under consideration the standardizing of a pocket length of 24⅝ in. for all classes of cars. This should be discouraged. The major portion of tank cars are equipped with yokes with a pocket length of 18½ in. and in observing the performance of the two lengths of yokes in service, we find that failure of the yokes with a pocket length of 24⅝ in. are much more frequent than failures of yokes with a pocket length of 18½ in. The longer yoke is also subjected to greater transverse stresses due to the radial action under curving conditions than the shorter yoke, which would tend to produce more failures in the longer yoke. All of these tendencies to failure militate against the safety of the tank and its load.

As the modern tank car is of such construction that it is strong enough to stand any accelerating and retarding force in train service and in ordinary handling in classification yards, little can be gained by adding more metal at certain points where stresses take place. The efforts of the Tank Car Committee and the Bureau of Explosives cannot result in any permanent good until some limitation is placed upon the usage of tank cars in classification yards.

Discussion

T. J. O'Donnell (Buffalo): The tank car question is one of the most vital questions in interchange at the present time. In our district we find a number of a certain class of tanks are giving us trouble, particularly at the bottom rivets and the seam. We might feel it is due to excessive switching or train service. The safety valve is one of the main things we are watching at the present time and the question of testing in interchange is raised. It is very dangerous to attempt to test the safety valve under load, particularly with commodities such as ammonia and others of a similar nature. I feel that our higher superior officers realize this more or less at the present time.

I do not think we have improved any in the last year with respect to placarding, because we have tanks traveling through our district with no semblance of the explosive or inflammable cards on the tank at all. I think we should all consider that it is our duty, as well as that of the agent and the yard master and the checker in the yard, to see that those commodities are protected, when traveling through the country, with the placard on the car, outlining just what is in the car.

Thomas B. Koeneke (Indiahoma Refining Company): Tanks should not be placarded on the metal if they are equipped with a placard board. Our rules now are to equip all tanks with the board. The use of cardboard in place of the thin card is also recommended. If the placard is placed on the tank, it frequently stays on the car, although it might later be filled with some commodity that is not inflammable. Cards placed on the tank will frequently wash off, particularly if it happens to rain after they are put on; and in a great many cases, if the refinery fails to put a card on, that car will travel five hundred miles without a card.

The shipper should see that cars are in proper condition, as well as the railroad inspector who accepts the cars. A great many railroads are not in position or will not undertake to repair these cars. For instance, we recently had a car loaded with crude oil, that was transferred at Texarkana, Arkansas, because it had become leaky. That car was held at the main shops of the road at Tyler, Tex., for about three weeks. They said they could not make the repairs, and sent the car in empty to East St. Louis. The car had six leaky rivets and it took about two hours' time to calk the car after it had been steamed out. As a matter of fact, the car could have been repaired under load, because the rivets leaking were in such a position they would not have had to jack the tank at all. It is satisfactory to move a car in to the owner if the repairs are extensive, because a great many roads are not prepared to repair them, but sending in these minor defects is quite expensive both to the railroads and to the owners.

In the Midcontinent field, we co-operate very closely with the Bureau of Explosives, and do everything in our power to see that these cars are handled properly. There are cases where a few men will make mistakes, and everybody should co-operate to prevent them. If a man loads a car which should not be loaded, and it gets out of the plant, the railroad inspector should take action on it. In a lot of cases he does not. Very frequently, the man loading and the man inspecting are sent to outside points to do duties that are not the same as they are familiar with; one man has to inspect and load a car when there should be a more efficient man for the inspecting alone, but because there are so few cars loaded at that point it would not justify having a complete force there.

Mr. O'Donnell (Buffalo, N. Y.): It might be a good idea for the refinery to send a representative to accompany each car to its destination. We send men with trains of stock and I think that it would be money well invested if a practical expert were traveling with tank cars, so that in every terminal they could watch the cars.

Mr. Koeneke: Gasoline is the commodity which has caused most of the accidents and has been the most expensive in property damage, but a car of gasoline is not worth enough to justify the expense of a man traveling with it. A man can take a stock train and all the cars will go to the same point, but with gasoline, a car goes here and a car goes there and a car goes some place else. If the car is in good condition, there is little likelihood of anything happening unless it is in a wreck or is damaged in switching.

Mr. O'Donnell (Buffalo, N. Y.): The time and money spent by those experts would be paid for with one accident; if they prevented one accident, it would be a mighty good investment.

Mr. Koeneke: That is out of the question, when you consider there are about 75,000 cars of gasoline shipped per month. In the terminals something of that sort could be done, but I do not think following them or riding the train would be very practical. In fact, very few roads will let you have a man ride the train; but in the terminals, one man could do a lot of good.

A. W. Fields (Indiahoma Refining Company): I would like to ask Mr. O'Donnell what trouble he is having with the tanks at Buffalo.

Mr. O'Donnell (Buffalo, N. Y.): We had one of the Class Five tanks that was leaking.

Mr. Fields: As I understand the specifications on Class Five tanks, there are no rivets on them. They are welded and will stand a pressure test of 300 lb. per sq. in. I have only seen about five of them, and I do not know of any that I have seen leaking. We have only a very few Class Five tanks in East St. Louis. Most of those go to the Monsanto Chemical Works and are loaded with chlorine gas.

Thomas O'Donnell (Bureau of Explosives): You find about seventy-five Class Five tank cars in the country altogether, and they are as safe, probably, as it is possible to make a container. They are welded and tested at 300 lb. with a safety valve concealed in the dome, and that valve tested at 200 lb. Under ordinary conditions, one of those cars should never appear on the repair track, as far as the container part is concerned, at least. So I think we do not need to put in much time discussing this tank, which is still under observation as to the type of dome and safety valve. The only thing is that it contains poisonous gas: sulphur dioxide or chlorine.

There is one point in Mr. Beasley's paper which I think we should emphasize, and that is the loading of a tank car. It should not be loaded with inflammable liquid until the outlet cap is hanging loose. That is the only test as to whether you have a tight valve. If it isn't tight, you will discover it before the car is put in transportation.

One of the main troubles we have with tank cars in the St. Louis Terminal District, in the winter time, is leakage from the outlet leg, and that is largely brought about in the cold weather through freezing of the water in the boot. The ice forms on the outlet valve and cap and the bottom will be broken downwards or the valve lifted, or the casing cracked. You probably would not notice leakage of gasoline until this ice begins to thaw or gets shaken loose by vibration.

In the course of a few recent years, I have seen tank cars lose their contents on account of the improper handling of such a leak. Before undertaking to stop a leak of that kind, the car should be hauled some place where there isn't any possibility of fire. The leak at the bottom is slight and you can haul it under careful handling. Then see if the valve cannot be replaced at the top by taking off the dome cover. Sometimes wrapping the bottom casing with burlap and turning steam on it will melt the ice and you can let it out through the cap. But do not take the cap off. If you do, the sleeve will come out and let out the entire contents, unless you have a man at the top to work the valve.

Under the existing conditions, we should not have pasted placards; we should have boards. That is vital at this time. Up to this time, tanks were allowed to retain their placards until cleaned by steam or loaded with some item that does not require a placard, but as soon as the new regulations go into effect, about the first of the year, all empty equipment must have placards removed. You can see the difficulty of removing a pasted placard, and you can see how easy it will be with placard boards. This is going to bring up a question in interchange about the charge for removing this placard, so you men want to bear in mind that this will soon go into effect.

As you know, the valve tests are being postponed until January 1, 1923, so that any tank moving now with the valve not tested may continue until January, 1923, with this exception, that if the car goes on the track for repair, it should be tested. In the proposed revision to the regulations, another vital thing will be that if a car is moving with a test overdue, you will not be required to test that valve on a car that contains a dangerous liquid, but you will have a defect card to take care of such a car, and it will say, "Test overdue," or words to that effect, and the car will be allowed to go on till empty. That is going to be quite a relief where you do not have the facilities, and no matter whether you have or not, it is dangerous at best to test a car with gasoline or inflammable liquid, especially in warm weather.

When you consider that approximately 120,000 tank cars are traveling continuously, I do not think that we can indict the railroads for bad handling. It is true that now and then a car gets away and is damaged, but I find a tremendous improvement brought about by this constant agitation for better equipment, and especially better tank cars. Since 1914, we have practically done away with the head blocks which were in themselves a tremendous loss in tank cars.

Twice during the last 10 days my attention was called to what I consider is an improper method of handling a loaded tank car and discharging it: That is building fires under tank cars of molasses. I do not think that should be allowed anywhere, just because they have no facilities for steaming the car. In one case, they built a fire under a tank of molasses within 15 feet of a car of gasoline; a selfish and, at best, a very dangerous thing to do. I want to call your attention to this in order that we may all help in conserving good equipment and not damaging it by unfair usage.

A. Herbster (N. Y. C.): What is the cause of cracked end heads in tanks? I have seen three in the last year, and none of the cars showed any other evidence of rough handling or rough switching. I would also like to ask how many fatalities or how many accidents have occurred from testing safety valves under load or empty?

The last speaker spoke in regard to removing placards from tank cars when empty. I feel that it is just as dangerous to allow a car to run empty, especially one that has been loaded with gasoline, because we never know how much of a load remains in the car.

Mr. O'Donnell (Bureau of Explosives): Formerly when we had head block end rests, the tank was moving all the time and pounding on these head blocks, and it became dented at both ends; and just where the head is dished, it cracked, as a rule on the inside. For that reason, the specifications for tank cars say that when the tank is re-anchored and the head blocks removed, even when there are no head blocks now, if the heads are less than 7/16 in. the head must be reinforced by steel shoes 3 in. thick at the bottom, where this weakness is known to be. Consequently, if the repairer failed to reinforce the end, this crack would develop as time went on and bring about the condition noted. Another reason is that in dishing the head, sometimes a concealed crack or defect in the metal is more apt to be found where this stress is laid. I have seen only one case of a recently built tank, a Class Three tank, having a cracked head plate.

As to the placards, it is well known that any empty tank car is dangerous; that is to say, it is dangerous to take off the dome and put a lamp in there, because the very fact that it is empty makes a space for the accumulation of gases which may be poisonous or inflammable. The general rule is that on no empty tank car is it safe to take off the dome and put in a light. That should dispose of this question of whether one tank car is more safe than another. We are going to have such a tremendous benefit and speed in the transportation of tanks, by removing placards, that the owners of these tanks, and in time the shippers, will be glad of the change. When you have a placarded tank you have to place it at a certain part of the train. The yard man does not know whether the tank is loaded or empty, unless he throws rocks at it, and then it is a guess. When placards are on only when they ought to be, we will know that placards stand for a loaded tank.

T. S. Cheadle (Richmond, Va.): We have had a good deal of trouble in our territory the last several years, on account of tanks due for tests passing from one interchange point and being caught at another. In some cases I found the inspector was mistaken and the tank was not due for test. I want to bring up the question of having the date the test expires as well as the date the test was made, appear on the tank. There are five different classes of cars, and I will venture to say you will not find many inspectors who can tell you when the test is due.

Mr. Herbster: May I add that you give the time limit for each type, when it is to be tested thereafter; then no matter how many tank cars you have, an inspector will know immediately the date the test expires and the number of months the tank can run with a new test.

Mr. O'Donnell (Bureau of Explosives): There are five classes of tank cars, it is true, but the four classes only are to be considered, because the other is for the transportation of poisonous gases, and it is covered by special regulations. Class Three tank cars in the transporation of sulphuric acid should, if they remain in that service, be tested every five years; but there isn't anything to prevent this tank being loaded with gasoline in the meantime, where it might come under the ten-year test, and, therefore, you would have confusion. We ought to have faith in that certificate that is stenciled on the tank, unless it is obvious that it has gone over the test or would not stand the test. The owner of this equipment, or some responsible parties have examined the tank and stenciled the date thereon. If the car is in apparent good condition after the test, so far as we know,—the interchange inspector, unless the ten years are up, could not tell what car is meant for a five-year test—he reports the condition of the car. He cannot test it under load. Certainly I would not want him to transfer a load of casing head gasoline if the test is overdue. It is something to be handled like this test of the safety valve, with a defect card and a letter to the owner or the lessee of the tank. I do not believe there is any danger in that.

Mr. O'Donnell (Buffalo, N. Y.): Has it ever occurred to the Bureau that it might be wise to put the date of this test on the bill of lading?

Mr. O'Donnell (Bureau of Explosives): No, I do not think it would be any good whatever. The bill of lading is somewhere in Oklahoma, you would have to transcribe that on to the waybill, and how many of you inspectors have it?

Mr. Davis (Sinclair Refining Company): Mr. O'Donnell mentioned a point that was not brought out in the paper, regarding removing of outlet caps prior to loading. We do that. The outlet cap is removed and is left hanging, and if the valve is defective it can be detected immediately and ground in or a new valve applied.

Mr. Koeneke: Isn't it a fact that all refineries have specially trained men in the inspection of these cars? It might be a good idea for a majority of the railroads, especially at terminal points, to take some pains in drilling one or two men in the handling of tanks. We have a plant located at East St. Louis, and we very frequently make transfers for lines in St. Louis terminals. The Terminal Railroad Association has men who are capable of repairing any tank under load, and we are seldom called upon to transfer for them. When the trunk lines call on us we do not transfer one car in ten. All that is needed is an outlet cap tightened or something like that. Such small things as that, if a man is experienced at all, will save a lot of moving as well as the danger while leaking.

Secretary Elliott (Terminal Railway Association of St. Louis): We handle many tank cars loaded from the Southwest, and there are so many minor defects that if we transferred all these cars, we would have burned the town up four or five times. I think Mr. O'Donnell will agree with me that one of the most dangerous things we do is to transfer tank cars. We have men trained on the Terminal Railroad to make such repairs, who have worked under Mr. Koeneke and under Mr. O'Donnell, until a tank must have something absolutely bursted before we have to transfer. We are asked to have men go around to the different roads to stop leaks on tank cars, and it is really laughable the things we are called upon to do that anybody could do. The men are afraid to go under a carload of gasoline and tighten an outlet cap with a wrench, and they will not take off a cap and put on a new one. It is just because they do not understand the tank cars. If you are having any trouble, train somebody in your terminal to look after tank cars and you will cut down your transfers 99 per cent.

Mr. James (Minnesota Transfer): Mr. O'Donnell, of St. Louis, mentioned the defect card in connection with safety valve tests. Would that defect card, issued when a tank was overdue for test, carry authority for the receiving line to bill the delivering line?

Mr. O'Donnell (Bureau of Explosives): These regulations are to be revised as soon as the Commission passes on them, and details have not been worked out.

Secretary Elliott: They do issue defect cards against the delivering line. That is in the changes in the rules.

F. W. Trapnell (Kansas City, Mo.): We handle a great many tank cars in Kansas City, but we do not have any trouble. I do not suppose we transfer a car a month for leakage. We have men who tighten up the outlet cap and fix the valves; and with any kind of oil that is not explosive, they will calk the rivets.

Mr. O'Donnell spoke about the inspector working on this carding of the car with "inflammable" cards. I find that the car inspector has no knowledge when the routing card says "oil," whether it is inflammable or not. It might be gasoline, it might be fuel oil, it might be a dozen kinds of oil that would not require the inflammable card.

Mr. O'Donnell (Buffalo, N. Y.): When a tank car goes through the yard and it is loaded, it is the duty of the inspector to know whether it has the four cards. He consults with the agent, he determines what is in the car, and we find cars with gasoline with no cards. It is as much the duty of the car inspector to see that car is well carded as it is of the bill clerk or anybody else.

Mr. O'Donnell (Bureau of Explosives): If a car contains inflammable liquids, it is placarded by the loader.

Mr. O'Donnell (Buffalo, N. Y.): I am talking about when the shipper overlooks it.

Mr. O'Donnell (Bureau of Explosives): There is a commodity card on these cars which tells you the name of the contents. I do not agree with my friend from Kansas City that it is just called "oil." If it is called "oil" it is not correct; gasoline is gasoline and is distinct from oil. When you find a shipper in any locality violating conditions like that, just give him a memorandum of it and he will be glad to straighten it out for you.

E. H. Mattingley (B. & O. C. T.): A great deal has been said about the proper method of testing safety valves and the handling of outlet valves and dome covers. The draft gear or the draft sills of the tank car deserve a great deal of consideration, and in handling tank cars we find in a great many cases there is considerable slack in the draft gears, which leads up to damage to the tank head, which Mr. Herbster has brought up. It is just as essential to adjust or remove the slack in the draft gear, in order to protect the car, as to test the safety valve or the outlet valve.

G. Lynch (Cleveland, Ohio): Whose duty is it to apply and remove the placards—what department of the railroad? I understand from the regulations that it is the duty of the shipper, and it also is the duty of the railroad to see that the shipper has them applied. Is there a penalty for failure to apply and failure to remove, and why is the 29-cent penalty asked for when the car is offered in interchange.

I think the whole thing is a matter for the transportation department and should be handled exclusively by that department, and that there should not be any penalty, when a car is offered in interchange, if it is not a mechanical defect.

Mr. O'Donnell (Bureau of Explosives): It is obvious that the protection of the placard is largely a railroad protection; therefore, the regulation is satisfactory that when the shipper loads a car and it contains an explosive or other dangerous article, including gasoline, that railroad should furnish the placard. Now, the shipper knows his commodity; the railroad does not. He has to make a declaration and he placards the car with the right kind of a placard, and it goes on its way in interchange.

It is of infinitely more importance that the danger signal be on the car than any arrangement for a 29-cent or any other charge, because the object is the protection of life and property. Therefore, in order to make the interchanges take an interest in the thing, this charge was put into interchange rules, and no charge is shown and there is no word about charge in the Interstate Commerce Commission's regulations.

Mr. Lynch: I asked why there is no penalty attached to failure to apply or remove the card. The 29-cent penalty does not recompense and I think it should be removed from interchange rules and a penalty incorporated in the Interstate Commerce Commission's regulations, to place the responsibility where it belongs at the loading and unloading point.

Mr O'Donnell (Bureau of Explosives): This regulation is in effect because of an act of March 4, 1908, and it has a definite penalty attached to it. It is reasonable to suppose that you would not want this full penalty attached to a man who left off one placard; but if he left off placards that were contributory to a death he would be imprisoned for 18 months or fined $10,000, or both.

J. J. Gainey (Southern): We have quite a few tank cars through the Cincinnati terminal, and I am a great deal like my friend, Trapnell, of Kansas City. We do not transfer a car a month, and we have little or no trouble at all at that interchange point.

F. C. Schultz (Chicago): The removal of the placards is something that is saddled on the car department that I think is absolutely wrong. They are not in a position to know anything about it. Usually in a terminal like this, the billing is a long way from the car. Of course, in case the car inspector discovers billing which indicates that the car was loaded with explosives, he should check the car to see if it has the proper placards; but to expect the car inspector indiscriminately to check such cars does not work out very satisfactorily.

Chairman Pendleton: I would not think that the inspector would be required to check the billing on a tank car if it is not carded "inflammable" or "explosive"; but if some of the cards were missing, I feel it is the duty of the car inspector to know that the car meets with all requirements.

Mr. Schultz: Where does he get the evidence?

Chairman Pendleton: If it is partially carded "inflammable," he should make careful inspection of the car.

Mr. Schultz: I realize if it had one card on and one missing, that would be notice to him that it was loaded with inflammables and he could then check. Most of the trouble we have is with box cars that have been loaded with inflammables and have the old placards on. My advice is to pull them off.

A. Armstrong (Atlanta, Ga.): We attempted, two years ago, to make the car inspector solely responsible for the placards. We found that at isolated points, where the inspector was perhaps two or three miles from the agent or from the location of the bills, this was next to impossible. So the plan which we are using at the present time, at the Atlanta gateway, is to make it an operating department responsibility. When the checker finds the car improperly placarded he makes a report to the yard master; he, in turn, makes a request on my office for a defect card, this request accompanied by a copy of the waybill. No defect card is issued unless a copy of the waybill is attached to the request. We find this works out very well.

Mr. Straub: Wouldn't it be a good idea to try to create the sentiment among large shippers to remove placards for every shipment? There are many placards that remain on a car for a great many trips. An inspector, when he sees a new defect, is going to take notice of it. The same way with placards.

Mr. O'Donnell (Bureau of Explosives): That is another evil that will have to be taken care of by this proposed change. If you see old placards on a box car, it is the neglect of somebody to remove them when the dangerous lading was removed from the car.

Mr. Straub: Isn't it a fact that these old placards remaining on tank cars cause a great deal of trouble at interchange points, of cars being lost?

Mr. O'Donnell (Bureau of Explosives): No, because at the present time they have to remain on the car until it is loaded with some other commodity or until it is steamed out. This proposed regulation will take care of that.

Mr. Cheadle: The Bureau of Explosives, in my territory, has ruled that both the car inspector and the transportation department are responsible for the application or removal of the cards. The ruling said that "The Car Inspector shall see that the car meets with the requirements as outlined in the Bureau of Explosives circular." Under that ruling, a car inspector is equally responsible with the transportation department.

Box cars should not be loaded unless they are properly carded, but they are. An inspector does not know whether it is loaded with moonshine, or what the load is. Therefore, if the car is placarded he passes it to the next interchange point, believing it is loaded with explosives. Now, if there is a placard missing on one side, it is his duty to notify the transportation department, and they will find out what it is loaded with.

E. J. Lee (Bureau of Explosives): The subject of tank cars was so thoroughly discussed this morning that I do not believe there is a whole lot to add; but there are two things that struck me that I would like to mention, that is, to tell you all that one of the greatest sources of trouble on the tank car is that bottom valve. We have been working on that for a long while, and I think Colonel Dunn threw a bombshell when he said, "Either take that bottom valve off the car or give us one that will work."

The Tank Car Committee has appointed a sub-committee to deal with the bottom valve and the safety valve, trying to perfect some device that will work. I understand there have been 31 bottom outlet valves presented to this committee for test, and they have about 17 on cars that were being put in a service test, and there are three or four of those few that show some signs of being what we are after, so we will have a valve there that will not leak. We hope before very long to have some standard type that we can recommend.

Another thing that hits me pretty close, is the matter of wrecks. Not long ago, I was called out to a wreck where five cars were turned wrong side up on a single track main line, leaking very badly. There were three bottom outlet valves smashed off of two of the cars, broken at the scoring and leaving the inside valve intact; but in some manner the inside valve was cocked up and a stream running out.

When I got out there, 12 hours after the wreck had occurred, I found the train master standing in front of the wreck, waiting for someone to help him. I said, "What have you done?" He said, "Nothing, only send for you. I have never handled a gasoline wreck before." Well, we walked all over and he said, "What is the verdict?" I said, "There is only one verdict and that is to transfer the cars." He said, "We haven't any pumps or equipment to blow it out with air. Can't we put a cable on and drag them out with this engine?" He wanted to drag those 10,000-gallon tank cars out of that wreckage. There is no question but he would have had a bad fire.

He finally found that the Standard Oil Company had a small portable pump at a town about 100 miles from the wreck, and ordered that pump sent over with a crew of men from the Standard Oil Company to transfer the cars. They got there about six hours after I did. They got the equipment set up and going about four hours after that.

It finally developed that at division headquarters they had a small portable pump that was used in unloading fuel oil and other heavy oil, and we finally got that sent down to the scene of the wreck. When that got going, it was just 24 hours after the wreck had occurred. It seems to me that 24 hours is too long for any experienced foreman to tie up a main line on account of a tank car of gasoline.

We had another case in Chicago that took eight hours to get somebody on the scene to pump the cars out.

The thought occurred to me, why not send out an inquiry to every mechanical department, asking them to ascertain whether or not their wrecking outfits are equipped with pumping apparatus and the necessary piping, or whether it was available in some other department, say the water service department; it does not have to be on the wrecker. When a wreck occurs, usually the conductor wires in and tells what he has on the train. If he has a car of gasoline, throw that pump in, for you probably will need it. Going back to this other wreck where they had five cars, the train master said, "Let's form a bucket brigade and transfer these cars." He had 22 men in his gang, and I said, "With a three-gallon pail, each man in your crew will have to make 666 trips from the scene of the wreck over to the other cars. You are going to waste half and the other half will evaporate, and what are you going to have left?"

A pump, either a hand pump or one that can work by steam or air, is one of the handiest things you can have in your wrecking outfit, and don't try to drag the cars out of the wreck until they are empty.

Mr. Campbell (Minnesota Transfer): Whenever we get a leaky tank car, we switch it out, run it to a track and see if we can repair it or make it safe, and there are very few that we cannot repair. Those we cannot repair under load, we transfer; but we do not average one a month that we have to transfer. We have a pump to pump them out.

A. Sternberg (Belt Railway of Chicago): We are prepared for transferring tank cars. We have a pump placed high above the car and we can pump out 10,000 gallons in two and a half to three hours.

I am glad to hear there is going to be some correction made in the outlet valves. If we can only get something that will not unseat when the cars are handled a little bit roughly, it will be a wonderful thing.

Mr. Mattingley: I move that we extend Mr. Beasley a vote of thanks for his splendid paper.

Motion seconded and unanimously carried by rising vote.

Car Department Apprentice System

By H. L. Shipman

Atchison, Topeka & Santa Fe

The need of competent car department repairers and mechanics was never more apparent than it is today. The only commodity that a railroad has to sell is transportation. The possibility of uninterrupted transportation is entirely dependent upon the condition of the rolling stock. Also this question has to do with the avoidance of wrecks due to burned off journals, draft gear breakages, and such defects.

The procuring of competent car repairers and inspectors is almost an impossibility, hence the necessity of educating men for this work. Many railroads have characteristics or special designs of equipment that should be recognized and understood, both in order to make repairs quickly and in order to bill in case a wrong repair has been made by some foreign road.

The most feasible method of obtaining the men desired is to educate them by an apprentice system. The apprentice system in the car department will educate the men to know the standards of equipment used on their road, will drill them on the Rules of Interchange, and will also make them first-class mechanics. This training will produce better men than can be hired and, as a result, the equipment will be maintained in better condition. Has anyone stopped to figure what it would mean in car days for a railroad to have its equipment in such condition that cars would very seldom have to be bad ordered en route under load? Also, what the reputation of delivering freight on time and without delays would be worth to any railroad? Any railroad is measured by its capacity to handle and deliver transportation on time.

The apprentice system not only produces better mechanics than can be hired, and indirectly, better equipment, but it also cultivates a spirit of loyalty to the company which money cannot buy.

To fit the needs of the coach and the freight car department, an apprentice system for the car department should be divided into two parts: First, coach and cabinet maker apprentices; second, freight car apprentices. Although this subdivision was not made during federal control, it is our opinion it should be made. The internal finishing of coaches demands a skilled mechanic, capable of doing accurate and exacting work. The freight car work does not require the high degree of skill and training of the coach shop, therefore, it is not necessary to spend the time in training the freight car apprentice that is required to train the coach carpenter apprentice.

The coach carpenter apprentice should serve a four year course, the same as all the mechanical trades. The time of the freight car apprentice should be shortened to two and a half years.

There is one other distinct difference in the two trades aside from that of skill and that is the physical strength required to perform the two classes of work. The cabinet maker apprentice does not have the continuous heavy work of the freight car apprentice, therefore, the age limit of the cabinet maker apprentice should be the same as the mechanical trades, namely 16 to 21 years of age at entrance, while the freight car apprentice should be from 18 to 25 years old.

The proper selection of apprentices is a very important matter and should be left to one who is a good judge of human nature, aside from any mental and physical examination that may be given. The character of any structure depends largely on the quality of the material that goes into it. There are many characteristics that should be noted in these boys before they are hired as apprentices. Among the most important are honesty, morality, tact, initiative and industry. This is a life work for which the boys are to be trained and, therefore, a careful selection should be made.

All boys entering an apprenticeship should be able to add, subtract, multiply, divide and work simple and decimal fractions. Any boy who has reached the age to enter an apprenticeship and cannot do these simple problems, lacks either mentality or ambition.

Occasionally a boy's traits are not sufficiently developed to determine his fitness, and he may have entered a course for which he has no talent. In order to allow for the possibility of such errors, a six months' probationary period should be established, wherein the boy is carefully watched by a board composed of the general foreman of the department, the department foreman, the gang foreman, the shop apprentice instructor and the school instructor. Each month this board has a session in which they consider the progress of each boy in his probationary period. If it is determined that a boy is not fitted for the trade he has entered, he should be dismissed from the service and told to hunt some other class of employment for which he has a greater liking. In doubtful cases, a boy's probationary period may be extended by the board. In any case, the boy knows and his parents know that his dismissal is not due to the spite or grudge of any foreman, but to his lack of aptitude or application.

The training of the car department apprentices might be considered under two headings: First, the shop training of the coach and freight car apprentices; second, their school training.

There should be a shop instructor appointed for every 25 or 30 boys in the shop. It is the instructor's duty to take charge of the boys in the shop and teach them their trade. The coach carpenter apprentices should be given nine months in the cabinet shop, nine months on outside coach body work, nine months on inside coach finishing work, six months on trucks, platforms, piping and steel work, six months in the freight car shop, and the last nine months back in the cabinet shop. Every variety of coach building work should be given them, the schedule of work changing to meet the changing conditions. As the needs of the company change, so should the definite work given these apprentices be changed.

The aim should be to make them broad men, and upon graduation they should be assigned to some particular class of work for which they have shown a peculiar adaptability and upon which they will soon become experts. These apprentices have had a sufficiently broad experience so that in later years they should make good foremen, if their other qualifications are such as to entitle them to promotion.

The shop training of the freight car carpenter apprentices should give them a thorough experience, first on body work of freight cars requiring light repairs, then on trucks, steel work, air, and then back again on the body work of cars undergoing heavy repairs. They should be of more mature years than the coach carpenter apprentices and started at approximately a helper's rate of pay. This rate of pay should be advanced every six months, the same as the coach carpenter apprentices.

The school work of the coach and freight car apprentices covers about the same general ground, except that the course of the coach carpenter apprentices should be more extended, due to the longer period of their course. The school rooms should be equipped and maintained by the railroad company. These schools should be in charge of technically trained men who also have a knowledge of the trade. In these schools they are taught to read a blueprint and make working sketches. All carpenter apprentices should be taught the fundamental operations of arithmetic, including fractions, and how to solve problems in board measure, how to make out a bill of material, and how to estimate the cost of various jobs. The freight car carpenter apprentices, in addition, should be taught the Rules of Interchange. All the instruction of the school should be individual. Each boy can then progress according to his ability.

The leading factors in the success of an apprenticeship system are: First, the unlimited support and backing of the management; second, a competent supervisor who will have entire charge of apprentice matters; third, skilled shop and technical school instructors, and fourth, suitable accommodations for the school instruction, provided by the company.

Any apprentice system thus installed and managed will be a paying investment not only from the shop standpoint, but also in the better service obtained from the equipment. The value of having a body of trained employees working for a railroad company cannot be measured in dollars and cents. Intelligent, skilled workmen, good inspectors and efficient foremen are a great asset to any railroad. The best way to procure them is to educate them by an efficient car department apprenticeship.

Discussion

Mr. Cheadle: The paper is evidently based on a large shop. My experience has been that many car men originate at small points. Then from time to time they get "town notions" in their head, and get the ear of a general foreman and he gives them a chance to come in to the shop as a mechanic.

The system outlined in the paper, if carried out, would accomplish just what is intended. We have a big problem to educate car men. We all realize how hard it is for us to educate ourselves, so we know it is hard for the other fellow to educate himself; he first has to have the desire to know the subject. My experience has been that to select an apprentice in the freight car department, first employ the man as a helper and if he develops qualifications then give him a show. The general foremen and the men who hold the most responsible positions are developed from men in the passenger car craft. For that reason, the schedule laid out for passenger car apprentices would certainly accomplish what the paper says could be accomplished.

E. H. Hall (Pere Marquette): We all know what it has been to educate the employees of the car department, especially apprentices, under the so-called "National Agreement," under which we were prohibited from training car men. The apprentice system outlined in the paper will add to the success of the operations of any shop.

The apprentice is badly needed at this time. We recently have recognized that fact in the present crisis, where we have had to take into the shops inexperienced men to carry on the work that was formerly carried on by mechanics with years of experience. The apprentice boys should be given every consideration that can be given, for the wonderful work they have performed during the past few months.

We had one experience where we were called upon to make some conversions in certain passenger equipment. One in particular was with a parlor car which we had to change into a club car with a smoking compartment. If it had not been for the apprentice boys who supported the railroad, possibly that car would have been in the shop today. Those boys, under a competent instructor, made these conversions, applied the panels and other cabinet work, and when that car went out it was in just as good condition as if a first-class mechanic had done the work; it was better than some mechanics would have done. Four apprentice boys performed this work, three of them with only two and a half years' experience in the coach department, and the fourth one just finishing his fourth year.

I do not think there is anything we could do that would be more beneficial than to take an interest in the apprentice boy, teach him and have patience with him. There are a number of railroads today that have an opportunity to work more apprentices than they have been able to work under the National Agreement.

I had an opportunity a few months ago to visit the shops of the Santa Fe at San Bernardino, Cal. It was wonderful to see the work they were accomplishing with inexperienced men, who had never seen the inside of a coach before and had only been there 30 days. Much of the success of their work was attributed to the apprentice boy who came back and worked in these shops and was willing and did step up and teach the inexperienced man who was hired as a mechanic, to do the work.

Everything should be done to encourage the apprentice system, and the instructor is the vital part of the apprentice system, to teach the boys and get their co-operation, which in the end will mean success to that shop.

Secretary Elliott: I certainly must agree with Mr. Hall. The Terminal Railroad is a switching line and we do not have the same opportunity to train an apprentice, on account of the character of work we perform, that you do in railroad shops. However, we were requested by the Railroad Administration to try out the apprentice system, and on the class of work we had, we started out something like 15 apprentices. I have six of those boys left and we found in taking our freight car work as it came, steel car work, framing, etc., those boys could do nearly as good work as any mechanic.

The thing Mr. Hall lays the most stress on is competent instructors. We found we were not getting any results from those boys at all, for the reason that the men themselves did not care to encourage them. So the foreman got out and encouraged the boys, and the result was we made nine dandy chaps. Two of those boys are as good as any mechanics we can hire. We should continue each year to encourage the railroads to promote the apprentice system.

One trouble we found was that the boys were rather light for our class of work. You cannot start them on the heaviest class of work and expect the same results you get from a strong man; you have to pick the work a boy can do until he grows up. Unfortunately, in the car department, we have very heavy work, and it takes a mature man to do it.

Mr. Hall: I recently had a time limit to get some mail cars out of the shop to conform to the Class One postal car regulations. We put two apprentice boys on the job, and they actually performed 50 per cent of the work, so far as following the prints was concerned. I have five other apprentice boys who have only been in the service about three months, and those boys do all the sash and door work. A short time ago we put them on some inlay work. We gave a boy the door and panels to inlay maple in the mahogany, and he made a perfect job of it. You could put the job that was performed by the mechanic next to the apprentice boy's job and you could not tell the difference. It was because he was interested and paid attention to the instructor.

C. J. Wymer (C. & E. I.): I am sorry to say that we did not find much loyalty in these apprentice boys, and since the war came on we would just about as soon have a farmer come in as anybody else. We have men who have had no previous experience but were more or less handy with tools, and the results we are accomplishing are in excess of what we got from the trained men we had before.

I believe the apprentice system is all right, especially where there are large shops in which an organization can be created in line with the plan set forth in the paper. A great many roads could not carry on such an elaborate system, on account of the overhead expense involved, but the Santa Fe, being a large system, can enter into those things more readily and in a better form. In a coach shop where fine mechanics are required, apprenticeship is very desirable; but when it comes to freight car work, I am inclined to believe that the old method of hiring helpers and training them until they are competent is about as good as any.

Chairman Pendleton: I agree with Mr. Hall and Mr. Elliott, that the main point is for the instructor, to get the boys interested, to handle them properly. Then there is no doubt you will get results.

Mr. Harring: My observation has been that it is going to be very difficult to get boys to start an apprenticeship in the car department. When you find a boy who will begin an apprenticeship, in nearly every instance he will go into the metal working crafts.

Mr. Goodyear: We are all boys, just overgrown boys. I have been working on apprentice boys for quite awhile, and the only manner in which I could ever handle them was to get down and be a boy with them, get their confidence and give them my confidence, and then work together.

You can never take a boy off freight car work and put him on passenger work and then make a successful freight car man out of him. If you put a man on as an inspector he will never again do you any good as a passenger car man.

Mr. Wymer: We once had an apprentice system but we have none now. We had trouble getting men to take it up. Under the old arrangement of the National Agreement, the helper did not have much opportunity to learn. But fortunately now our railroad has helpers who are real helpers. We have young men, bright and capable with tools, who are employed as helpers. They have supplied themselves with tools and fitted themselves to do all classes of work, looking forward to the day when they will be mechanics.

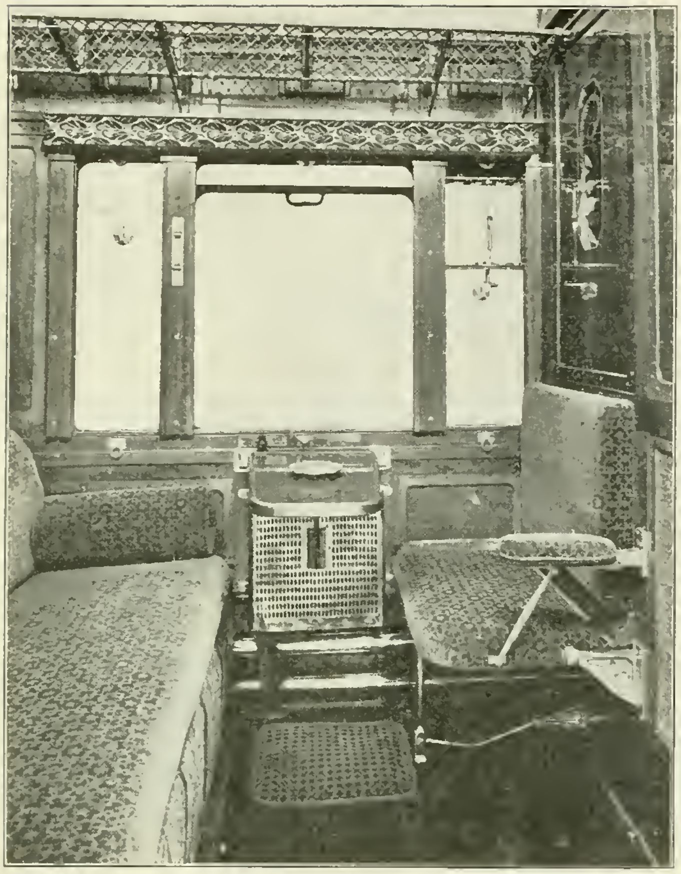
Secretary Elliott: I move you that the paper be incorporated in the proceedings of this meeting, and that the author be extended a vote of thanks for his very able paper.

The motion was seconded and unanimously carried.

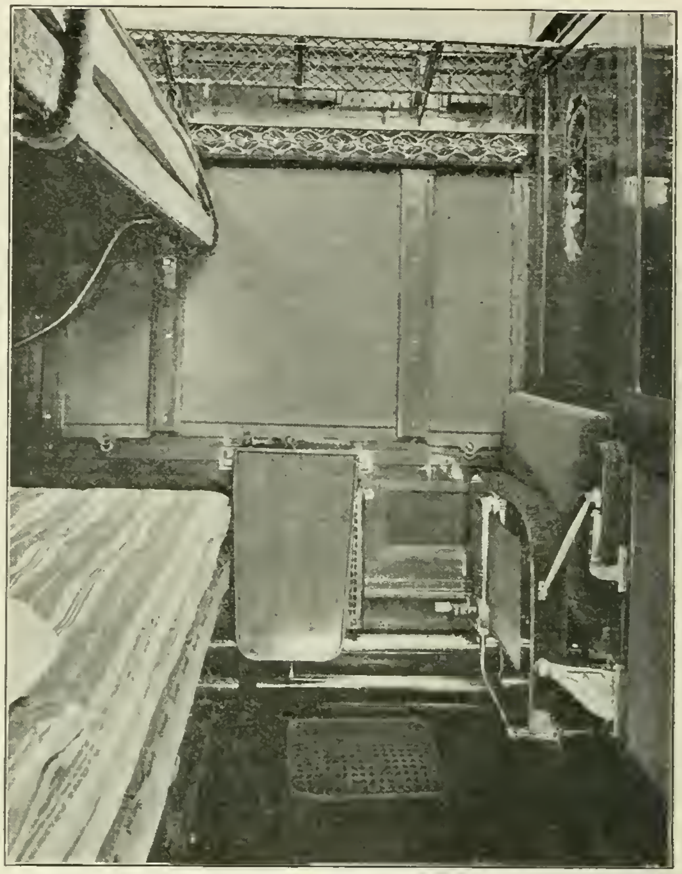
* * *

Pittsburgh Air Brake Club

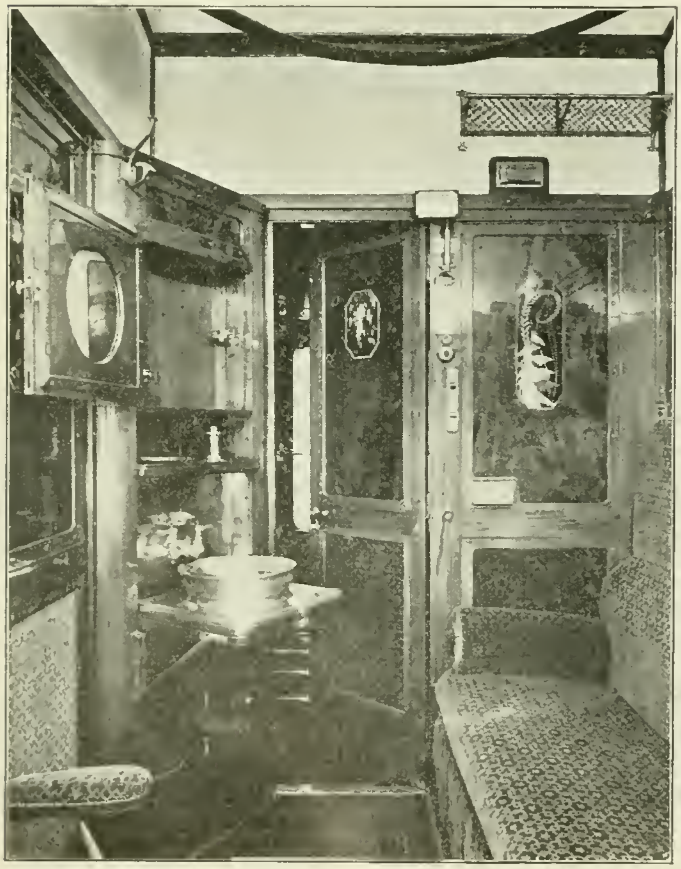
Seated—Left to Right—R. J. Cunningham, W. A. B. Co.; R. W. Williams, W. A. B. Co.; F. W. Pennington, W. A. B. Co.; W. A. Jex, T. & O. C. Ry.; R. W. Long, P. & L. E. Ry.; L. G. Plank, Penna. System; J. W. Walker, Penna. System; F. H. Parke, W. A. B. Co.; W. W. Shriver, B. & O. Ry.; J. M. Denser, Penna. System; Bert Hyanes, N. Y. A. B. Co.; Harry Sneck, B. R. & P. Ry. Standard—Left to Right—F. C. Young, W. A. B. Co.; Ralph Wolfe, N. Y. C. Lines; W. R. Garber, K. & M. Ry.; C. T. Jackson, N. Y. C. Lines; A. L. Berghane, W. A. B. Co.; W. M. Nelson, B. R. & P. Ry.; E. H. Weaver, W. A. B. Co.; G. A. Stenson, W. A. B. Co.



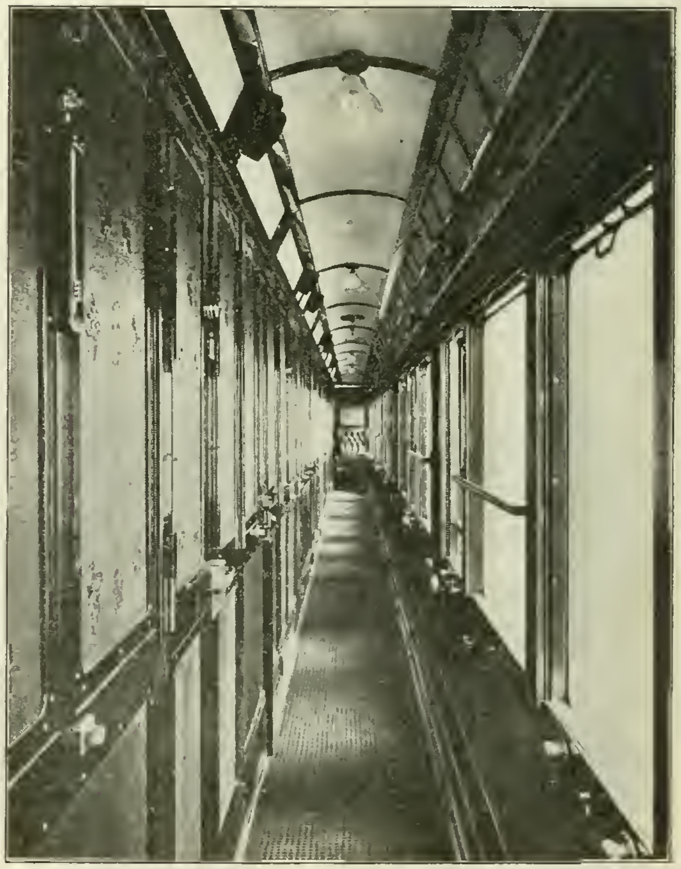
Double Compartment, Looking Outward



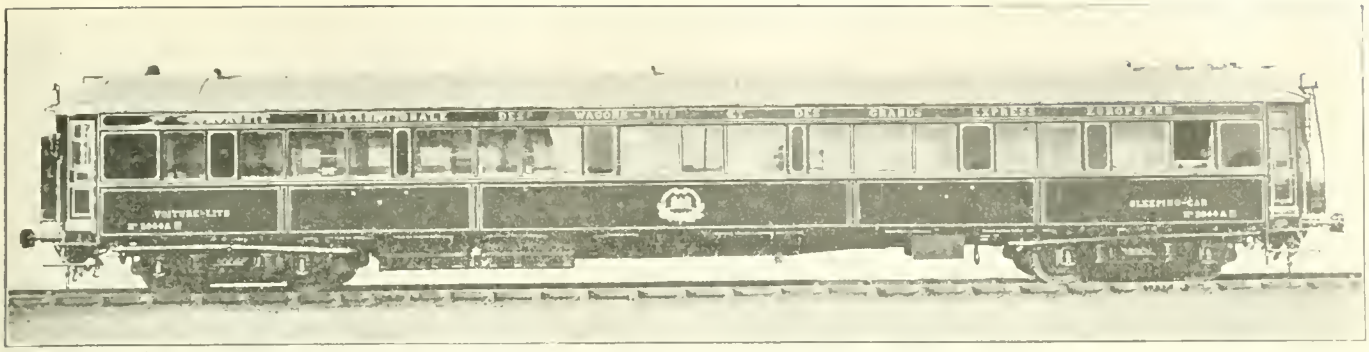
Compartment with Two Berths



Double Compartment, Looking Toward Corridor



View Along the Corridor



All-Steel European Sleeping Car Built by Leeds Forge Company, Ltd.

New Cars for International Sleeping Car Company

Leeds Forge Company Build 40 Steel Cars of Interesting Design, Handsome Appearance and Increased Comfort

THE cars of the International Sleeping Car Company (Compagnie Internationale des Wagons-Lits et des Grands Express Europeens) are operated over many different railroads in France, Belgium, Germany, Austria and other European countries. Owing to the different requirements of the various lines in regard to couplers, brake systems, heating systems, signals, lamp brackets and other details and the fact that the runs are frequently long and cross the borders of several countries, the design of the cars necessarily is a much more complicated matter than would be the case were they to be operated only in a limited area.

The Leeds Forge Company, Ltd., of Leeds, England, are now completing the delivery of 40 new cars to the International Company. These are the first all-steel sleeping cars to be used in Europe and the longest and heaviest coaches ever built in England. In general appearance, beauty of interior finish and arrangements for the comfort of the passengers these cars are particularly noteworthy.

General Arrangement

The cars have been designed to carry 16 passengers in eight one-place compartments and four two-place compartments, six of the one-place compartments being provided with communicating doors capable of being locked from either side. The seats turn over to form the bed, the bedding being secured to the underside of the seat in dust-proof containers. The seat back of the two-place compartment is arranged to lift to a horizontal position to form an upper berth, being supported by pull-out brackets fixed to the body side and corridor partition and by safety straps suspended from the ceiling. The two-place compartments are each also provided with a tip-up seat at the window side and opposite to the main seat, a folding table being fixed to the body side between.

In the first six cars, which were for use on the Peninsula and Orient Bombay Express service of the Paris, Lyons and Mediterranean between Calais and Marseilles, the two-place compartments were fitted with corner wash basin cabinets instead of dressing rooms as provided in the remaining 34. These dressing rooms, of which there are two, are arranged one between each two-place compartment and are provided with locks operating simultaneously on the doors leading to each compartment. A porcelain wash bowl is fitted, both hot and cold water being provided, also mirrors, decanters, drinking glasses, brush boxes, towel rails and soiled towel baskets. The window to the dressing room in the corridor partition is of obscured glass of St. Gobian pattern. The interior of the dressing room is finished in white enamel, all metallic fittings being silver-plated.

Each single compartment is provided with a wash basin cabinet, the basin, which is of the tip-up type, being white-metal, silver-plated, as is also the casing. Hot and cold water are available at each basin. A hinged table forms the front of this portion of the cabinet. The upper portion of the cabinet forms a cupboard for the decanters and drinking glasses and the lower portion contains the chamber utensils.

The leading dimensions and weights of these cars are given in an accompanying table.

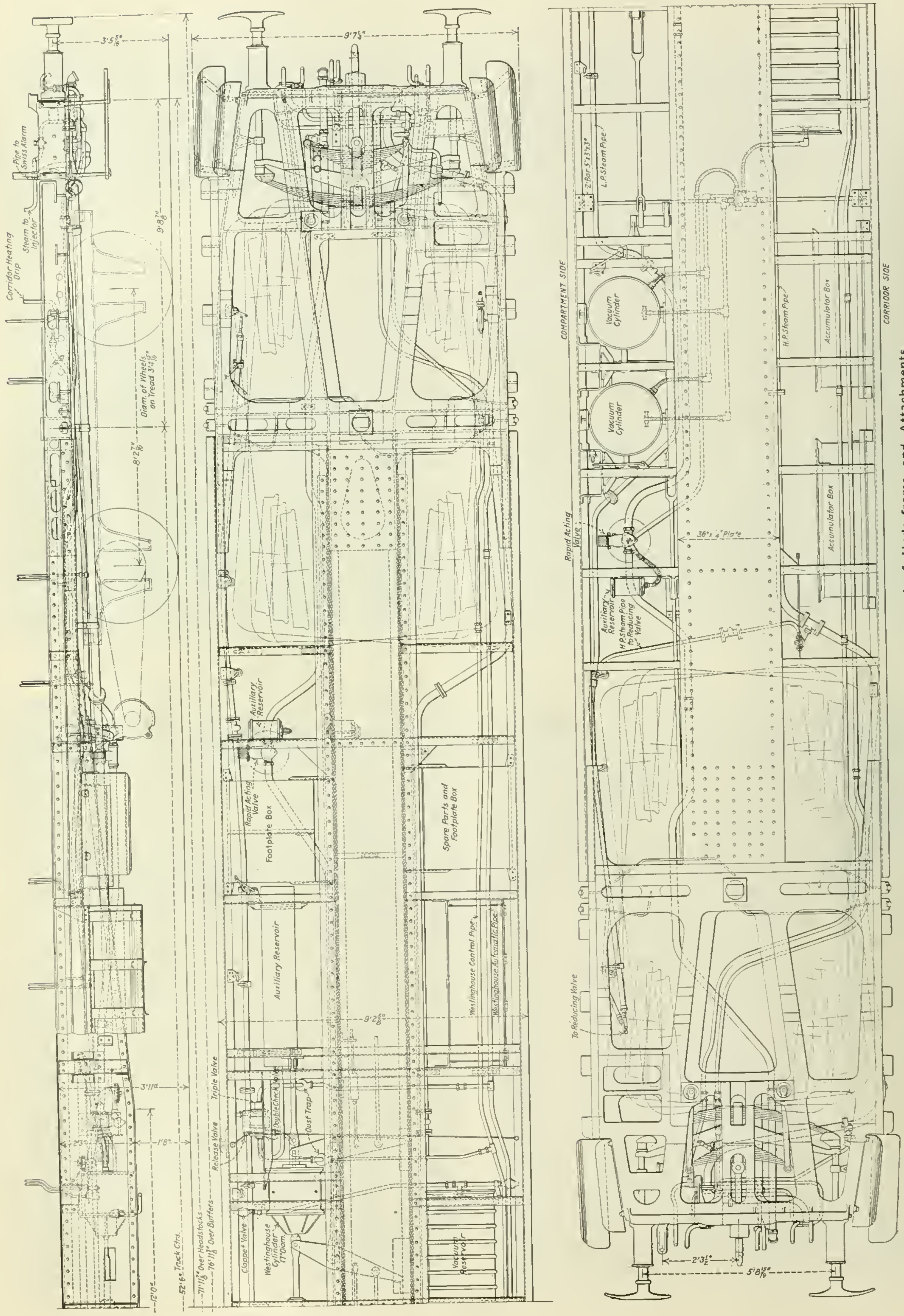
Construction of the Body

The structure of the body is entirely of steel, being built on jigs in units comprising full length compartment side, full length corridor side, body ends, platform ends, full length roof and canopies, thus insuring complete interchangeability as well as ease of production. These units, which largely consist of pressings and rolled sections, all made to templates, are readily assembled whole on the underframe, leaving the shell ready for the interior finish. To insure absence of vibration and drumming, the steel work has been covered on the inside with canvas and insulation from heat and cold has been provided. Free air circulation between the outer skin and inner finish is also arranged for the prevention of condensation.

The sides are constructed of ⅛-in. pressed steel side-posts of varying sections connected longitudinally at the base to rolled angles, which rest on the underframe, on the outside to a heavy belt-rail molding, and on the inside to a bulb section; at the top the posts are connected by two angle side-plates. The sides below the belt-rail are sheathed with ⅛-

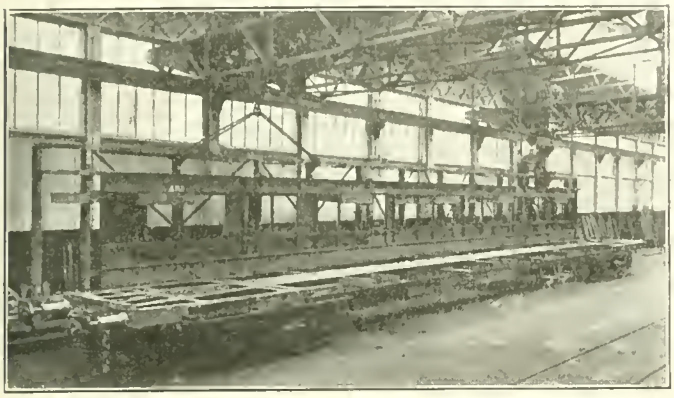
DIMENSIONS AND WEIGHTS

Dimensions:		
Length over buffers	23.452 m.	76 ft. 11⅜ in.
Length over endsills	21.940 m.	71 ft. 11⅞ in.
Distance between truck centers	16.000 m	52 ft. 6 in.
Truck wheelbase	2,500 m	8 ft. 2 7/16 in.
Diameter of wheels	1.040 m.	3 ft. 4 15/16 in.
Journals	130mm by 280mm.	5⅛ in. by 11 in.
Height, rail to top of roof	4.000 m	13 ft. 1½ in.
Maximum Height	4.024 m.	13 ft. 2 7/16 in.
Height, rail to center of buffers	1.050 m.	3 ft. 5 5/16 in.
Maximum width	2.875 m.	9 ft. 5 5/16 in.
Weights:		
In running order	54 English tons	121,000 lb.
Per axle	13½ English tons	30,250 lb.
Truck		15,230 lb.



Plan and Elevation Showing General Arrangement of Underframe and Attachments in. steel plates of a special quality. The sheathing above the belt-rail is of ⅛-in. plate, pressed in to form the window openings, four windows being pressed in one piece. Steel moldings are used to cover the butt joints of the side-plates, the whole side being riveted together with rivets counter-sunk on the outside to give a clean appearance to the exterior. The sides thus become deep girders capable of supporting the whole of the superstructure.

The roof is a departure from the former clerestory type, being elliptical. It is constructed of rolled angle carlines riveted to upper partition plates, the latter extending down to the side-plate level across the compartments and shaped to suit the ceiling at the corridor, the angles carrying the ceilings being riveted to either side. These upper partitions are connected longitudinally by angle upper side-plates and by angle purlins, the whole being sheathed by 1/16-in. roof plates lined with canvas to prevent drumming.



Erecting Jig Is Not Removed Until Side Unit Is Mounted on Underframe

The compartment partitions of 1/16-in. steel plate with angle framing are riveted to the underframe, body side and roof and upper partitions thus effectively preventing side swaying with resultant creaking of the woodwork. To the underframes and partitions is fixed a steel flooring on which is secured the wood partitions and floor covering.

Lowering Roof with Crane Onto Sides

The vestibule end is built up of ⅛-in. pressed steel channel section posts and cross rails, sheathed on the exterior with ⅛-in. plates and on the interior with 1/16-in. plates with steel cover moldings. Incorporated with the vestibule ends are cupboards for ice and wine, utensils and coal, with linen cupboards in the ceiling—all of steel—the cool wine cupboard being insulated with asbestos and zinc lined.

The vestibule is provided with two doorways at the sides, a door to the corridor and a communicating door to the next coach through the collapsible vestibule. These doors are of teak.

Underframes

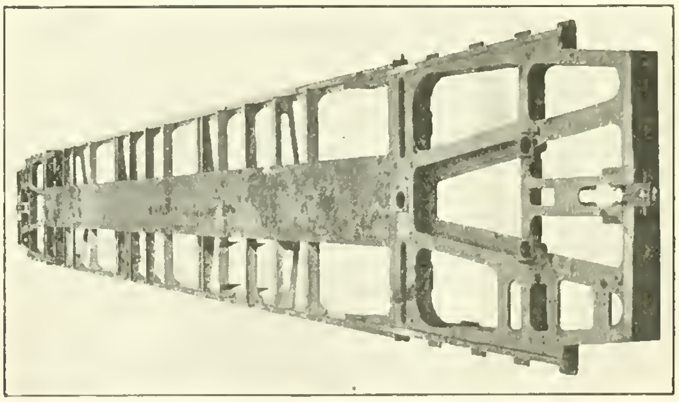
The underframes are of unusual design and consist of a small number of parts, this result being obtained by the use of large steel castings for the ends of the frames. These castings were supplied in a machined condition by the Commonwealth Steel Company, St. Louis, Mo., to the designs of the Leeds Forge Company. Although somewhat similar castings have been used for some time on heavy coaches in America, this is the first occasion on which they have been used in conjunction with side buffers. The castings dispense with a large number of individual parts which would be necessary with the type of buffing and drawgear adopted for these cars. Tail pieces extend from the end castings towards the center of the car in such a manner as to give a thoroughly strong connection with the remainder of the frame. The cast steel construction for the ends of the underframes give great resistance in the event of a collision.

The central portion of the frame consists of a fish-bellied girder built up of two web plates. The depth of this main girder at center of frame is 2 ft. 3 in. and at the part connecting to the end casting 10 in.

The four main crossbearers extend from side to side of the car passing through slots in the web plates of the center girder, other pressed crossbearers and floorbearers being built into the frame.

The side frames are made of rolled Z-sections connected firmly to the tail pieces of the end castings and arranged to form landings for the bottom angles of the body sides.

The buffing gear is of the equalizing type, the ends of the buffer shanks being fitted with shoes bearing on large laminated springs and connected by equalizing bars.



Underframe with Cast-Steel End Pieces

Trucks

The truck frame consists of one steel casting of which the pedestals, bolster suspension brackets, brake hanger brackets, etc., are cast to form integral parts, thus reducing the number of pieces to a minimum. The wear of pin holes is taken care of by the insertion of hard steel bushings and the pedestals and bolster wearing surfaces are faced with liners. The bolsters and spring planks are also of cast steel, having been manufactured, together with the frames, by the Commonwealth Steel Company. The trucks are of the equalizing beam type with double elliptic and helical springs, designed to obtain the easiest possible riding.

Interior Finish

The floors are covered with felt, cork-lino and carpet in the compartments and with cork, linoleum and carpet in the corridors. Bronze handrails are fitted over the fixed windows in the corridor, straps and handrails are provided to enable the dropping windows to be used as a means of exit in an emergency. In the corridor are also boxes for literature, notice frames, thermometer, candle lamps and cupboards for soiled linen and spare parts.

A seat and bed for the conductor or porter is fixed at one end of the corridor. The lavatories are situated one at each end, one being provided with a water closet and tip-up wash basin, the other with a water closet only, all fittings for both being white-metal, silver-plated or polished. The ceilings are removable for access to the water tanks and piping. The lavatories are finished in white enamel, the floor composition being cement and white marble chippings.

A signal alarm apparatus is fitted, capable of being operated from each compartment and from both ends of the corridor, the alarm valve being situated in the vestibule. Each compartment has also a push-button which operates a semaphore fixed above the door in the corridor partition, the bell being at the conductor's end of the corridor. Ventilators of the torpedo extractor type are fitted to the roof, communicating to the corridor and lavatories.

The woodwork of the compartments and corridor is of polished mahogany, constructed in sections ready for fitting into position. The steel compartment partitions are covered on each side with a one-piece section while the corridor partition is made up of several sections. The portions of interior finish fixed to the body sides in the compartments and corridor are also made in sections of suitable size. The wash basin cabinets are each made as one unit, as are also the cupboards in the corridor. The dressing rooms consist of two units, ready for fixing in position, thus ensuring the minimum of time actually spent finishing the inside of the car where working space is limited.

Four-Wheel Truck with Cast-Steel Frame

The scheme of decoration for the woodwork of the compartments is inlaid veneered panels above the window sills and figured velvet panels below, that for the corridor being embossed leather above the window sills and plain leather and lincrusta below.

The ceilings are composed of impermeable millboard to which is secured a border pattern of Anaglypta, the whole painted white and secured in position with polished mahogany moldings. The roof steel upper partitions are also covered with a frame to which is secured impermeable millboard with a border corresponding to that on the ceilings and painted white, with polished mahogany securing moldings.

The seats which have comfortable, high backs are upholstered in figured velvet, the material being supplied by the Wagons-Lits Cie., to their own design, as are also the inlaid panels and embossed leather.

The double compartments are provided with three windows of the frameless, balanced type, two dropping to the full extent, the other dropping to the extent of a top glass louvre ventilator operated from inside or out. The single compartments are provided with two windows, one dropping full, the other to the ventilator. The corridor is provided with both dropping and fixed windows. All windows are fitted with roller curtains.

The exterior of the coach sides and ends are finished in royal-blue decorated with gold lining. The roof is painted black as is also the underframe. The vestibule interiors are finished to match teak. The outside lettering on the sides is of bronze.

Heating, Water and Lighting Systems

High and low pressure steam pipes pass through the underframes, the former having connections to a reducing valve placed in the body and the latter to the individual steam heaters.

There are two heating systems, one the usual through steam heating by means of serpentine radiators in the compartments and straight piping in the corridors, the other by hot-water circulation. For the latter a heating chamber is provided at one end of the corridor, in which is fixed a coal-fired boiler. Circulating pipes of copper are run from the boiler to a hot-water tank in the roof and from thence round both sides of the car. The hot-water tank is divided into two portions, the water in one portion being heated by radiation from the water in the other portion which is heated by the boiler, the water thus warmed being used for the wash basins. The cold-water tanks fixed in the roof are also provided for supplying the wash basins. These tanks are filled from connections at the side of coach on the side sills. All tanks and piping, other than for high pressure steam, are of copper.

The electric lighting installation is of the Dick system. The current is generated by a dynamo slung from the underframe and driven by a belt from a pulley attached to one of the axles, the current passing to a pair of battery boxes slung on the frames and thence to the switchboards. Each compartment has a triple electrolier, two bulbs of 27 volts each being used for lighting, a single light with blue globe being provided as a night light. In addition there are reading lamps situated at the head of each berth. The lavatories have each one light, the corridor four lights, the vestibules one each, and one is provided in the roof over and outside each platform entrance door. The switchboard and regulator are placed at the end of corridor near the conductor's bunk.

Brakes

As these cars are run over many railway systems, some of which use the vacuum and others a compressed air brake, it has been necessary to arrange the brake rigging for use with either system. When the cars are operated in trains having the vacuum system two 24-in. diameter cylinders operate a pair of brake shafts from which the power is transmitted to the brake shoes by suitable foundation brake rigging, and when the Westinghouse compressed air system is in use, the power is obtained from a 17-in. diameter brake cylinder. Furthermore, the vacuum brake is fitted with rapid action valves while the Westinghouse brake is fitted with a double pipe line so that the system may be either automatic or controlled.

The foundation brake rigging is necessarily somewhat complicated as the brakes must be applied by either the vacuum or the compressed air cylinders, or by the hand brake controlled by a wheel placed in the vestibule at one end of the car. The trucks are equipped with a clasp brake, the shoes being suspended only 2 in. below the center of the axle. All brake-rigging is elevated well above the track.

The appearance of the end of the car is complicated by the unusual number of hose connections required for the vacuum brake, the automatic and control pipes of the air brake and the high and low-pressure steam heat hose.

Orders Have Been received in the Crewe railway works for a large number of locomotives for the London & North-Western (England). Thirty engines of a very powerful type are to be built immediately and others will follow. A large order for new boilers has also been received and the works at Crewe will be busy for a considerable time.

Freight Cars—Are They Assets or Liabilities?[*]

Large Opportunities for the Car Department to Decrease Maintenance Costs, Claims for Damage and Car Shortage

By C. B. Peck
Associate Editor, Railway Mechanical Engineer

THE freight car is the one factor among many that go to make up a railroad, which to the public is the ultimate measure of the capacity to furnish transportation service. No matter to what extent a shortage may be caused by a lack of other facilities, to the shipper and the public at large the situation is made known by the inability to furnish cars for loading, and is measured by the extent of the car shortage. A car shortage may be more the result of an inadequate supply of motive power, terminal facilities, passing tracks—and in some cases of main tracks—than it is of an inadequate number of freight cars. It still is true, however, that the control of the service of the car itself offers the quickest means of alleviating a shortage because it does not involve the outlay of capital for other facilities.

Utilization of Freight Cars

It is not out of place, then, to look into the various phases of freight car utilization and to see if, within the limitations imposed by other facilities, their value as assets may not be increased. Just how the average freight car spends its time depends considerably upon the demand for cars. Of course, the most effective use is made of them when the demand is greater than the supply. The latest figures available from which an answer to this question may be derived are for the month of September, 1922. Although there were a few surplus cars not in use during that period because of local maladjustments in distribution, there was a large net shortage. It is true that this shortage has materially increased since, but it was large enough in September, so that the results ought to be fairly typical of the effectiveness with which freight cars are ordinarily used.

During September the trip of the average freight car was about 438 miles, 311 miles of which were made under load and the remainder empty. This trip required a fraction over 18 days, but during this time the car spent only 1¾ days in trains. There were reported 12.5 per cent of the cars on the lines in bad order at the end of the month. This amounts to an average of 3.6 days of every trip either on repair tracks or awaiting movement to and from repair tracks, an amount more than twice the time actually spent in movement. About 2½ of the 18 days were spent in intermediate yards and terminals and almost 3 days in passing through interchanges from one road to another. Time in the hands of shippers for loading and unloading, the time required in placing, and delays over which the railroads have no control, accounted for approximately 7¼ days. This situation is summarized in the following table:

Length of average trip	438 miles
Movement under load	311 miles
Movement empty	127 miles
Time moving in trains	1.7 days
On repair tracks	3.6 days
Stored	0.3 days
In intermediate terminals	2.5 days
Passing through interchange	2.9 days
In the hands of shippers and delays beyond the control of the railroads	7.2 days
Average time per trip	18.2 days

Under the present abnormally high percentage of cars in bad order the largest single item of idle time within the control of the railroads is that caused by holding cars out of service for repairs. This situation is partly the cumulative result of the inability to keep up repairs during the war, followed by the tremendous retrenchment policy necessary during 1920 and 1921, and partly the immediate result of the recent shopmen's strike. It is true that the percentage of bad orders is now being reduced, partly by an actual gain in the number of cars repaired and partly by returning to service without repairs many cars which were set aside for general overhauling while business was slack. However, the immediate need is for the maximum constructive effort during the present heavy demand, since every car turned off the repair tracks in condition to stay off will add about $200 a month to the revenue as long as the shortage lasts.

Cycle for General Overhauling

One of the most effective means of bringing about a permanent reduction in the time spent on repair tracks, during which cars are liabilities and not assets, would be the adherence to a regular cycle of general overhauling. This is not a new idea. It was generally adopted many years ago for the maintenance of locomotives, which are scheduled for periodical classified repairs on a mileage basis in order that the maximum service may be obtained for each dollar spent in repairs with as little time out of service in the shops as possible. Conditions under which cars operate make it impossible to give them the same attention while they are in service that is given to locomotives. Isn't it, therefore, a matter of even greater importance that a regular shopping schedule be adopted and adhered to? With an established percentage of the equipment scheduled for heavy repairs regularly on the basis of from 7 to 10 or 11 years' service, depending upon the class of equipment, programs of improvement to refit the equipment to meet changing conditions could be planned and carried out before frequent failures and repeated patching have contributed materially to excessive loss of service time and excessive expenditures.

Another means of reducing the time cars are held out of service in bad order is to utilize the time each car is on a trip to the repair track by doing all work likely to require attention in the near future. The minimum time a car is held out of service is seldom less than one day, even though the work immediately required does not take more than an hour or two. When cars are as scarce as at present the loss of this day's service results in a loss of an average of more than $6.00 of revenue. Does not the saving justify taking the fullest advantage of every opportunity to make recurring trips to the repair track as infrequent as possible?

Repairing Foreign Cars

A common cause of delay on the repair tracks, in the case of foreign cars, used to be the necessity of waiting for standard material from the owner. The best data available indicates that standardization of parts requiring frequent renewal has progressed so far that there is now rarely any excuse for delays from this cause. Thus there is less reason for neglecting foreign cars than there used to be.

In the disposition of foreign bad order cars there are several business factors which are not within the control of the car department but in which it has a real interest. The first of these is the per diem rate, which, with rare exceptions, must be paid by the handling line even while it is holding the car out of service for repair. To the extent that this factor is taken into account in the disposition of cars it is detrimental to the foreign bad order situation. There is another factor on the other side of the account, however. About a year ago, in a paper before the Western Railway Club, N. D. Ballantine, superintendent of transportation, Union Pacific system, brought out the fact that the cost of empty mileage should be weighed carefully against the per diem cost of holding and repairing the foreign bad order car before deciding to return it empty to the owner for repairs. It is generally admitted that the average cost of moving empty cars is about five cents a car mile. Mr. Ballantine pointed out the necessity of determining whether or not the return of a bad order car to the owner would ultimately result in an equal empty car mileage in order to secure another car to replace the bad order for loading. In other words, if the prevailing movement of traffic is in the direction in which the empty car must be sent to the owner, and the distance is great, the net results to the railroad may be much more favorable if the car is retained and repaired, even at the expense of considerable per diem, and perhaps of a part of the cost of the repairs.

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[*] From a paper presented before the Car Foremen's Association of Chicago, December 11, 1922.

I have long believed that the billing prices for labor and material in the rules of interchange are on a basis too low to serve the best interests of the railroads in securing the maximum return in service for each dollar spent in repairs, as well as in reducing the loss of car days on repair tracks arising from the present generally irresponsible attitude toward the foreign car. This is a question worthy of the consideration of all men having to do either with the maintenance or the distribution and service of freight cars.

Losses at Interchange and Inspection Points

Time lost on repair tracks is not the only part of the average trip in which car department men are interested. Under the present mileage, of the average haul almost three days of each 18-day trip is spent in passing through interchanges. This is an average in which the multitude of direct interchanges between delivering and receiving lines as well as those at such gateways as Chicago, St. Louis and Kansas City are given proportionate consideration. For trips in which passing through a terminal like Chicago is included, this average is undoubtedly much too low.

Part of the time of each interchange is chargeable to the mechanical department for inspection and the set back of bad order cars after the load has been transferred. It is probably generally true that mechanical inspections are made at the same time that seal records are being taken and side cards applied by the transportation department and to the extent that this is true the mechanical department cannot be held wholly responsible for the inspection time. The responsibility for any improvement or any reduction in the amount of time required for these operations would, therefore, rest jointly with the operating and mechanical departments.

Mechanical inspection on the delivering line is not likely to be very comprehensive unless of empty cars for loading or loaded cars for unloading and reloading on its own line. Except for safety appliances and safety of running the principal responsibility for thorough inspection rests on the receiving line, because if that line fails to protect itself it is sure to be the goat in the settlement of repair bills.

But is the situation the same with respect to intermediate switching lines in terminals like Chicago? Is there not a possibility for increasing the extent to which joint inspections are depended on at the point of delivery to the intermediate line? Time is available to make a thorough inspection before the car is delivered because seal records must be taken and the car side carded. Would not a thorough joint inspection at this point satisfy the requirements of the intermediate line and permit cars to be moved for delivery without a long additional delay? The success of such an arrangement would, of course, depend on making the transportation records jointly and on side carding for ultimate destination within or through the terminal rather than merely indicating the immediate interchange.

The saving of time would not be the only advantage of such an arrangement. Would it not have a material influence in reducing the number of loads transferred by receiving lines? Certainly where the delivering line owns the cars they might frequently be repaired under load.

No doubt there are many interchange points within a terminal district such as Chicago where it would be impracticable to maintain joint inspection forces. But where all controversies over interchange are subject to the jurisdiction of a terminal inspection bureau is there not some way in which the benefits of joint inspection may be extended even beyond the limitations imposed by employing joint forces?

Reduction of Loss and Damage Claims

As has been mentioned, cars held out of service in bad order are liabilities rather than assets because, during times of heavy demand, the railroads are losing more than $6.00 per car on an average for every day so held. But all defective equipment is by no means on the repair tracks, defective cars in service are also a fruitful source of loss. Defective equipment is responsible for the payment of approximately ten per cent of all loss and damage claims and is one of the large single groups in the classified list compiled by the freight claim division of the American Railway Association. This general figure, however, does not tell the whole story, for with grain, flour and other mill products, sugar, coal and coke, 45½ per cent of all claims are attributable to defective equipment and the claims from this cause on these commodities account for 71 per cent of such claims for all commodities. Is it not evident that a proper inspection of cars for these commodities before loading at all stations large enough to employ a reasonable portion of the time of an inspector would be justified? On at least one road the payment of claims was reduced from about three cents to less than one cent on each dollar of freight revenue in a period of considerably less than one year and one of the factors in this splendid result was the development of this very practice.

Here, again, the establishment of and adherence to a regular cycle of general repairs would be of great benefit. Except for the damage caused by nails on the interior of box cars, leaky roofs and sides of box cars are probably the most common causes of claims within this classification. The condition of the superstructure when once it gets bad is not materially improved by repeated light repairs of a patchwork nature. The condition is likely to stay bad until the car is given a general overhauling. This class of claims would be materially reduced if every practicable effort were made to overhaul cars, say every eight years.

The transfer of lading is another fruitful source of loss and damage claims which rightly may be attributed to defective equipment. In a terminal like Chicago the number of these transfers runs into the hundreds—at times it might not be an exaggeration to say into thousands—every month. Every such transfer is a potential source of claims against which the railroads have a poor defense. Under the rules the receiving line, which generally makes the transfer, can usually shift the responsibility for the cost to the delivering line. I wonder, however, if the fact, that when a basis for claims is once established the payment may readily amount to more than the revenue from the consignment, is always taken into consideration when these transfers are made?

Opportunities in the Department

Many conditions touched on and the suggestions made are not entirely within the jurisdiction of car foremen or officers of the car department. However, most of the big improvements in economy of railway operation or maintenance in the future will undoubtedly come from a closer co-operation between the various departments involved rather than through the efforts of any of these departments individually. The clearer the understanding of all factors involved by every one concerned, the more likely we are to have the kind of work required to put the whole field of railway operation in which the use and maintenance of freight cars forms so large a part on a sound business as well as on a sound technical basis.

The business aspects of this problem so far as it affects the car department are suggested by the following questions to inspectors, foremen and officers of the car departments:

To Inspectors: Are you sure that you are not asking for protection on defects which won't justify the cost of the clerical work and correspondence involved in making your protection stick? Are there not many cases where the road that pays the bill is better off than the road that avoids the responsibility?

To Foremen: Do you know that the repairs you supervise are of such a nature that the expenditure will earn an adequate return? When you have cars in for attention to such parts as draft-gears or trucks are you missing the opportunity to fix the roofs, floors, etc., so that the car will be able to earn its average of $6.00 a day without another trip on some other repair track?

To Officers: Do you try to develop sound business judgment in your supervisors with respect to the control of their expenditures? Do you encourage them to exercise their own initiative to the utmost extent? Must they follow your instructions blindly or have you given them the reasons for those instructions so that in applying them they may exercise intelligence and good judgment?

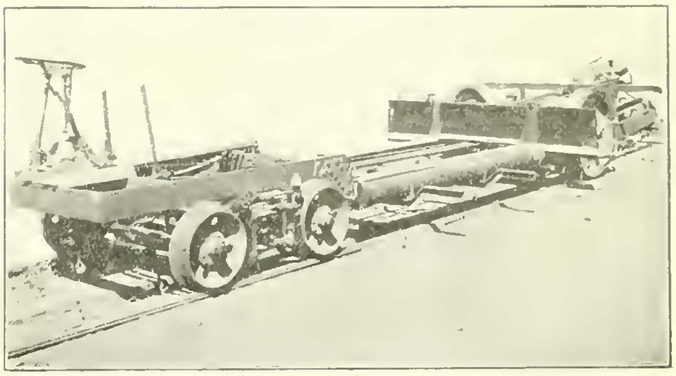
Light Weight Gasoline Car for Heavy Grade Line

The Hetch-Hetchy Railroad is a 68-mile line built by the City of San Francisco to transport material for the Hetch-Hetchy water supply project. The road passes through a rugged and sparsely settled country and is built with maximum grades of four per cent. The character of the traffic is well suited for motor car operation and this type of equipment has been used for several years.

A gasoline-driven passenger car, which is of special interest because of the unique features included in the design, has recently been delivered to the Hetch-Hetchy railroad. The most striking feature of the construction is the location of the gasoline engine, which is placed at the rear of the body behind the driving wheels. The motor, rated at a nominal 25 hp., is carried on a sub-frame supported at the rear end by a long semi-elliptic spring attached to an extension of the main frame and at the forward end, near the center of the driving axle, by a pivot pin and horizontal coil springs.

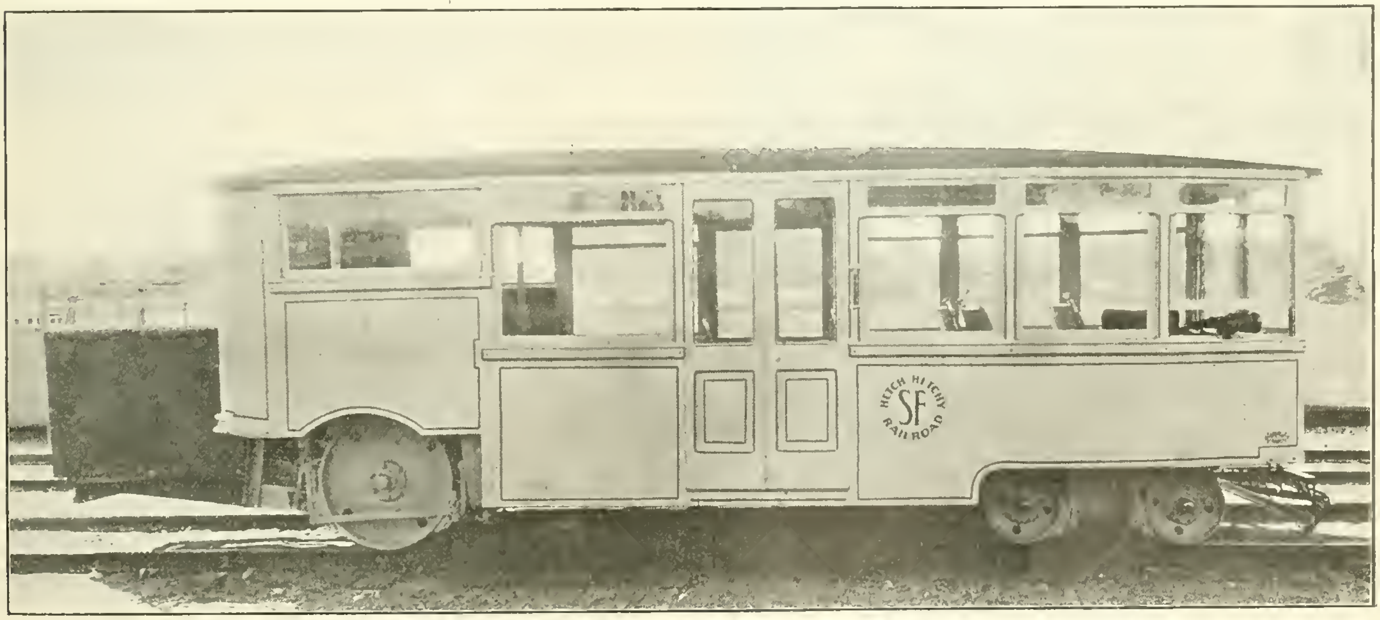
This unique construction has numerous advantages. Since there are no revolving parts in front of the rear axle, a very low-hung body can be used. A considerable increase in seating capacity is also obtained without lengthening the wheel-base of the car. Vibration is minimized and motor noises, smoke, or odors are kept away from the car body.

The total length of the car is 25 ft. 2 in., while the body is 15 ft. 6 in. wide and 20 ft. 3 in. long. The driving wheels are 33 in. diameter. The four-wheel leading truck has 18 in. wheels and a wheel-base of 36 in. The distance between center of truck and driving wheels is 14 ft.

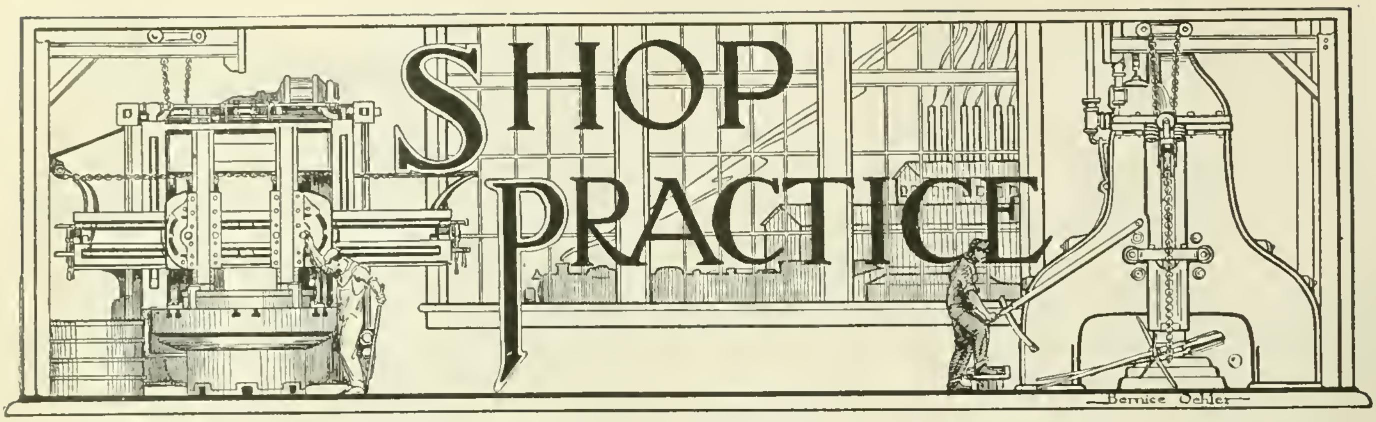

Underframe and Trucks With Motor and Controls

The brake rigging follows steam railroad practice, clasp brakes being used on the driving wheels, and single brake shoes on the forward truck. The steering wheel used on road vehicles has been replaced by a brake wheel.

The car seats 30 passengers, weighs but 10,400 lbs. complete and makes 8 miles per gallon of gasoline. It is stated that it makes the 12-mile 3.4 per cent grade on the Hetch-Hetchy at a speed of 27 miles per hour. This car is probably the lightest in proportion to its seating capacity that has yet been built, weighing only 347 lb. per passenger. It was built by A. Meister Sons Co., Sacramento, Cal.



The Location of the Engine at the Rear of the Body Is a Distinctive Feature of This Car



Double Mandrel for Turning Crown Brasses

IT is usually conceded the best practice to machine crown brass driving box fits complete at one setting on a draw-cut shaper. Where a shaper is not available, however, crown brasses are frequently turned on an engine lathe, and a special double tool-post arrangement and mandrel for speeding up this operation are illustrated in Fig. 1. Details of the mandrel and driving yoke are given in Fig. 2.

Referring to Fig. 1, it will be noted that the lathe has two tool-posts *M* and *N*, tool-post *M* having been applied after the lathe was purchased. This tool-post, being attached to the original lathe carriage, has power longitudinal feed the same as tool-post *N*. Power cross feed is not necessary in turning crown brasses and is therefore not provided.

The double mandrel consists of a 4-in. shaft, to which are applied sliding end collars *A* and *B* and center collar *C*, which is a shrink fit on the shaft. All three of these collars are forced to revolve with the shaft by hardened steel keys in suitable keyways. Three ¾-in. set screws are provided in each of the end collars and six in the center collar to hold the brasses securely in place. Set screws *S* through the 4-in. shaft provide adjustment of the brasses and assist in holding them while taking heavy cuts. The ends of the shaft are threaded to receive heavy hexagon nuts *D* and *E* and one end of the shaft beyond nut *D* is squared to fit a double driving yoke, bolted to the lathe face plate, with one end showing at *F*. Two brasses are placed in this mandrel in diametrically opposite positions and the 4-in. nuts tightened, holding the brasses against the center plate *C*. Light trial cuts are taken to see if the brasses are correctly centered and, if so, the set screws are tightened all around, holding the brasses firmly.

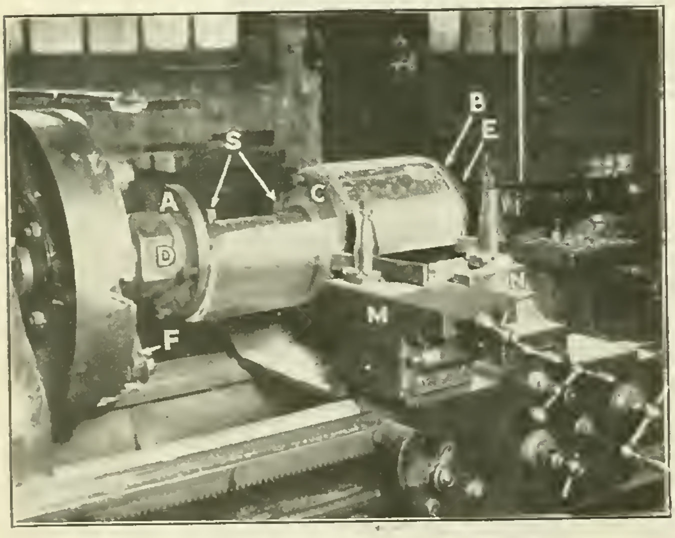


Fig. 1—Two Crown Brasses Are Turned at the Same Time

It is obvious that the time of turning crown brasses with this double tool-post lathe and double mandrel is little over one-half of what it would be ordinarily. It takes about 25 min. to turn a single brass, but with this double mandrel, two brasses can be turned in 28 min., or an average of 14 min. apiece, including the time of set up and taking a roughing and finishing cut. Placing the crown brasses diametrically opposite balances the mandrel and causes one tool to cut while the other tool is idle. As a result, a practically uniform torque is required to turn the mandrel; gear shock and jar are greatly reduced; and a smoother, better job is secured.

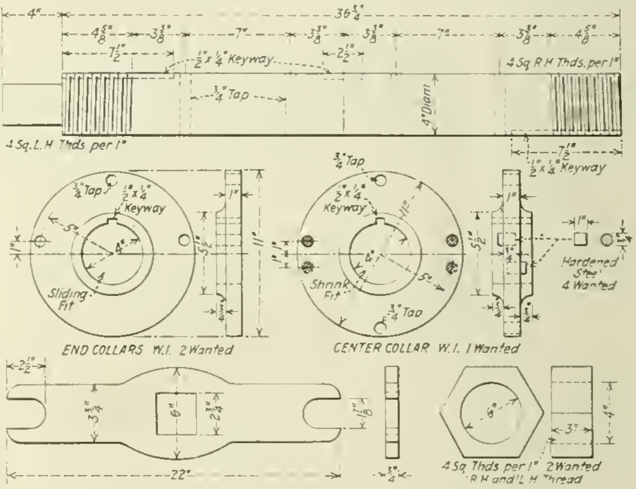


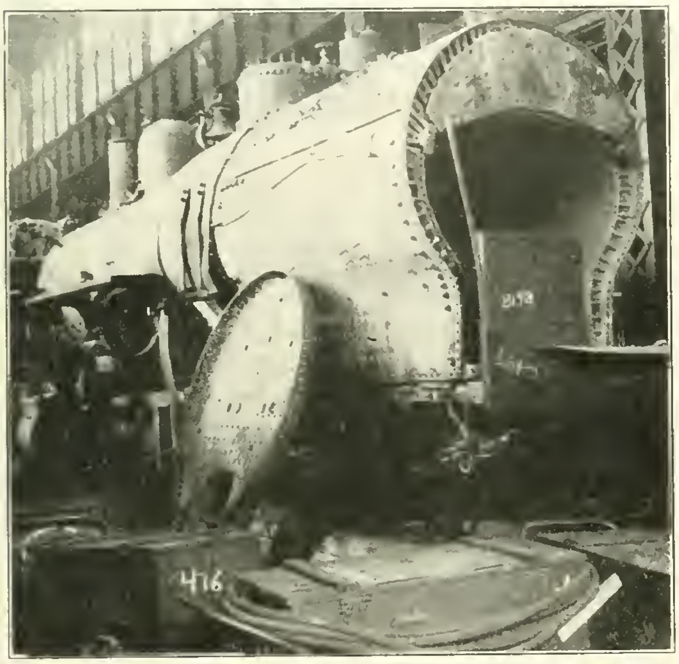
Fig. 2—Details of Double Mandrel and Driving Yoke

Burning Out Staybolts with Gas Cutting Torch

STRIKING results in burning out bolts of all kinds with the oxyacetylene torch are now being accomplished, and, on boiler work such as shown in the illustration, the cutting torch proves especially valuable. In the shop where the photograph was taken, one operator specializes on this work. In burning out staybolts he first melts a hole in the center of the bolt a little deeper than the thickness of the boiler sheet, then giving the hand and torch a rotary motion which completely cuts off the staybolt inside the sheet, leaving a conical end on the cut-off bolt. The shell of the old bolt left in the sheet can then be carefully removed with a hammer and chisel without damaging the thread. In the case of rivets, experience has shown it best to burn a good-sized hole completely through the rivet, then driving out what is left of the head and shell, releasing the sheets.

Results of Tests

In an actual test the operator referred to has burned out 253 rigid staybolts in 66 minutes, or at a rate of almost four a minute. In another case where firebox side sheets were to be renewed, 1,038 flexible staybolts and 592 rivets were burned out in 15 hr. 10 min. by this one operator. Considerable skill is needed in the manipulation of the torch, in order not to burn the tip or run into the sheets or mud ring, especially when burning out long bolts or rivets. It is said that frame bolts up to 8 in. long can be burned out with a torch, the length of bolt removable in this manner depending upon its diameter. The torch is also used to cut out superheater flues, a set of 43 flues being cut out in 55 min. by one operator, whereas it takes about 2½ hr. with the more common machine method. Other operations economically performed include cutting out front-end netting plates, and ashpan sheets. Flue sheets can be scarfed at the rate of 12½ ft. an hour.



On Jobs Like This the Gas Cutting Torch for Burning Out Rivets and Staybolts Saves Money

Method of Renewing Fireboxes

The illustration shows a method of renewing fireboxes by removing the back head, made feasible largely by the development of gas cutting of staybolts and rivets. The particular advantage of this method is that the complete firebox can be removed without taking the boiler from the frame, or drilling the outside wrapper sheet rivets and removing the complete boiler back end, as is sometimes done. This effects an important saving in time and labor.

In the case illustrated; the rivets and staybolts holding the back head, together with all other rivets and staybolts holding the firebox, were quickly and economically burned out with the gas cutting torch. A total of 1,670 rigid and flexible staybolts on this entire job were burned out by one man in 16 hours. There are 278 rivets in the back head, 270 in the mud ring and 93 rivets in the flue sheet, making a total of 641 rivets, cut out in 12 hours, also by one man. A comparison of these figures with the time required to cut out rivets and staybolts by former methods will quickly show the advantage of the gas cutting torch for this work.

Salt Baths for Heat Treating*

A number of different combinations of salts for heat treating are used and recommended by various people, but each has some vital defect or objectionable quality. Most of these combinations are eutectic mixtures of metallic chlorides, such as calcium chloride, barium chloride, sodium chloride and potassium chloride.

Calcium chloride is hygroscopic, must be carefully washed off the steel, or will cause corrosion, and has a tendency to pit. Calcium chloride alone has a melting point around 1420 deg. F., which is too high for use.

Barium chloride alone has a melting point variously stated from 1580 to 1760 deg. F., which is too high for use except for high speed steel. It is claimed that barium chloride develops a pitting action after it has been in use a few days at temperatures around 2012 deg. F. and almost immediately at temperatures around 2372 deg. F. Some authorities say, but this has not been found true by the writer, that the addition of a small amount of NaOH every few days keeps down this pitting action.

Sodium chloride melts around 1472 deg. F. and appears to be rather inert as far as corrosive and pitting action is concerned, except at the surface in contact with air. The original impurities, however, in sodium chloride such as magnesium salts, sulphates, etc., might be the source of the trouble which has occasionally been found with fused sodium chloride. The melting point of sodium chloride is too high, however, for it to be used alone.

Potassium chloride melts at around 1438 deg. F. and has the same objectionable features as sodium chloride, and in addition it has greater volatilization. Fumes of any of these salts are of course objectionable although those of calcium chloride are the most objectionable.

Sodium carbonate melts at around 1508 deg. F. and thus has too high a melting point to be used alone. There is some question as to its decarburizing effect when used at high temperatures on high carbon steel especially.

Potassium carbonate melts at around 1652 deg. F. and is open to the same objections as sodium carbonate.

Some eutectic mixture of two or more of the above salts will no doubt be the best solution of the problem.

A proper salt bath for the heat treating of complicated parts of high grade steel other than high speed steel should meet the following requirements:

1. It should have no corrosive or pitting action upon the steel.
2. It should have neither a carburizing nor decarburizing action on the steel.
3. It should melt at some temperature below 1020 deg. F.
4. It should not give off objectionable fumes at 1700 deg. F.
5. It should not attack the cast iron or alloy pot used for heating.
6. It should not deposit a sludge in the bottom of the pot.
7. It should leave only a thin film of molten salt adhering to the piece of steel as the piece is lowered into the quenching bath.
8. The salt and oil mixtures on the steel after quenching should be easily removable, by rubbing with waste.
9. The salts should be such that no harm would be done if the steel is tempered while some of the salts still remain upon it.
10. The salts should be non-hygroscopic.
11. The salts should have no rust promoting action.

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* Conclusions drawn in a paper presented before the New York Chapter of the American Society for Steel Treating, by Sam Tour, metallurgist, Doehler Die-Casting Company, Brooklyn, N. Y.

Schedule Assists in Rapid Shop Reorganization

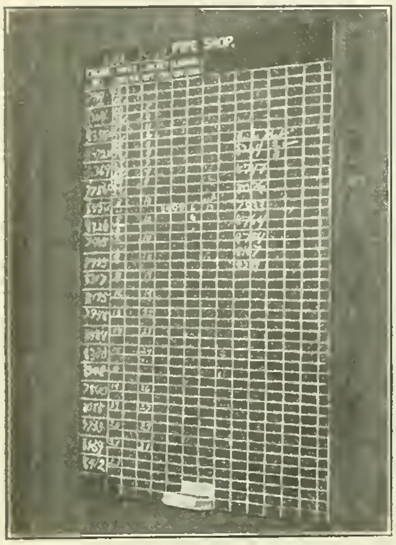


Fig. 1—*Typical Department Schedule Board*

Output of Jackson Shops of the Michigan Central Quickly Raised Above Normal by Simplified Shop Schedule, Efficient Trucking System and Delay Checking Department

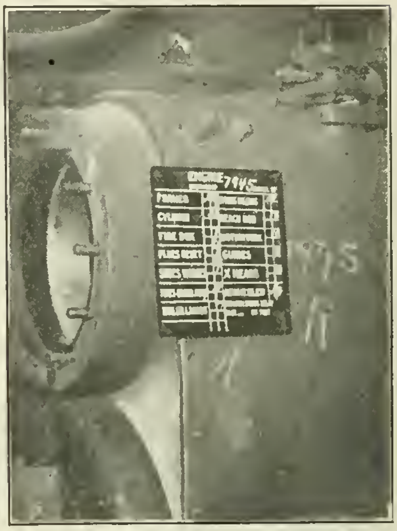
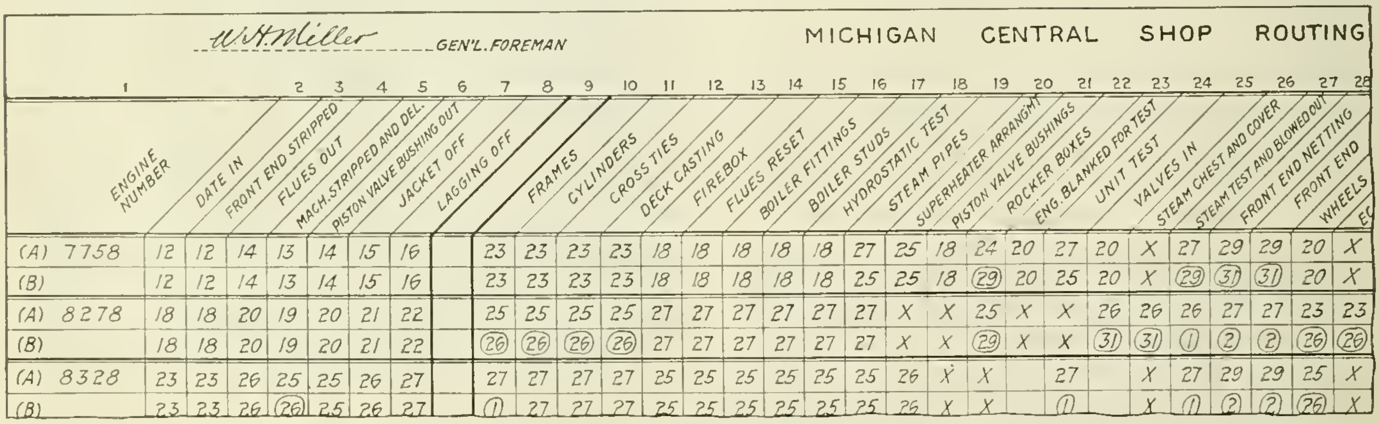


Fig. 2—*Dates for Erecting Shop Operations*

WITH a normal output of approximately 18 heavy and 20 light repair locomotives a month, the Michigan Central repair shops at Jackson, Mich., closed down during the first three weeks of last July as a result of the strike, and the output dropped practically to zero. Reopening the last of the month, the shop force was being rapidly recruited when the so-called Willard-Jewell strike settlement occurred and many of the striking shop men returned, swelling the total shop force in the month of October to almost 25 per cent above normal. During August and September the shop organization was gradually rebuilt and the output increased until, in October, all departments were well balanced and functioning smoothly, so that 25 locomotives were given heavy repairs and 20 light repairs. This output represented an even greater increase over pre-strike months than the proportionate increase in men employed. It was a striking achievement considering that new men were trained, old men relocated, departments built up and the entire shop put on a production basis in three months.

Table 1—Employees and Output of Jackson Shops, April to October, 1922

	April	May	June	July	Aug.	Sept.	Oct.
Shop force	555	554	569	211	346	641	783
Roundhouse force	323	311	282	160	229	225	288
Total employees	878	865	851	371	575	866	1,071
Heavy repair locomotives..	15	18	15	0	6	5	25
Light repair locomotives...	23	20	19	8	20	41	20
Locos. turned in 24 hrs...	64.2	54.7	51.9	60.2	64.6	65.1	70



W.H.Miller GEN'L. FOREMAN

MICHIGAN CENTRAL SHOP ROUTING

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

ENGINE NUMBER	DATE IN	FRONT END STRIPPED	FLUES OUT	MACH. STRIPPED AND DEL.	PISTON VALVE BUSHING OUT	JACKET OFF	LAGGING OFF		FRAMES	CYLINDERS	CROSS TIES	DECK CASTING	FIREBOX	FLUES RESET	BOILER FITTINGS	BOILER STUDS	HYDROSTATIC TEST	STEAM PIPES	SUPERHEATER ARRANGMT	PISTON VALVE BUSHINGS	ROCKER BOXES	ENG. BLANKED FOR TEST	UNIT TEST	VALVES IN	STEAM CHEST AND COVER	STEAM TEST AND BLOWEDOUT	FRONT END NETTING	FRONT END	WHEELS	EC
(A) 7758	12	12	14	13	14	15	16		23	23	23	23	18	18	18	18	18	27	25	18	24	20	27	20	X	27	29	29	20	X
(B)	12	12	14	13	14	15	16		23	23	23	23	18	18	18	18	18	25	25	18	㉙	20	25	20	X	㉙	㉛	㉛	20	X
(A) 8278	18	18	20	19	20	21	22		25	25	25	25	27	27	27	27	27	27	X	X	25	X	X	26	26	26	27	27	23	23
(B)	18	18	20	19	20	21	22		㉖	㉖	㉖	㉖	27	27	27	27	27	27	X	X	㉙	X	X	㉛	㉛	①	②	②	㉖	㉖
(A) 8328	23	23	26	25	25	26	27		27	27	27	27	25	25	25	25	25	25	26	X	X		27		X	27	29	29	25	X
(B)	23	23	26	㉖	25	26	27		①	27	27	27	25	25	25	25	25	25	26	X	X		①		X	①	②	②	㉖	X

Fig. 3—Reproduction of Upper Section of 7½-ft. by 21-ft. Master Schedule

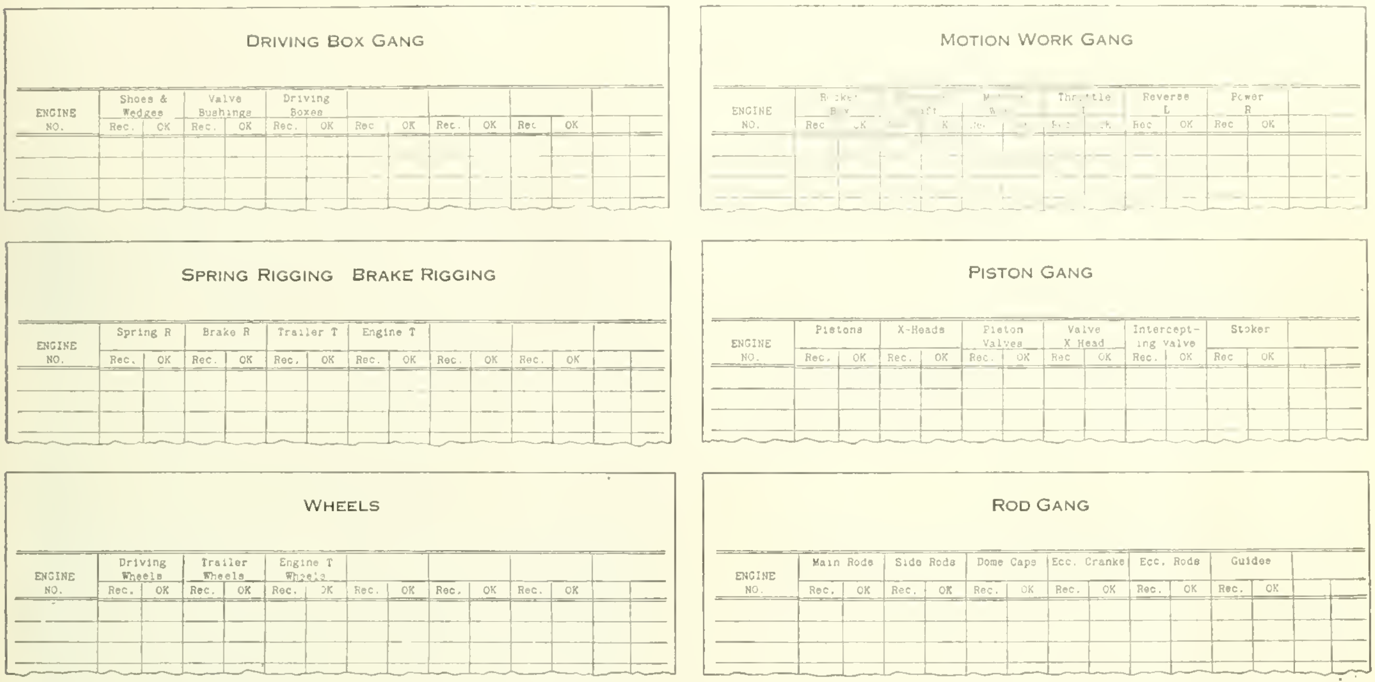
In view of the results obtained, a brief analysis of the shop force and output by months, as shown in Table I, will be of interest. The total number of employees at Jackson previous to the strike was about 862, of whom 556 worked in the repair shops and 306 in the roundhouse. When the strike was called on July 1, only 60 men reported for work and these men were sent to the roundhouse together with the shop foremen to keep as many locomotives as possible in service. The output of heavy repair locomotives was slow in picking up during August and September, as shown in the table, owing to the concentration of work on light repairs; but by October, the shop output had increased fully 25 per cent and the roundhouse 23 per cent.

Salient Features of Shop Organization

Credit for the rapid reorganization of Jackson shops is doubtless due first of all to the character and ability of the supervisory officers and shop foremen who remained loyal to the railroad in the emergency. They formed the foundation on which the new organization was built. Unquestionably, the factor of second importance, and the one forming the basis of this article, is the simple and effective shop schedule or routing system, by means of which shop operations are controlled. Next in importance is the efficient power-trucking system, directed by the schedule foreman, and designed to secure material and parts from the storehouse or stripping gang, keep them moving through the various shop departments, and truck them to the erecting shop for assembly as soon as they are finished. Mention should also be made of the special shop efficiency department consisting of the assistant shop supervisor and five specialists who devote practically all their time to tracing and removing the causes of delay as indicated by red marks on the schedule board. This department has developed many improved methods, jigs and fixtures which tend to speed up the schedule and increase the general efficiency of the shop as a whole.

Simplified Shop Schedule System

The schedule system employed at Jackson shops is unusually simple, being carried out with as few printed forms as possible. Its success is largely due to the fact that everyone believes in it and works for it, from W. H. Flynn, superintendent of motive power; F. P. Neesley, division master mechanic, and C. W. Adams, shop superintendent, down to the youngest shop foreman.



Driving Box Gang

Engine No.	Shoes & Wedges		Valve Bushings		Driving Boxes								
	Rec.	OK	Rec.	OK	Rec.	OK	Rec	OK	Rec.	OK	Rec	OK	

Motion Work Gang

Engine No.	Rocker Box		[illegible]		[illegible]		Throttle I		Reverse L		Power R		
	Rec	OK		K					Rec	OK	Rec	OK	

Spring Rigging Brake Rigging

Engine No.	Spring R		Brake R		Trailer T		Engine T						
	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	

Piston Gang

Engine No.	Pistons		X-Heads		Piston Valves		Valve X Head		Intercepting valve		Stoker		
	Rec.	OK	Rec.	OK	Rec.	OK	Rec	OK	Rec.	OK	Rec	OK	

Wheels

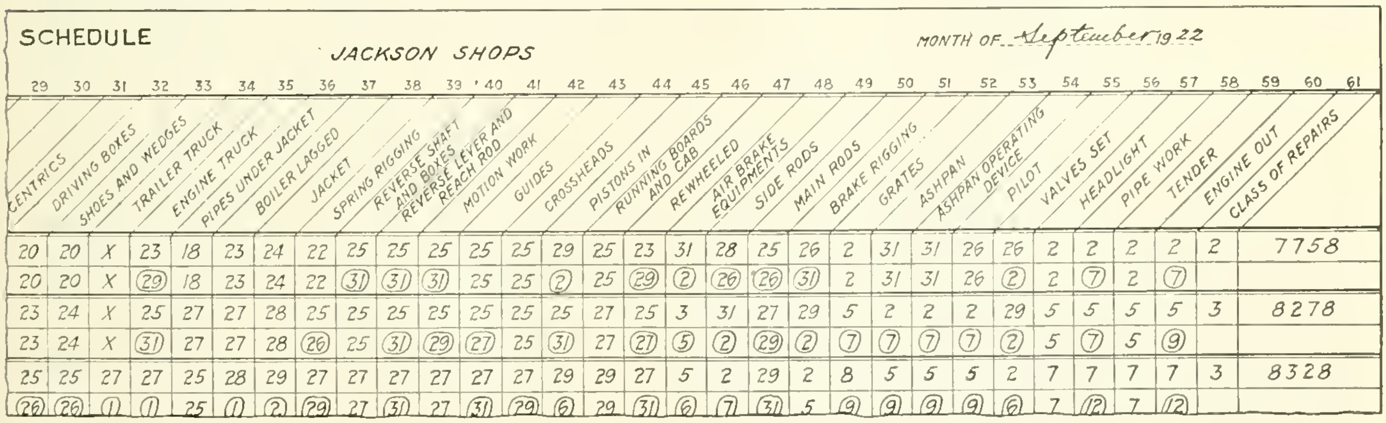
Engine No.	Driving Wheels		Trailer Wheels		Engine T Wheels								
	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	

Rod Gang

Engine No.	Main Rods		Side Rods		Dome Caps		Ecc. Cranks		Ecc. Rods		Guides		
	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	Rec.	OK	

Fig. 4—Headings of Important Department Schedule Boards, Similar in Size and Lay-Out to the Board Shown in Fig. 1

In brief, the master schedule consists of an immense board, 7½ ft. high by 21 ft. long, taking up the entire front wall of the room in which the foremen meet frequently to discuss the progress of the work. This board is ruled in squares, and provided with a heading, as illustrated in Fig. 3. Horizontal columns *A* indicate the dates on which various operations are due, columns *B* showing the dates on which these operations are actually completed. In case of delay, these dates are marked with red chalk, indicated in the illustration by numbers enclosed in circles. Obviously, a red date is a signal for investigation and action by all concerned.



SCHEDULE

JACKSON SHOPS

MONTH OF September 1922

29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61

Centrics	Driving Boxes	Shoes and Wedges	Trailer Truck	Engine Truck	Pipes under Jacket	Boiler Lagged	Jacket	Spring Rigging	Reverse Shaft and Boxes	Reverse Lever and Reach Rod	Motion Work	Guides	Crossheads	Pistons In	Running Boards and Cab	Rewheeled	Air Brake Equipments	Side Rods	Main Rods	Brake Rigging	Grates	Ashpan	Ashpan Operating Device	Pilot	Valves Set	Headlight	Pipe Work	Tender	Engine Out	Class of Repairs
20	20	X	23	18	23	24	22	25	25	25	25	25	29	25	23	31	28	25	26	2	31	31	26	26	2	2	2	2	2	7758
20	20	X	㉙	18	23	24	22	㉛	㉛	㉛	25	25	②	25	㉙	②	㉖	㉖	㉛	2	31	31	26	②	2	⑦	2	⑦		
23	24	X	25	27	27	28	25	25	25	25	25	25	25	27	25	3	31	27	29	5	2	2	2	29	5	5	5	5	3	8278
23	24	X	㉛	27	27	28	㉖	25	㉛	㉙	㉗	25	㉛	27	㉗	⑤	②	㉙	②	⑦	⑦	⑦	⑦	②	5	⑦	5	⑨		
25	25	27	27	25	28	29	27	27	27	27	27	27	29	29	27	5	2	29	2	8	5	5	5	2	7	7	7	7	3	8328
㉖	㉖	①	①	25	①	②	㉙	27	㉛	27	㉛	㉙	⑥	29	㉛	⑥	⑦	㉛	5	⑨	⑨	⑨	⑨	⑥	7	⑫	7	⑫		

Board, Taking Up the Entire Front Wall of the Foremen's Room at Jackson Shops

About the twenty-second of each month, the shop superintendent and foremen meet in the foremen's room to schedule engines for the following month, and another meeting is held on the tenth of the month to make necessary schedule revisions. From work reports and inspectors' reports the condition of each locomotive is known, and a reasonably accurate estimate can be made of the time needed for each repair operation. Dates are accordingly chalked on the master schedule board. All the foremen are present, and if they feel that any of the dates cannot be met, the matter is thrashed out then and there. It is the intention, however, to set the schedule slightly ahead of what can be accomplished, and continually shorten the schedule as better shop methods are developed.

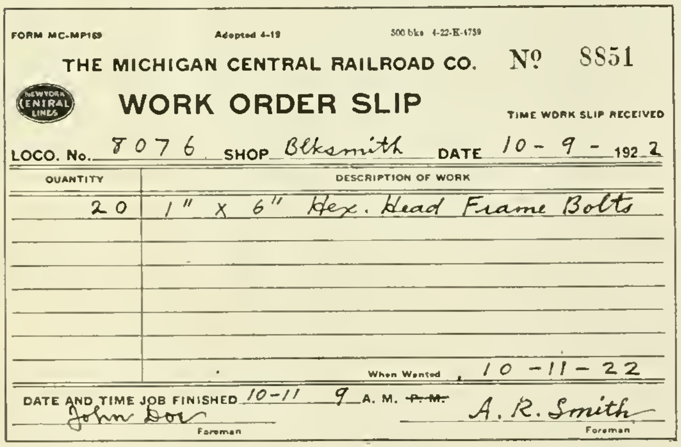
The foreman of each important department has a printed form covering the work of his department to be filled out in accordance with the master schedule and carried by him for reference. This form is also duplicated in chalk on a department board, located in a conspicuous position for the information of the workmen. Fig. 1 shows such a board in the pipe shop and Fig. 4, the headings of schedule boards located in other important departments.

Dates for the completion of erecting shop work on each locomotive are chalked on an 8-in. by 9-in. piece of sheet iron, painted, lettered and attached to the cylinder, as shown in Fig. 2. Dates when material should be received from the machine shop and when it should be applied to the locomotive are shown. Erecting shop men are thus enabled to tell exactly when different operations are due without consulting the foreman. The only other forms in connection with this simplified schedule system are two small ones used to report delays to the foremen, and causes of delay to the shop superintendent. There are, however, two additional small shop forms, one being a work order slip form for outside work and small material not mentioned on the schedule, and the other consisting essentially of a form issued by the schedule foreman for the movement of material.

Work Order Slips Effectively Used

The work order slip (Fig. 5) is of sufficient importance to be described in some detail. In general, it is made out in triplicate by a foreman who needs work done in another department. The original white slip goes to the department which will do the work; the second blue slip goes to the routing office which looks up pattern numbers and gets the rough material from the storehouse or casting platform; the third yellow slip is retained by the issuing foreman for reference. When the work is completed, the time is entered on the original slip; it is signed by the foreman and returned to the routing office which arranges for the finished material to be trucked to the proper department. The work order slip also serves as a record of time spent on individual jobs and is used in computing costs.

A typical work order slip, made out for 20 hexagon head frame bolts, is illustrated in Fig. 5. It is issued by an erecting shop foreman against the blacksmith department which, if the bolts are not in stock, makes them on a forging machine. As soon as the bolts have been forged, the blacksmith foreman fills in the time on the work order slip and returns it to the schedule office. The schedule, or routing foreman, then knows that the bolts are made and fills in form 234 (Fig. 6), giving it to one of the truckers, who trucks the bolts to the machine department for turning, and subsequently to the erecting shop foreman who issued the original order.



FORM MC-MP169 Adopted 4-19 500 bks 4-22-K-4739

THE MICHIGAN CENTRAL RAILROAD CO. Nº 8851

WORK ORDER SLIP

TIME WORK SLIP RECEIVED

LOCO. No. 8076 SHOP Blksmith DATE 10-9-1922

QUANTITY	DESCRIPTION OF WORK
20	1" x 6" Hex. Head Frame Bolts
	When Wanted 10-11-22

DATE AND TIME JOB FINISHED 10-11 9 A. M. ~~P. M.~~

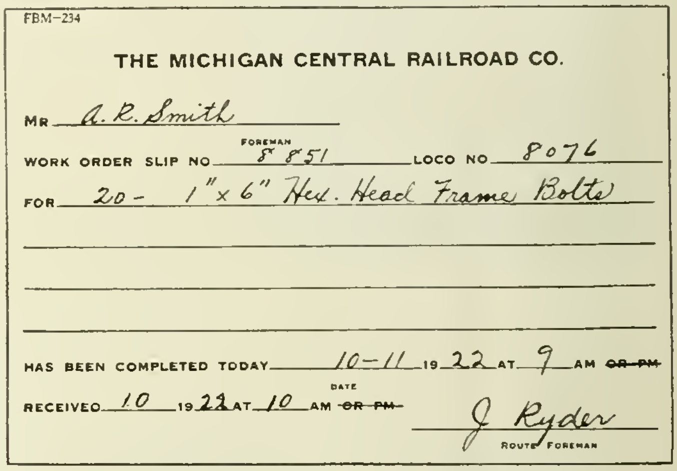
John Doe
Foreman

A. R. Smith
Foreman

Fig. 5—Typical Work Order Slip Made Out Against the Blacksmith Department

Special attention is called to the work order board (Fig. 7) attached to the forging machine water pipe, as illustrated. One half of the board is painted black and marked "Work Order," the other half being painted red and marked "O.K." Two hooks are provided at the bottom, and when a work order slip is received at the forging machine, it is hung on the black hook at the left. When the work is completed, the slip is transferred to the red "O.K." hook at the right. Most people hate to see a lot of work piled up ahead of them waiting to be done and advantage is taken of this trait of human nature by means of the work order board. It is used not only at the forging machine, illustrated, but at every important machine and job throughout the shop. Workmen naturally try to get the slips onto the O.K. hook as fast as possible. Moreover, foremen can walk through their departments and tell at a glance which machines have a lot of work ahead and which will soon be caught up.

Dates on the master and department schedule boards are made with yellow chalk, the date when the work is actually completed being put on with blue chalk, except in the case of delays, when red is used. Delays are, therefore, indicated on the master department schedule boards by red dates which are conspicuous and attract attention. In order to avoid questioning and possible censure, there is a definite effort on the part of both foremen and men to have as few red dates as possible appear on the boards.



FBM-234

THE MICHIGAN CENTRAL RAILROAD CO.

MR A. R. Smith
FOREMAN

WORK ORDER SLIP NO 8851 LOCO NO 8076

FOR 20- 1" x 6" Hex. Head Frame Bolts

HAS BEEN COMPLETED TODAY 10-11 19 22 AT 9 AM ~~OR PM~~
DATE

RECEIVED 10 19 22 AT 10 AM ~~OR PM~~

J Ryder
ROUTE FOREMAN

Fig. 6—Brief Form Indicating That Work Is Done (Essentially An Order for the Movement of Material)

In addition to the monthly schedule meeting, the foremen meet every Monday, Wednesday and Friday after working hours to check up the progress of the work, settle any questions which may arise, and discuss any suggestions for improved shop operation. Minutes of these meetings are taken in shorthand and later distributed to the various foremen who thus have a permanent reminder of the points discussed. These meetings prove extremely effective in ironing out any differences which may arise between the respective foremen, enabling them to work as a unit for the general betterment of the shops.

Schedule Foreman Has Charge of Routing System, Trucking and Shipping to Outside Points

Shop schedules can never be a success unless run by men of extensive practical shop experience. Obviously, if a clerk is employed simply to go through the motions of filling out forms in the office, the results will be negligible as far as increasing shop output is concerned. As previously intimated, the importance of the schedule is appreciated at Jackson and a real job has been created for the schedule foreman who has general charge of the routing system, work order slips, trucking material, and shipping to outside points. This schedule foreman is relieved of minor details by an assistant who checks the progress of the work each morning and afternoon. A clerk is also provided in the routing office to take care of all work order slips and shop orders.

The importance of the prompt movement of material and its relation to the shop schedule is recognized by giving the schedule foreman three Ford gasoline tractors and three Mercury storage battery tractors together with 10 laborers for operating the trucks and handling material. The schedule foreman, knowing when the work on various locomotive parts is completed, is in the best position to see that this material is moved promptly. As fast as one operation is completed on a part it is moved along to the next machine.

The schedule foreman also has direct charge of ordering and shipping all material to outside points, which work bulks large in the Jackson shop operations. While the erecting shop is of the longitudinal type and more or less difficulty is experienced in transporting material through it on that account, an effective trailer and tractor system has been developed which not only speeds the movement of material through the shops but saves a great amount of hard manual labor, formerly required when trucking by hand. The trailer system has another advantage in that material can be loaded on the trailers and then moved, a considerable number of units at a time, without tying up a tractor or being compelled to wait for one.

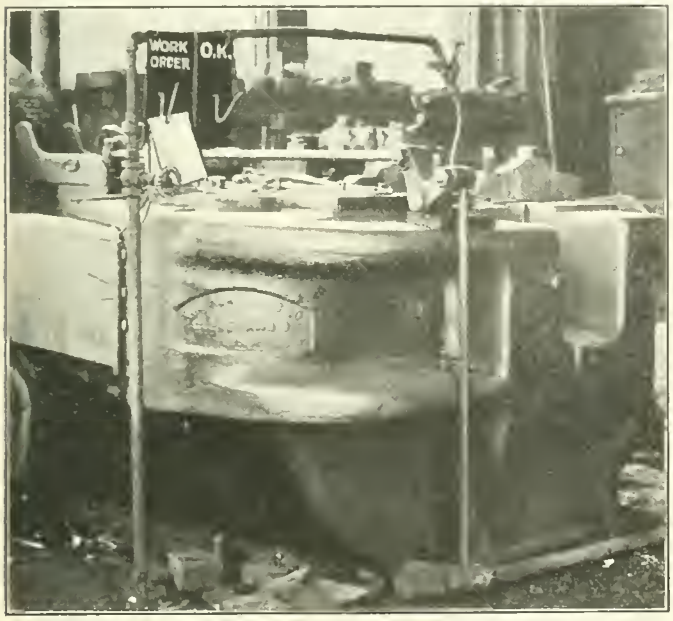


Fig. 7—Men Like to Get Work Order Slips on the "O. K." Hook

The importance of the schedule foreman in the scheme of shop operation described is evident and it seems logical that the man who has charge of the progress of both schedule and outside work should also have charge of getting the material, moving it from point to point about the shop and shipping it to outside points when completed.

Unusually Heavy Repair Work at Jackson

A close examination of the master schedule, illustrated in Fig. 3, will show that the first three locomotives were allowed 18, 16 and 14 days in the shop, the time actually taken being 23, 18 and 17 days respectively. While these shopping periods may appear unduly long, it should be noted that in each case the locomotive was given unusually heavy repairs involving jacket and lagging removal and firebox repairs. Probably there are shops no larger than those at Jackson, which turn out more than 25 heavy repairs a month, but in fairness it should be pointed out that locomotives sent to Jackson shops are given unusually heavy repairs and in fact many locomotives, credited only with light repairs, receive practically heavy classified repairs owing to the rigid Michigan Central ruling on mileage. (Unless a locomotive has made a specified mileage, it cannot be given general repairs.) The proximity to the roundhouse and consequent large number of light repair locomotives also tends to disrupt the shop organization for heavy repair schedule work. In fact, preference is given to light repair or roundhouse work whenever it conflicts with the schedule work.

Shop Efficiency Department

Railroad shops, unfortunately, are not like the "one horse shay," with each department as strong as the other. In consequence a close observation of the master schedule board will usually show weaknesses in certain departments. Obviously, it is the duty of the shop superintendent to take the necessary steps to strengthen weak departments, but one man cannot attend to all the details of this work which is handled at Jackson shops by a special efficiency gang, under the direction of the assistant shop supervisor. The gang consists of two machinists, two boilermakers and one blacksmith, all expert workmen experienced in their respective lines.

A series of red marks in the same department, as shown on the schedule board, always indicates some trouble which may be caused by inefficient machines or methods. In either case some slight change will often remedy matters and allow this department to get its work done on time and eliminate the red marks. As a rule, when one department has been brought up to the mark in this way, some other department proves to be the limiting factor and so it goes. As a result of the work of the efficiency department, a continual improvement in shop methods and output is obtained.

Among the devices which have been developed comparatively recently may be mentioned a double crown brass turning jig, a power-operated device for pulling in cylinder bushings, a jig for milling throttle lever quadrants, a motion work bushing press, several effective brass room tools, a set of guide liner dies, etc.

Experimental Room

Another unusual feature at Jackson shops is an experimental room in which is segregated all the tool work done for the efficiency department. This experimental room is entirely separate from the main toolroom, being equipped with an 18-in. lathe, an upright drill, a 24-in. shaper and a grinder. All new jigs and fixtures, or devices intended to facilitate the shop work are made in this experimental room, which is allowed to be used for nothing else. It is well known that where work of this kind is carried on in the ordinary toolroom it becomes sidetracked whenever a rush job comes in, and the result is a delay in the development of new tools if the work is not stopped altogether.

In view of the results accomplished, it may safely be said that the shop schedule, as installed at Jackson shops, has justified its existence. It amply fulfils the expectations of those who for years have advocated this method of controlling railroad repair shop operations.

* * * *

International

Derailment Near Paris, France

Powerful Valve–Setting Rolls

THE work of setting valves on modern heavy locomotives can be greatly facilitated or retarded, depending upon the method employed for rolling the main wheels. Many types of hand-, pneumatic- and electric power-driven rolls are used, but in the majority of cases these are not entirely satisfactory. They frequently lack sufficient power, provide too jerky motion, or are difficult to set up. To overcome these difficulties a new electric power-driven unit, arranged to drive the rolls through a powerful universal joint, has been developed at the Jackson shops of the Michigan Central, as illustrated in Fig. 1. A plan and elevation of this device, together with construction details are shown in Fig. 2.

The principal advantage of this device is that sufficient power can be instantly obtained by means of the convenient controller handle, to revolve the main wheels in either direction one complete revolution in 30 seconds. Moreover, the controller handle provides easy and accurate control of the motor, enabling fine adjustments of driving wheel position to be obtained. It is said that adjustments less than 1/64 in. of the driving wheel circumference can be obtained, thus saving a large amount of time formerly spent reversing the wheels whenever they went beyond the mark. Other advantages are the ease of set-up and the fact that the compact power unit is mounted on a truck, readily movable about the shop. One man can easily apply the rolls beneath the wheels, move the truck into position, connect the universal coupling and be ready to turn the wheels inside of 15 min., depending somewhat on how far it has been necessary to go for the truck.

Referring to Fig. 2, it will be noted that power is supplied from a 5-hp. motor, operating at 810 r. p. m. and transmitting power through suitable reduction gears, a 1-in. single lead worm with 31 tooth gear, to the universal joint and rollshaft. All gearing is carefuly protected and the controller box so located that the handle is within easy reach of the valve setter. The truck wheels are made small and the entire power unit built as low as possible so that the drive shaft on the truck will be only slightly higher than the rollshaft. The universal joint, therefore, operates efficiently at a very slight angle. The truck could be handled more

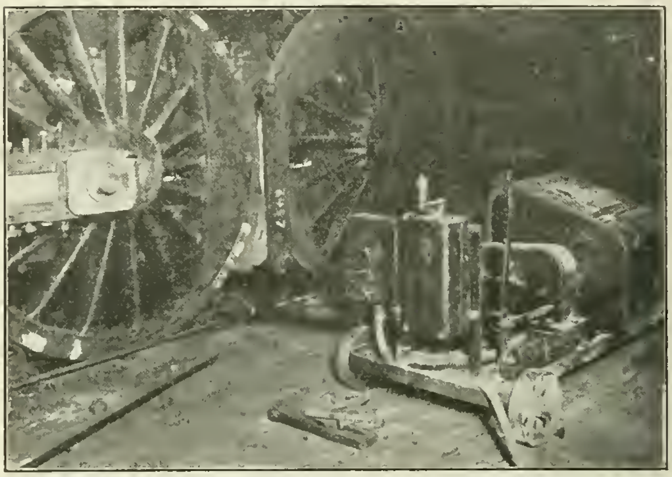


Fig. 1—Compact and Readily Portable Unit for Rolling Main Wheels in Valve Setting

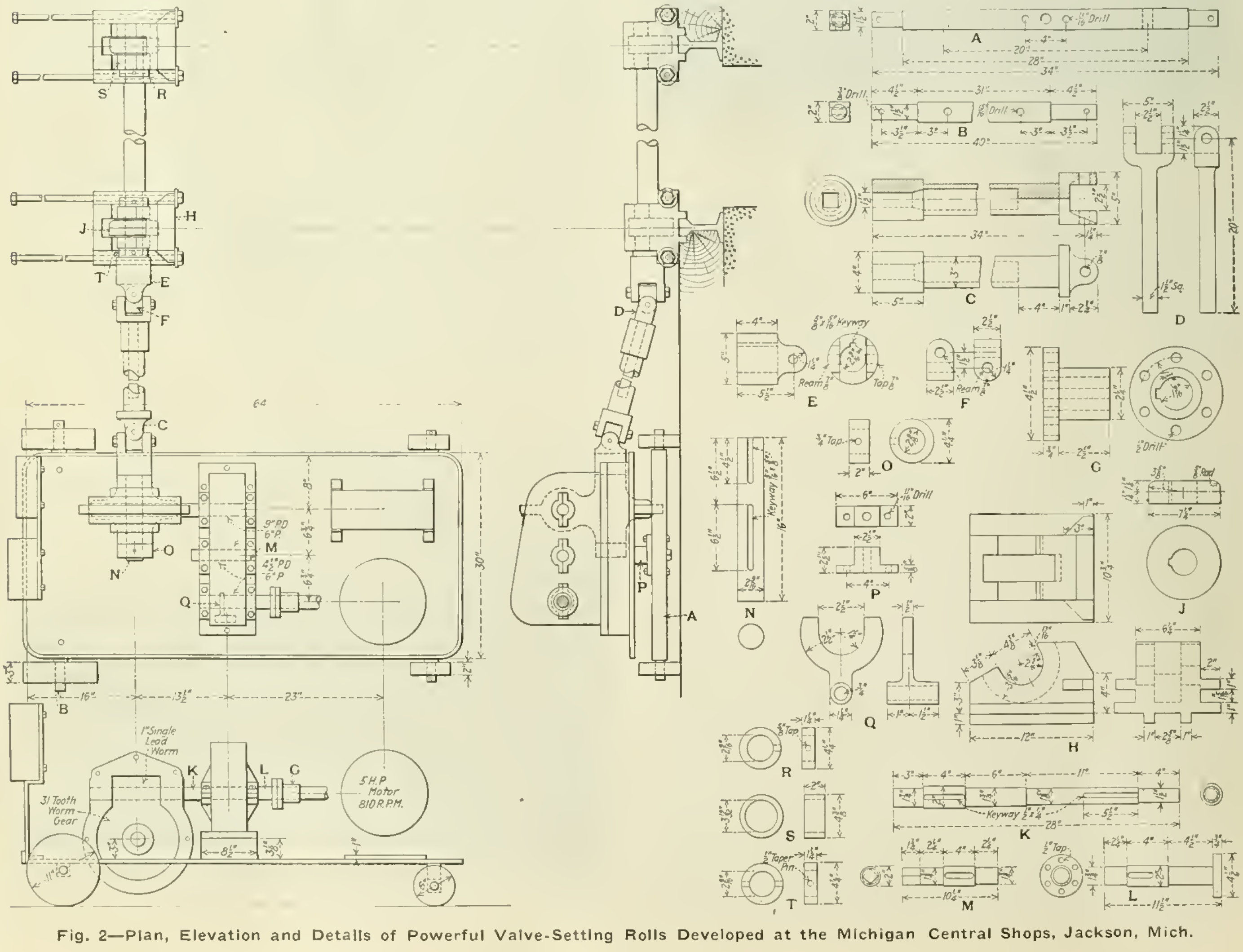


Fig. 2—Plan, Elevation and Details of Powerful Valve-Setting Rolls Developed at the Michigan Central Shops, Jackson, Mich.

easily about the shop with larger wheels, but experience showed that it was necessary to have the entire power unit as low as possible.

The rugged design of the universal joint is evident from the illustration. Another point worthy of attention is the comparatively large rolls in contact with the driving wheels. These rolls are 7¼ in. in diameter and provide a larger arc of contact with the driving wheel tire than would be obtained with smaller rolls. It is stated that these rolls will turn the driving wheels without removing any of the weight on the driving boxes. The entire arrangement of power unit and rolls is the result of considerable experiment at Jackson, and the final design as illustrated seems to be entirely satisfactory.

Principles of Oxyacetylene Fusion Welding

Part 9—Welding Low Carbon Steel

By Alfred S. Kinsey*

LOW carbon steel is the easiest of all metals to weld except wrought iron, which is due to the fact that it is almost free of chemical impurities such as carbon, silicon, manganese, phosphorus and sulphur. The nearer the steel approaches pure iron the easier and better it can be welded. That is, it is less liable to be oxidized with a small percentage of chemical ingredients.

Worn Couplers Reclaimed by Oxyacetylene Welding

Step 1.—Use a flash joint for very thin steel. In the welding of thin steel the edges should be bent up about 1/16 in., thus forming what tinsmiths call a flash joint. The edges then should be laid closely together, making a butt joint, and their upright edges melted down flat. This takes the place of welding rod and prevents the weld from being thinner than the rest of the metal. No flux is needed. The thinnest sheet steel may be welded this way with the oxy-acetylene torch.

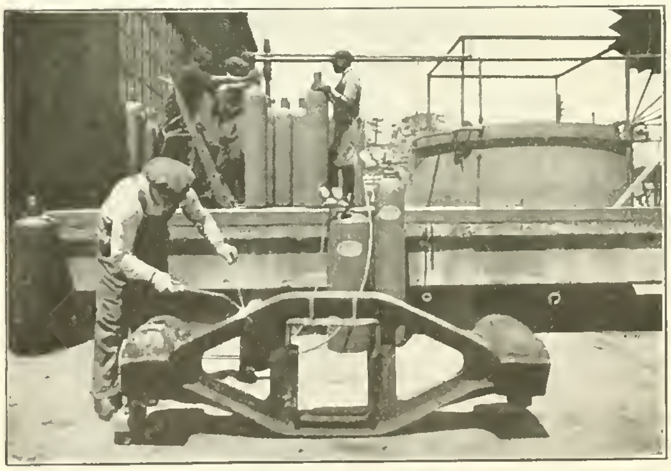
Step 2.—Use a butt joint for sheet steel. For 1/16-in. to ¼-in. sheet steel, all that is necessary is to place the edges together and weld them. No flash or rod is necessary, unless there should be a liberal collapse of the metal at the weld. Then a ⅛-in. pure iron rod should be melted down into the joint.

Step 3.—Use a single vee joint for light steel plate. For steel from about ¼ in. to ¾ in. thick the edges to be welded should be beveled at an angle of 45 deg. each, or a total of about 90 deg. between the edges to be welded. The bevel should end with a sharp edge at the botton. The vee formed by the two bevels is necessary in order that the metal may be melted from the bottom upward. If no vee was used the flame could not penetrate through the metal to the bottom without burning the surface metal which was melted first.

Do not place the edges closely together. Separate them from 1/16 in. to ⅛ in. so that the flames may lick the metal under the joint, and also so that any slag may flow down through and out of the joint. The strongest welds of this type are made by leaving the joint open and then tacking a butt plate under the joint about ⅛ in. away from the metal. This allows the slag and some of the clean metal to flow through the joint, and thus insure that the whole vee is filled with clean, strong metal. Of course the butt plate is removed after the weld is cold.

Step 4.—Steel should be double-veed for thick welds. Steel over an inch thick should have its ends veed from the top surface down to the middle and from the bottom surface up to the middle of the metal. This will make double vee, both of which can be filled with welding rod. On steel of ordinary thicknesses this may be quickly accomplished, but in the heavier sections, like the frame of a locomotive, for example, which might be 5 in. thick by 7 in. high, the welding should be done as fast as possible, and in order to do so both vees should be welded at the same time. That is, two welders should work at the job at a time, one in each vee, and it has been found that the most satisfactory way is to use three welders on that size job, one of the two welders being relieved about every 15 minutes by the third man.

Step 5.—Steel should be heated slowly to a red heat. In welding steel it might be assumed that because the oxy-acetylene flame has a temperature of about 6,300 deg. F., it should be used to heat up the ends to be welded as fast as possible. This would not be good metallurgy. No matter what is to be done to the steel, if it is heated to a bright red



Welding Tension Member of Truck Side Frame the heating should be done slowly until the metal has reached a bright red color, which corresponds to a temperature of about 1,200 to 1,400 deg. F., when the heating may proceed as rapidly as desired. The reason for this is that the flat-sided grains of steel are composed of crystals which are interlocked when the metal is cold, and which must be separated by expansion as the metal is heated. Slow heating allows the crystals to unlock without deforming them, and once they are separated rapid heating can do no harm. Then when the metal cools down the grains will fit flat side to flat side and the untorn crystals will reassemble as originally arranged, and the shrinkage of the metal will take place without the development of any of the shrinkage cracks sometimes found in a weld.

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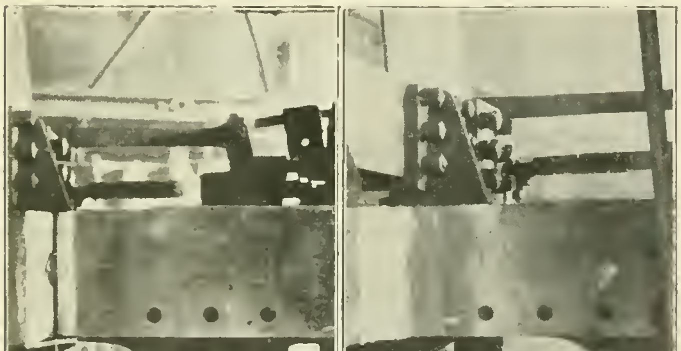
*Professor of shop practice, Stevens Institute of Technology; advisory service engineer, Air Reduction Company.

Step 6.—Steel welds should be thoroughly fused. Before attempting to melt the welding rod into the vee of a weld, the welder should be sure that the metal of the ends to be welded, called the base metal, is flowing. By that time the welding rod should have been slowly heated to the melting point. Then the two molten masses will run together and fuse satisfactorily. That is, when the whole molten mass is of uniform temperature, there will be an equal opportunity for all of the grains of the metal to come in contact with one another, they will fit snugly and there will be no unequal rates of cooling to form shrinkage cracks.

In welding thick steel it is common practice for the welder to use two ¼-in. rods side by side rather than one thicker one which would be harder to melt.

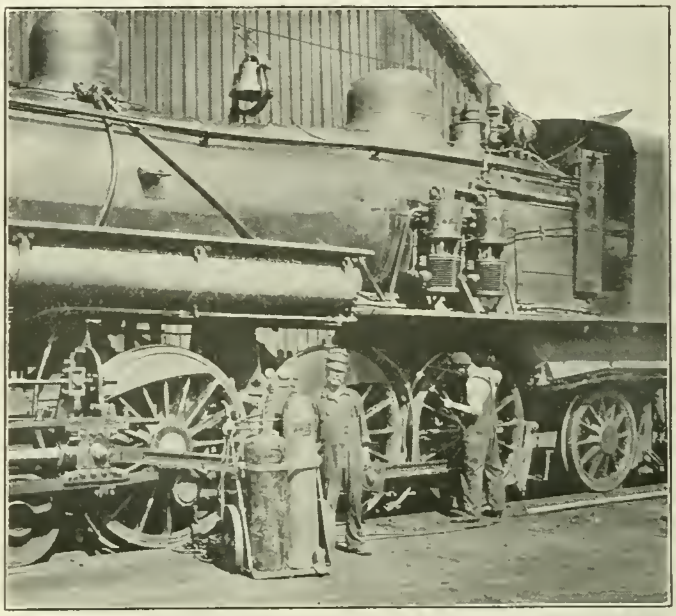
Step 7.—Steel welds should be hammer refined. It should be remembered that when a steel forging or a piece of rolled steel bar is welded by fusion the metal is melted in the vee and then allowed to become cold and solid. The metal therefore has been changed from a fine-grained forging to a coarse-grained casting, and thereby it has lost from 10 to 25 per cent of its tensile strength. This can be mostly overcome by hammering the weld after the metal has cooled from the liquid condition to a bright red color.

The reason why the steel in the cast condition is weaker than when it is in the hammered or rolled state, is that when it is allowed to cool from the liquid condition to the solid the grains do not shrink to their former size, nor do they go back so closely together. The grains of steel are flat-sided, and the strength of the metal depends largely on these sides being brought in close contact so that the law of attraction which holds them together will not be interfered with. In addition to this, each grain is composed of crystals which arrange themselves somewhat like a fern leaf, each group fitting into the next one so that they are uniformly distributed and closely in touch. Now when heat is applied to a piece of steel its crystals gradually unlock and separate, which causes the grains to enlarge and pull away from the adjoining grains, thus enlarging the whole piece of metal. This is called the expansion of steel, and amounts usually to about 3/16 in. per foot of length.



Broken Locomotive Frame Before and After Welding

If the steel is heated to the liquid state, the attractive power between the grains will be almost all gone and the air may get into the metal and form a thin scale of oxide between the grains. Then when the metal cools to the solid condition the attractive power is reduced because of the poor contact of the grains, and in addition to this the crystals do not go all the way back to their original position of interlocking. The whole piece of steel therefore is weakened.



Building Up Sharp Driving Wheel Flange

Now if after a weld of steel is made the metal is allowed to cool to a bright red and is then hammered well with a regular blacksmith or machinist hammer, the oxides will be forced from between the grains, the grains will lie in closer contact, and the jar from the hammer blows will cause the crystals to go back almost to their original position, thus making the grains smaller. This is called *hammer refining* steel, and it similates the condition under which the steel forging or rolled bar steel was made before it was welded. It is well known that the finer the grains of steel the stronger will be the metal. For example, if a piece of soft tool steel is heated to a bright red and then immersed quickly in cold water its grains will be refined to about half their former size, and the tensile strength of the steel will have increased about 25 per cent. But of course as the low carbon steel weld cannot be heat treated this way, its grains must be hammer refined. It is to be remembered that only a few metals will stand hammer refining. Cast iron will not take any hammering at all.

Step 8.—Steel welds should be reheated. After the completion of a good size weld of steel it should be reheated to a dark red color, about 1,000 deg. F., until thoroughly heat-soaked, then covered with sheet asbestos to insulate it from the air, and allowed to cool slowly. This will bring all of the grains of the steel to an equal temperature and thereby relieve any unequal strains between the grains which might have been caused by the weld cooling at unequal rates. Once the piece of steel is uniformly heated and the strains equalized the good results can be retained only by unheating the whole job at a slow, constant rate. In ordinary work this can be satisfactorily accomplished by covering with asbestos. It is true that but very little of this reheating has been practiced so far, but it is also true that some welds have developed cracks when cold which the welder could not explain. The reheating of a big steel weld may be economically done by the use of a big burner using kerosene or fuel oil or some cheap gas.

Step 9.—Steel welds should be annealed. This may be accomplished by heating the whole job to a bright red color, about 1,400 deg. F., and allowing it to unheat very slowly while in a charcoal pack. It will be noticed that this is an operation for the annealing or softening of the weld which is quite different from relieving unequal granular strains. To anneal a piece of steel means to change the nature of its carbon. When a weld is being made and the metal is changed from the solid to the liquid state all of the carbon in the steel takes the form of cementite carbon. Then if the liquid metal is allowed to change back slowly to the solid condition the cementite carbon transforms to its usual nature in solid soft steel of pearlite carbon. But if, as often happens, parts of the weld are allowed to cool quickly and irregularly, only part of the hard cementite carbon goes back to pearlite carbon, and the metal will be hard and soft in spots. The hard spots may be filable, but they are nevertheless too hard to harmonize with the soft metal, and the whole job should be uniformly annealed. Therefore the metal must be heated past what is known as the recalescent point (about 1,400 deg. F.), which is the point of retransformation of the cementite carbon to pearlite carbon, and then unheated very slowly by being packed in crushed hardwood charcoal.

Notice that the color and temperature for annealing are a bright red and about 1,400 deg. F., while those for relieving granular strains are a dark red and about 1,000 deg. F. These temperatures are not hard to approximate. The annealing temperature of 1,400 deg. F. may be exactly determined by testing the metal with a small horse-shoe magnet. When the recalescent point is reached steel is non-magnetic and it will not attract a magnet.

Step 10.—Steel welding rod. When a piece of steel is veed preparatory for welding care should be taken to see that the vee is filled with metal of the same nature and physical characteristics as the original bar, called the base metal. For example, if the steel has a tensile strength of 50,000 lb. per square inch the weld metal should have about the same strength and this would be determined largely by the character of the rod fed into the weld.

It is well known that if a welding rod is of exactly the same chemical composition as the base metal the resulting weld will be weaker than the base metal. For example, it has been attempted to weld worn locomotive driving-wheel tire flanges with turnings from the same kind of tires, but the welds were so inferior that they failed. It is also a well known fact that to use a piece of steel sheared from a piece of boiler plate, to weld that same boiler plate, will make a weld weaker than the base metal.

It is recognized therefore that welding rod must be made with its chemical elements so selected and proportioned that the completed weld will be as strong as the original bar.

Now even though welding rod is made of proper chemical and physical characteristics to produce good welds, such precautions may be made valueless by improper handling of the rod by the welder. When a weld is being made the bottom and sides of the vee first should be thoroughly melted and a pool formed, and then the rod melted down into the molten mass. This will make good fusion and a satisfactory weld. Care should be taken not to let the rod melt and run down on the metal of the vee before the vee is melted and flowing at the bottom.

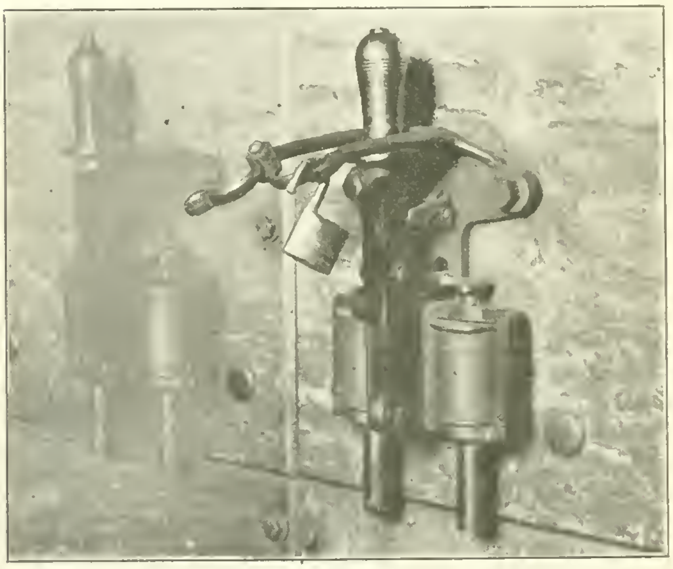
Again the best results may be obtained by using the welding rod a little as a puddle-rod to stir up the molten metal sufficiently to allow the oxides to float to the surface and be taken out of the weld.

In big steel welds it is better to use two [illegible] rods held side by side and melted at the same time, than to use one bigger rod. The melting of the smaller rods will be more easily controlled.

It will therefore be seen that so far as welding rods are concerned they should be carefully selected for chemical and physical properties, and that they then must be fused properly into the vee.

Safety First for Crane Repairmen

THE illustration shows a safety device designed to prevent accidents to shop employees while repairing cranes. The switch, shown at the right in the illustration, is in the main circuit to the electric traveling shop cranes. In case of a crane breakdown, the man who is to make inspection or repairs goes to the powerhouse, opens this switch and locks it in the open position by means of the padlock, shown, and a key given to him by the power plant engineer. He retains this key while necessary crane repairs are being made, and it is impossible for anyone to close the switch, accidentally or otherwise, and possibly kill whoever is on the crane at the time.



Lock for Crane Switch in Power House

After the crane repairs have been completed the man in charge of the work returns to the powerhouse and unlocks the switch with his own hands, the engineer then throwing in the switch. This relieves the power plant engineer of responsibility and insures that no workmen are on the crane when power is turned on. While the crane switch lock may seem an unnecessary precaution, the fact of the matter is that accidents of the kind mentioned have actually occurred. The bracket and lock arrangement, illustrated, affords a positive means of preventing such accidents.

Problems in Hardening Steel

ONE of the most fascinating and yet obscure subjects in ferrous metallurgy concerns the problem of hardening steel by a suitable quenching treatment and subsequently tempering it by slight heating. The interest is centered around the hard constituent or structural condition, known as martensite, the name being derived from the noted German metallurgist, Martens. An investigation, recently completed by the Bureau of Standards, Washington, D. C., has a bearing on this general subject, and the results are published in scientific paper No. 452, entitled "Structure of

Martensitic Carbon Steel and Changes in Microstructure Which Occur Upon Tempering."

The study with which this paper deals was based upon the microstructure of a series of steels of progressively increasing carbon content, when hardened under different conditions of temperature and heating periods, and the changes in structure which ensue in them upon careful tempering.

Practically nothing is gained in hardness by using very high temperatures or very long heating periods prior to the quenching of steel, provided that the "critical" temperature is exceeded upon heating. This conclusion was based upon small specimens treated in the laboratory; in practice, of course, allowance must be made for the size and shape of the pieces treated. The general conclusion is valid, however.

The changes which take place in a hardened steel upon tempering occur in well-defined stages. Until the temperature of reheating exceeds 250 deg. or 300 deg. C. (480 deg.—570 deg. F.) no marked change is to be noted in the visible microstructure, even at very high magnification, although pronounced changes in the dimensions and density often do take place even at such low temperatures. Above 250 deg. C. the separation of the carbon-bearing compound, cementite, from the martensite begins and at 400 deg. to 500 deg. C. (750 deg.—930 deg. F.) the steel shows a very fine granular structure under the microscope. As the temperature of reheating is increased, the granules increase in size, although a high magnification is still required for seeing them, and the steel becomes softer and finally loses all of the high tensile properties it gained by the hardening treatment.

Hose-Clamping Press

In most railroad shops it becomes quite a problem to keep the air hose in good condition for use in the various departments. New hose has to be fitted up, fittings which have blown out reapplied, and defective hose sections cut out. This work is usually done in the toolroom and unless some labor-saving method is developed, one or more men will be employed continuously repairing hose.

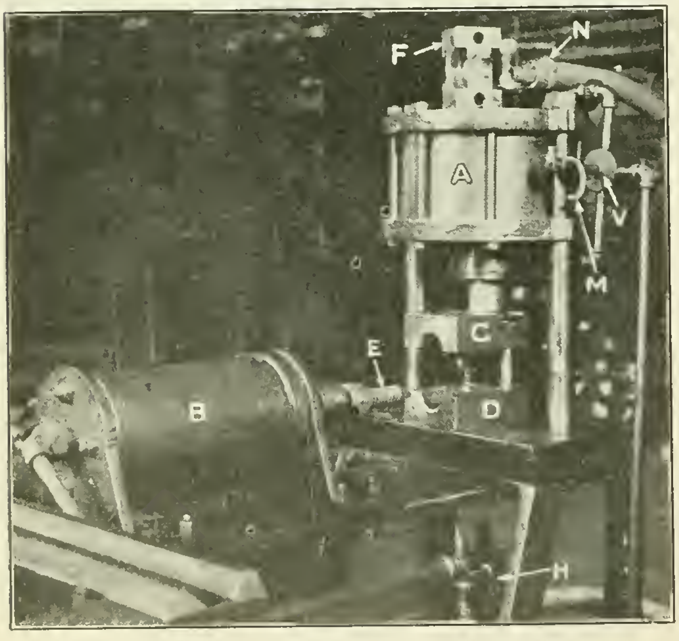


Fig. 1—An Effective Home-Made Hose-Clamping Press

A special hose-clamping press designed to facilitate hose repairs has been developed at the McKees Rocks shops of the Pittsburgh & Lake Erie as shown in Fig. 1. The device consists of an 8-in. cylinder *A* with an effective stroke of 2½ in. placed vertically in the frame work shown. The horizontal cylinder *B* is 4½ in. in diameter with an effective stroke of 6 in. Both of these cylinders are rigidly fastened in the frame work, being operated by three-way valves, one of which is shown at *V* and the handle of the other at *H*. The piston in cylinder *B* is returned after each stroke by means of a spring.

In assembling the nut and swivel in a length of hose, the dies *C* and *D*, shown in detail in Fig. 2, are used, the nut and swivel being held on an extension of the piston rod at *E*. The hose is next placed between dies *C* and *D*, being firmly gripped in the smaller section of the die at the right as soon as the dies come together. Operation of cylinder *B* forces the swivel *E* into the hose with far less effort and in a much shorter time than could be done by hand.

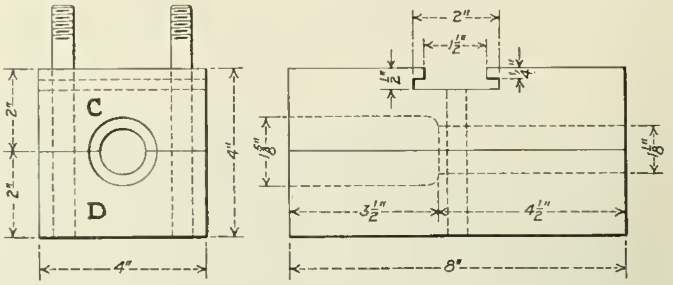


Fig. 2—Dies Used in Assembling Hose and Fittings

It also enables a relatively larger swivel to be forced into the hose than would be otherwise possible and the result is that when the clamp is applied there is less chance of a leak.

The hose, swivel and nut being assembled, the next operation is to apply the clamp. The more common form of clamp consists of some form of circular band usually tightened by means of a small bolt and nut. The practice at McKees Rocks is to substitute for this clamp one made of ¼ in. round iron long enough to go completely around the hose and lap over possibly one inch. Such a clamp before and after application is shown at *M* and *N* in Fig. 1. To apply this clamp, dies *C* and *D* are removed from the machine, dies *F* and *G* being substituted. The construction of these dies is clearly evident from Fig. 3, and their operation by means of cylinder *A* presses the clamp firmly about the hose, when it has sufficient stiffness to resist any tendency of the nut and swivel to pull out.

Two sizes of hose, namely the ½ in. and ¾ in., are used, necessitating two sizes of each pair of dies. The clamps are made out of ¼ in. stock, 2½ in. and 3⅜ in. long respectively, bent in a circular form as shown at *M*, Fig. 1. Before the use of this hose-clamping press it took one operator practically all the time to keep the hose repaired at this shop. One man can now do this work in about one hour a day.

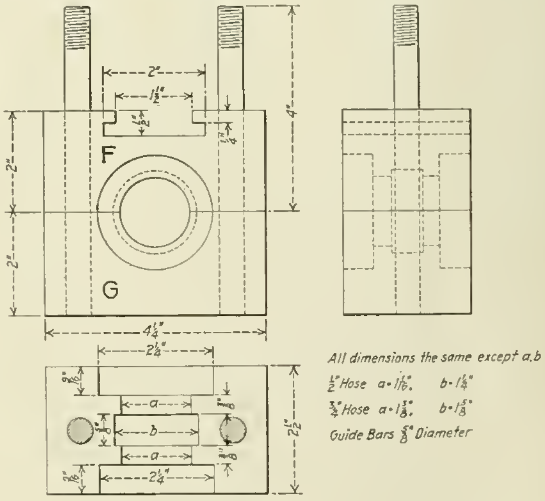


Fig 3—Dies Used in Applying Hose Clamps

Boring Cross Compound Air Compressor Cylinders

Need for Smooth, Accurate Cylinder Boring Pointed Out; Special Holding Bracket and Cutters Described

ONE of the railroad shop machining operations which requires a high degree of accuracy and finish is reboring worn air compressor cylinders. Unless these cylinders are true, and have a smooth finish, it will be impossible to fit piston packing rings in such a way as to avoid excessive air leakage past the rings and consequent loss of compressor efficiency.

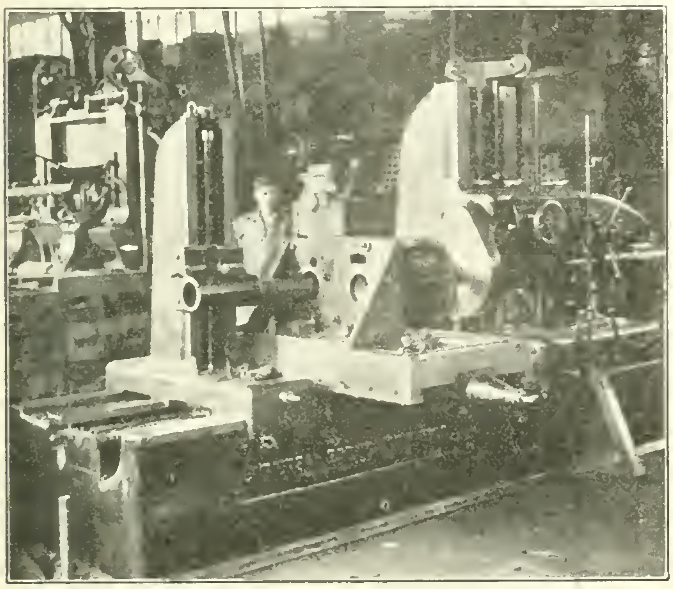


Fig. 1—Modern Boring Machine Set Up to Bore Air Cylinders

Strictly speaking, the re-truing of worn air compressor cylinders should be a grinding operation but if a suitable grinding machine is not available the next best type of tool for the job is a modern, heavy, accurate, easily-operated boring machine of either the vertical or horizontal types. Such a boring machine of the latter type is illustrated in Fig. 1, having been installed only recently in a prominent railroad shop.

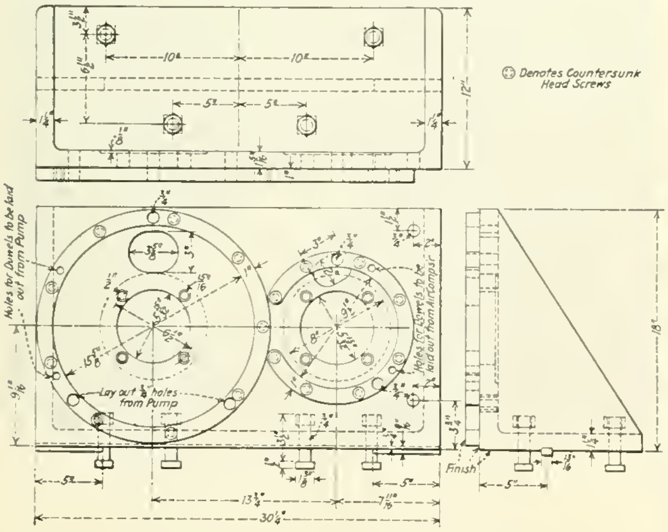

Denotes Countersunk Head Screws
Holes for Dowels to be laid out from Pump
Holes for Dowels to be laid out from Air Compr.
Lay out ⅝ holes from Pump
Finish
13¾"
7 11/16"
30¼"
18"
12"

Fig. 2—Details of Cylinder-Supporting Bracket

In addition to air compressor cylinders being true and smooth individually, it is highly essential that the upper and lower cylinders be in exact alinement. Otherwise there will be trouble with piston packing rings and piston rod packing. Also, in the case of duplex and cross compound compressors, cylinder center lines must be the standard distance apart or the cylinders will not be interchangeable. Both of these difficulties were experienced on the railroad referred to, and by careful checking, it was discovered that the cylinders were frequently not in exact alinement and center lines not a standard distance apart, owing to an accumulation of errors in reboring.

As a result of this discovery, it was decided to bore air compressor cylinders on as modern and highly accurate a machine as there was in the shop, using a special cylinder-holding jig or bracket which would insure all cylinders being bored alike and according to the original standard. The machine selected for this job is shown in Fig. 1, with the bracket bolted to the work table and a cylinder in place ready for boring. Details of the bracket, designed to accommodate Westinghouse 8½-in. cross compound cylinders, are shown in Fig. 2.

Referring to Fig. 2, this bracket is cast in the form of a knee, the vertical face being planed square with the work table and maintained square with the boring bar by two 13/16-in. keys. The bracket is rigidly bolted to the work table by four ¾-in. bolts and nuts. The cylinder cannot be bolted directly to this bracket on account of the cutter bottoming, so one complete ring and a smaller partial ring of 1-in. square iron, accurately machined, are secured to the bracket by countersunk head screws as illustrated.

Four dowel holes in these rings, an exact reproduction of the dowel holes on a standard center casting, position the cylinder accurately with respect to two 5 15/32-in. center holes. These center holes are spaced 13¾ inches apart on centers, or the standard distance between high and low pressure cylinder center lines.

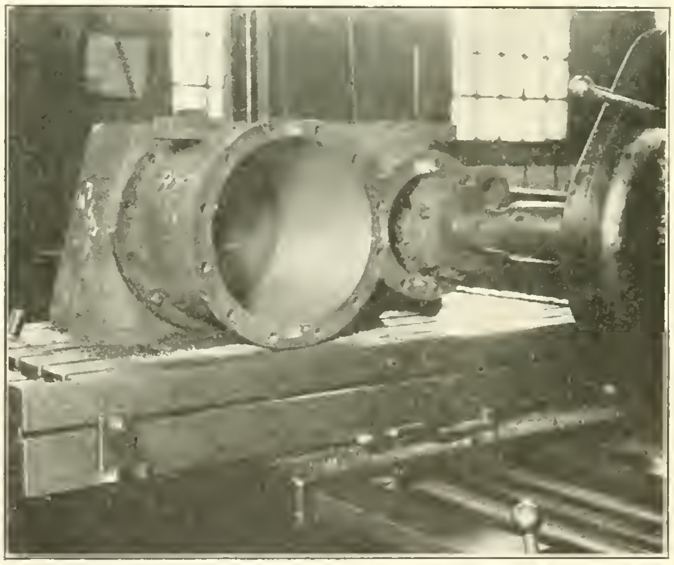


Fig. 3—View Showing Start of Cut in High Pressure Cylinder

From the foregoing it is evident that a machinist can quickly hoist a cylinder into place, position it on the dowels and bolt it to this bracket, being sure without any testing that it is square with the work table and the boring bar.

In addition, if the boring bar is centered in the 5 15/32-in. holes before boring, the resulting cylinders will be the standard distance apart and correctly located with respect to dowel and bolt holes. It was originally proposed to support the outer end of the boring bar in special bearings, bolted to the bracket and accurately centered in the 5 15/32-in. holes, thus avoiding any calipering whatever in the set-up. However, this practice was discontinued in favor of guiding the boring bar in its usual outboard support. In any case it is far easier and more accurate to center the boring bar in the correctly-located bracket holes rather than in large and frequently inaccurate cylinder counterbores.

Two special boring cutters are used on this job, a close-up of the bracket and cylinder with one of the cutters just starting a cut in the high pressure cylinder being shown in Fig. 3. Fig. 4 shows details of both the low and high pressure cylinder boring cutters. Referring to Figs. 3 and 4, the substantial construction of the cutters is apparent. They are designed with sufficient excess weight and strength to practically eliminate vibration. They are made of steel with four adjustable cutting tools, being keyed to the boring bar in each case by two large set screws.

As previously stated, the time of setting up air compressor cylinders on this jig is reduced to a minimum; the cylinders are set up accurately; and ample provision is made for centering the boring bar accurately. With substantial boring cutters, removing metal at four points simultaneously, the result is an extremely smooth and accurate cylinder. Two cuts are usually required, just enough material being removed to true the worn cylinders. It takes approximately two hours to set up and bore a pair of cylinders, a roughing and finishing cut being taken in each.

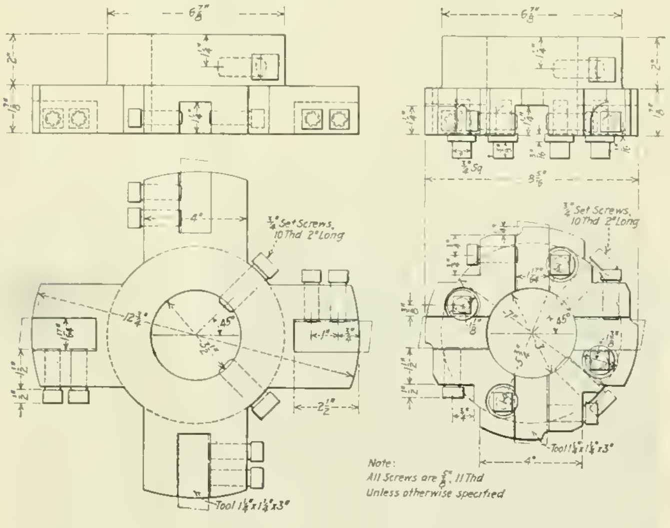

6 5/8"
6 5/8"
4"
3/8" Set Screws, 10 Thd 2" Long
3/8" Set Screws, 10 Thd 2" Long
12 3/4"
45°
45°
1"
2 1/2"
3/4" Sq
3 5/8"
4"
Tool 1 1/4" x 1 1/4" x 3"
Tool 1 1/4" x 1 1/4" x 3"
Note: All Screws are 5/8", 11 Thd Unless otherwise specified

Fig. 4—Details of Low and High Pressure Cylinder Boring Cutters

Difficulty in maintaining air compressor piston packing rings and piston rod packing has been largely overcome by boring cylinders in the manner described on the horizontal boring machine. This machine has also proved its value in the shop where it is installed by relieving a serious congestion of boring work. It is used for boring ash pan hopper cylinders, main extension driving boxes, side rod bushing holes and other boring jobs. It is also used occasionally with special forming cutters for machining steam pipe joints, milling piston rod keys and other similar work.

Machine-Forged Safety Chain Bolts

THE cost of forging safety chain bolts by hand in the blacksmith shop would be excessive and, inasmuch as large numbers of these bolts are required, it is a paying proposition to make special dies and manufacture them in quantity on forging machines. Standard safety chain bolts are thereby obtained at an important reduction in cost.

The right-hand half of a set of dies for making safety chain bolts is illustrated in Fig. 1 and a pile of finished bolts in Fig. 2. These bolts are made in a 2 1/2-in. forging machine at the rate of about 30 per hour. The first operation, after cutting stock to the right length, is to heat and bend it by hand around a suitable pin in an anvil, forming the eye, as shown by one of the vertical bolts in Fig. 2. The bolt is then reheated, upset in the forging machine and the collar welded and formed. At the time this photograph was taken the eyes were hand-formed, causing more or less variation in the stock left over at the bend. As a result, the forging operation left considerable flash which had to be removed with a handle chisel and sledge. By the use of a suitable pneumatic or power-operated jig for forming the eyes, the same amount of stock would be left over in each case and a practically perfect safety chain bolt with little or no flash could be secured.

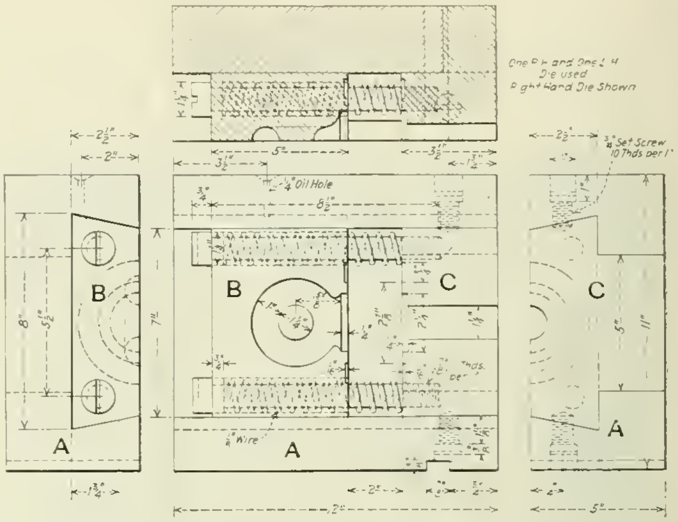

One R. H. and One L. H. Die used Right Hand Die Shown
1/4" Set Screw 10 Thds per 1"
1/4" Oil Hole
1/8" Wire
A
A
A
B
B
C
C
2 1/2"
2"
5"
3 1/2"
3 1/2"
1 1/2"
6 1/2"
8"
7 1/2"
11"
5"

Fig. 1—Right-Hand Half of Die for Forming Safety Chain Bolts

Referring to Fig. 1 the construction and operation of this die will be evident. The right-hand half, illustrated, consists of body *A* with sliding part *B* to form the head of the bolt, and stationary part *C* to grip the stock while being upset. Part *B* moves in carefully fitted taper ways, being held by two 7/8-in. by 8 1/2-in. filister head bolts and returned at the end of each stroke by the coil springs shown. An oil hole is provided by means of which sliding part *B* can be lubri-

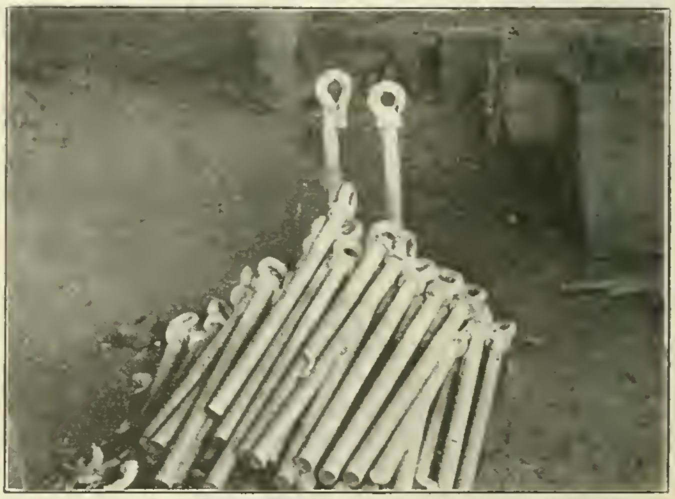


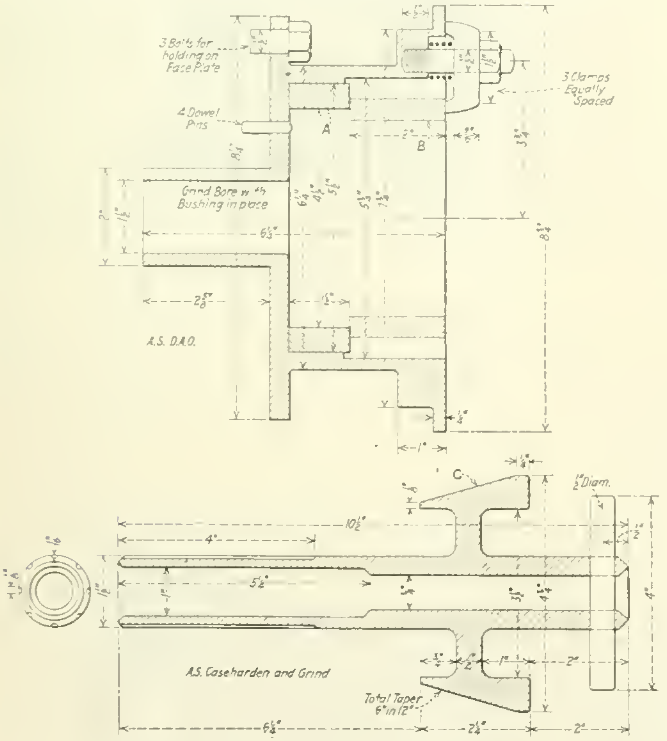
Fig. 2—Finished Safety Chain Bolts; One Bolt, With the Eye Formed Previous to Upsetting, Shown

cated, insuring its easy movement without sticking or undue wear.

Part *C* is accurately fitted to body *A* (shown by the right end view) and held securely to it by two ¾-in. set screws. It will be noted that the shoulder on the bolt is formed by a suitable recess, part of which is in *B* and part in *C*. In operation, the partly-formed bolt is reheated to a welding temperature and inserted in the forging machine with the eye in position in part *B*. The moving left-hand die (a counterpart of the one illustrated) moves to the right and grips the bolt at the shank between the two halves of part *C*. Operation of the forging machine ram then forces moving part *B* against *C* compressing and welding 2 in. of stock and forming the desired shoulder.

Internal Grinder Centering Chuck

THE drawing below illustrates an attachment for centering and holding bushings for internal grinding on a chucking grinder. The body of this chuck, which is bolted on the face plate, has three clamps as shown for holding the bushings. Removable rings inserted in the chuck provide the proper support for bushings of varying diameters and lengths. For example, ring *A* is the size used with bushing *B*. The arrangement for centering the bushings is especially interesting. The bushing is placed in the chuck and before it is clamped, the conical mandrel *C* fitting the bushing is inserted. This mandrel has a straight stem which fits an accurately ground center hole in the body of the chuck. As the mandrel is pushed in, it locates the bushing, bringing it to a central position after which it is held by tightening the clamps. The mandrel is then removed and the interior of the bushing is ground.



Special Chuck and Mandrel for Centering Motion Work Bushings To Be Ground Internally

Suggestions for Thermit Welding

THE following suggestions and recommendations not previously published in instruction books on Thermit welding will be of interest to welders engaged in making repairs to heavy sections made by this method. Locomotive frame welders in particular will find the suggestions of practical value.

Making Pattern Wax Plastic: In previously published directions for making plastic the yellow pattern wax to be applied between sections to be joined by Thermit welding, it was recommended that the wax should be placed in a pan and warmed until it became plastic, or else melted entirely and allowed to cool until it became plastic. Another way of making wax plastic, which has been found very satisfactory, is to pour the melted wax in a small stream into cold water. Very shortly thereafter it can be removed with the hands and the water squeezed out. It then will be found sufficiently plastic for use.

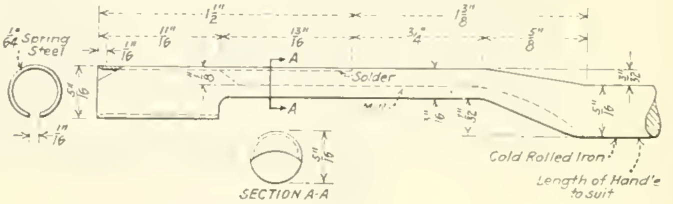
Connecting Top of Pouring Gate and Riser: After hollowing out a basin in the top of a rammed up mold, a channel or trough should be cut in the top surface of the mold, connecting the top of the pouring gate and the top of the riser. This will cause the first slag, overflowing on top of the mold, to quickly run across to the riser and thus while the metal is very liquid, equalize the pressure on the pouring gate und the riser.

Use Liquid Fuel, Not Gas, for Preheating in Thermit Welding: The use of gas for preheating in Thermit welding should be discouraged because in order to properly preheat a section in a mold without badly burning away the preheating gate, it is necessary to use vaporized liquid fuel (gasoline or kerosene) which can be blown into the mold as such a velocity that the location of the flame can be varied at will. Thus by increasing the velocity at the end of the burner pipe, the lower part of the frame can actually be cooled down and the upper part heated. The flame at all times can be so regulated that the heating gate will be dried out but will not be burned. This is not the case with any gaseous fuel, whether it be natural gas or illuminating gas, etc., and in all such cases the flame will either start at the end of the burner pipe, or will be blown completely out. This mass of flame passing continually through the restricted heating gate during the entire preheating operation is bound to do considerable harm, and in all cases the lower part of the mold and the section being preheated will be at considerably higher temperature than the upper parts.

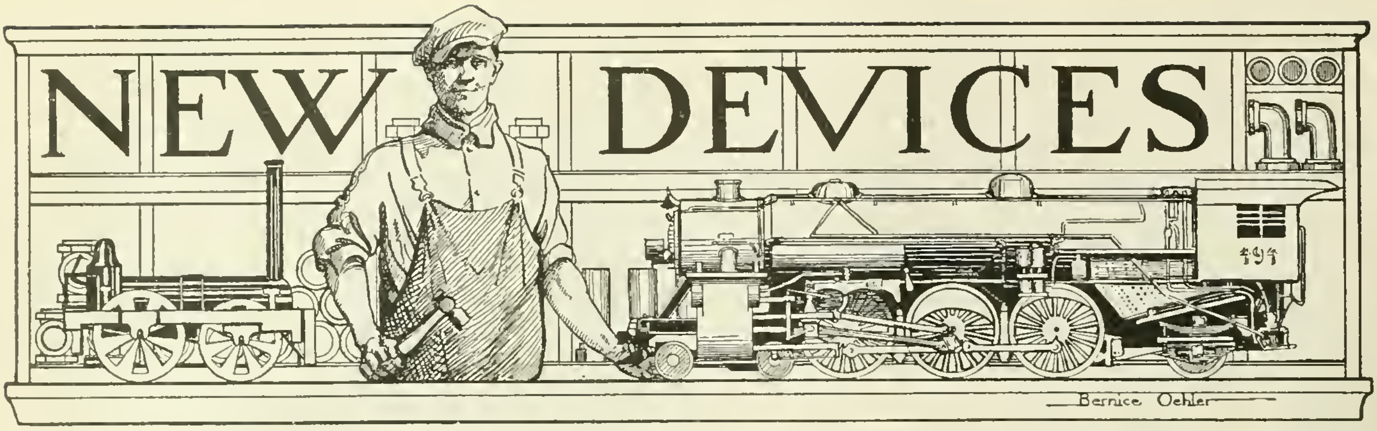
Character of Flame in Preheating: Too rich a flame during the early part of preheating may not be harmful, but especially toward the end care should be taken that no excess oil be used, so that the lean flame will tend to burn out from the molding material any oil which may have penetrated during the early part of the preheating.

Removing Reversing Valve Rods

ANYONE who has been obliged to take off the cylinder heads and piston head and take out the piston of an air compressor in order to remove a broken reversing valve rod, will appreciate the value of the device shown in the illustration. This is designed so that it can be inserted in the hole in the piston rod. The circular piece of spring steel on the end, when forced over the end of the valve rod, clamps it securely so that it can be easily taken out.



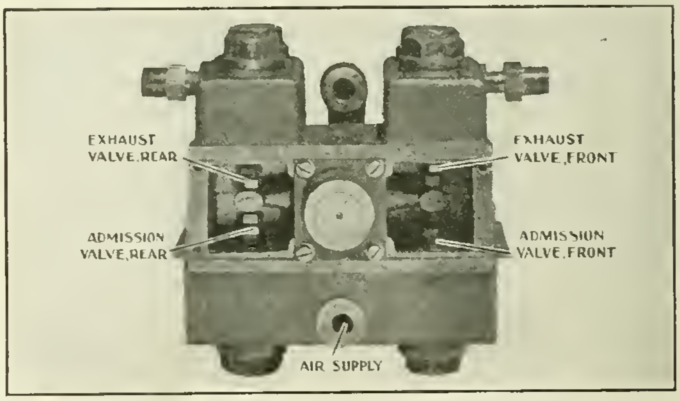
Convenient Device for Removing Broken Air Compressor Reversing Valve Rods Without Taking Off the Cylinder Heads



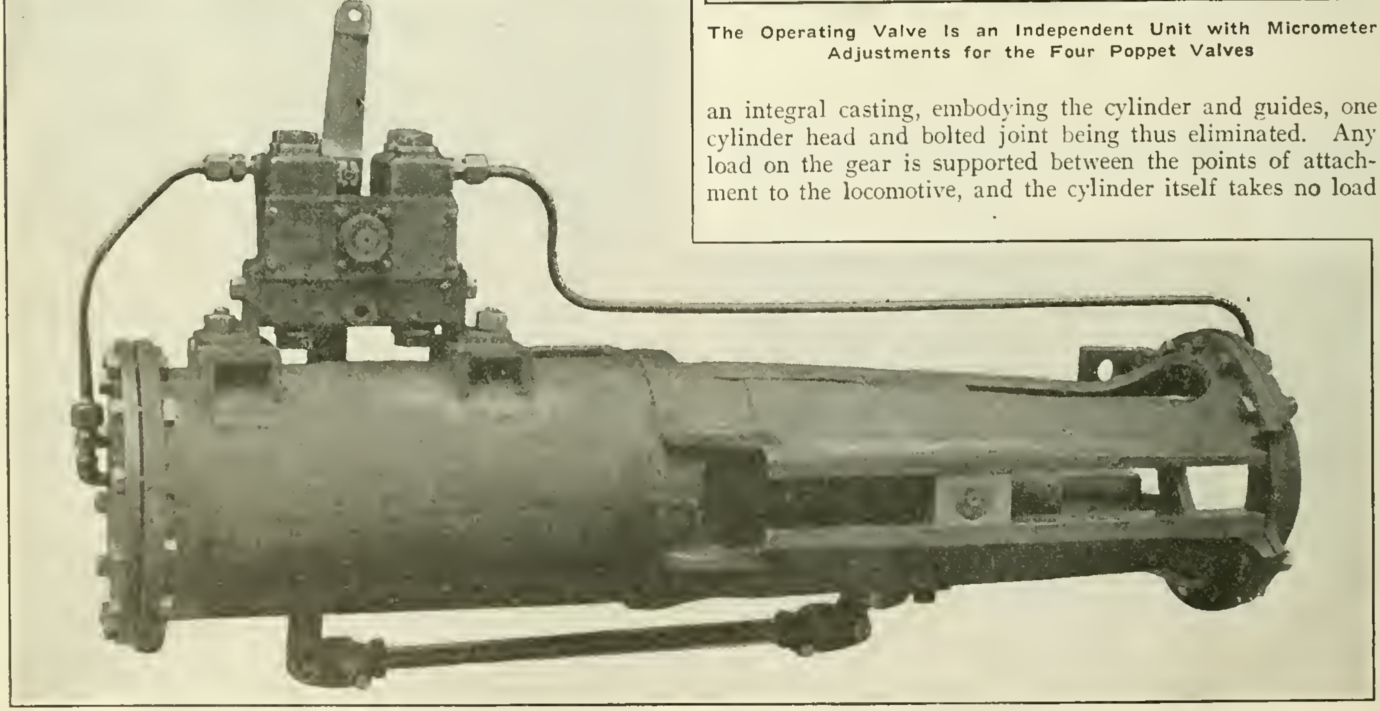
All-Service Locomotive Power Reverse Gear

THE All-Service power reverse gear is the result of developments extending over a period of about four years, during which the designers, the Transportation Devices Corporation, Indianapolis, Ind., carried on an extensive investigation covering all phases of the reverse gear problem. The concrete result has been the incorporation in this gear of certain features, the value of which has been amply demonstrated.

Desirable features of construction and operation claimed for the All-Service reverse gear include equal adaptability to passenger, freight or switching service, interchangeability with the majority of reverse gears now in service, and positive prevention of creeping. Fine adjustment, air cushioning is provided for passenger and freight service, and quick reverse, easy handling for switching service. In addition, stuffing boxes and glands are eliminated, and the operating valve is readily removable for repairs without removing the entire gear from the locomotive. Many of the parts subject to wear can be obtained from standard stock always carried by the railroads. The provisions made for lubrication are such that in this respect the gears require no attention from the enginemen.

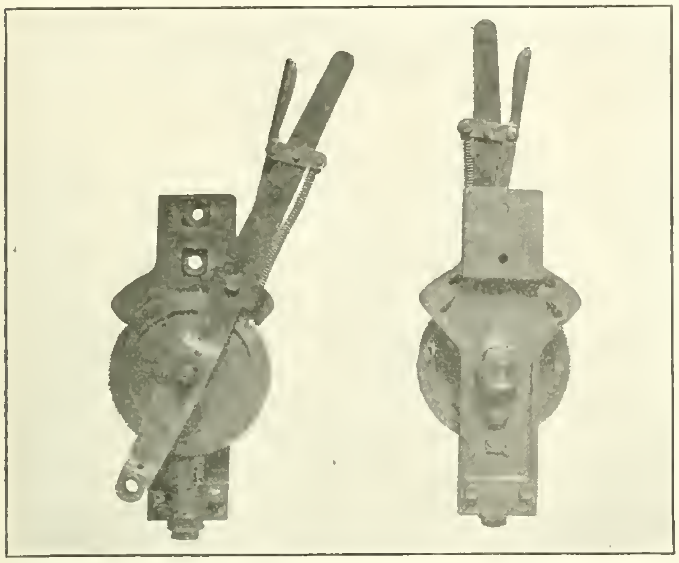


The Operating Valve Is an Independent Unit with Micrometer Adjustments for the Four Poppet Valves



All-Service Power Reverse Gear with Cylinder and Guides on Integral Casting

To obtain the above features, the body of the gear is made an integral casting, embodying the cylinder and guides, one cylinder head and bolted joint being thus eliminated. Any load on the gear is supported between the points of attachment to the locomotive, and the cylinder itself takes no load other than internal pressure. A floating cylinder, moving within the main body cylinder, and a fixed piston head are provided, thus eliminating the usual piston rod, crosshead, stuffing box and packing. By this construction the packing rings, or sealing medium, are subjected to air pressure in one direction only for each of the air pressure chambers of the gear. This permits employing the same methods and materials in successful use for years in packing air brake cylinders; cylinder leakage is reduced to the minimum; and there is no possibility of air leaking from one pressure chamber to the other. Furthermore, the absence of any piston rod or stuffing box as a contributory cause for leakage makes the gear proof against creeping due to instability of pressures.

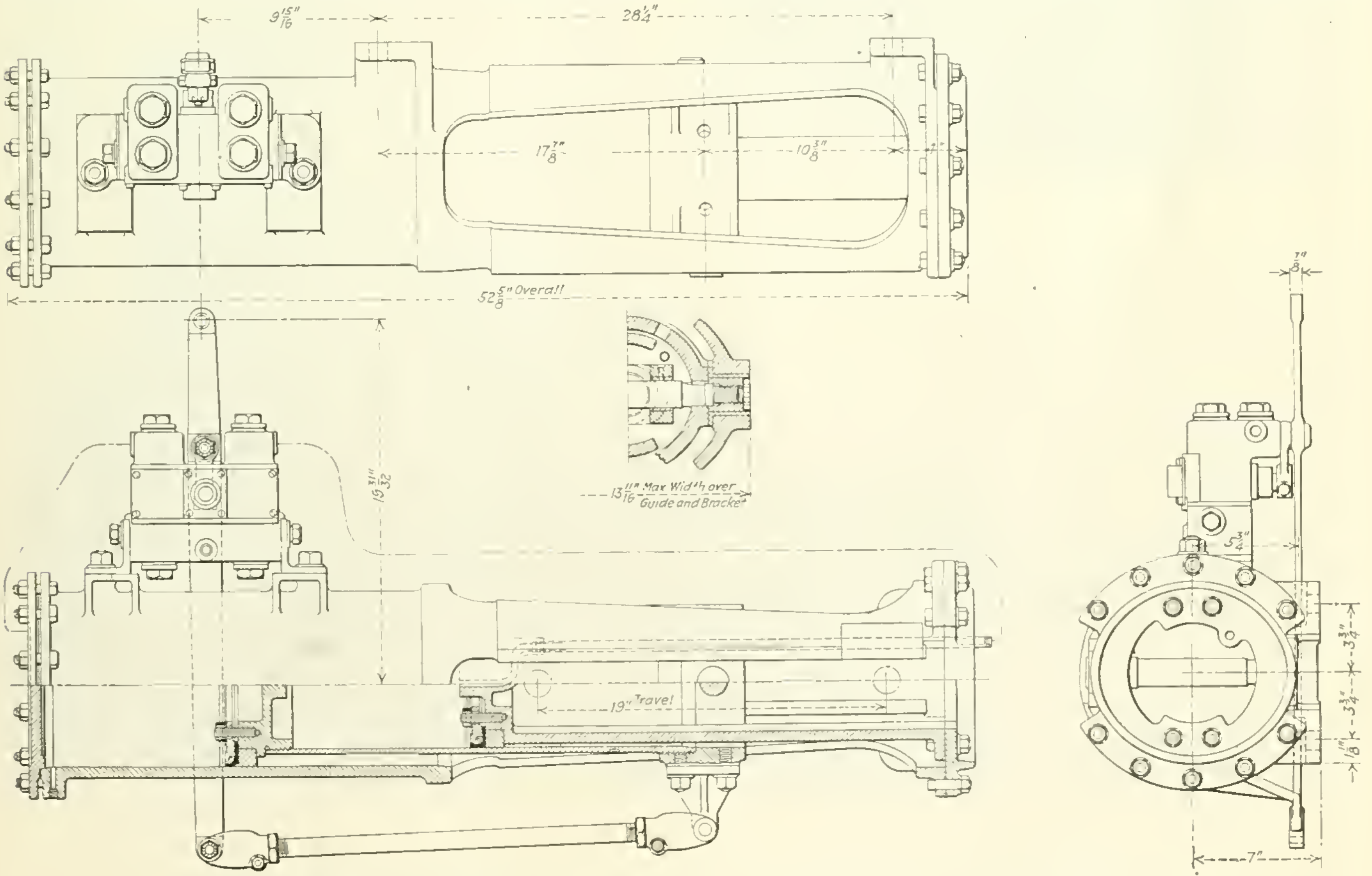

Reverse Lever with Fine Tooth Circular Quadrant

Lost motion of connection levers and bearings is one contributory cause to inaccurate reverse gear operation and in this gear, hardened steel pins and bushings are used throughout, all fits being ground. To insure long life of cylinder packing cups, the cylinder walls are also ground surfaces. Maximum accuracy and smoothness are thereby obtained with the reduction of air leakage to practically nothing.

The operating valve is applied as an independent unit on the gear, performing the same function as the triple valve with respect to the brake cylinder or reservoir. The four-poppet valve principle is employed to give long life to valves and allow separate adjustments of exhausts and admissions for each of the two air chambers. Micrometer adjustments are provided for each poppet valve to allow of independent clearance, or no clearance at all, and to make the gear sensitive to any adjustments that may be required, either because of the gear moving itself, or being moved by the engineman. It is apparent from the illustrations that this valve can be readily removed and taken to a bench for repairs, another valve being applied in the meantime without disturbing the gear or unduly delaying the locomotive.

Some unusual features are included in the reverse lever and especially the quadrant. A circular quadrant without stops is used to insure full travel of the level. The wear of the quadrant teeth with corresponding lost motion of the lever is compensated for in revolving a new set of teeth to the operating arc of the lever. V-notched teeth are used to make available a large number of adjustments. The notches and quadrant latch are so designed that the reverse lever can be placed in any cut-off position desired. The fineness of adjustment is determined by the fineness of the engineman's movement of the lever.

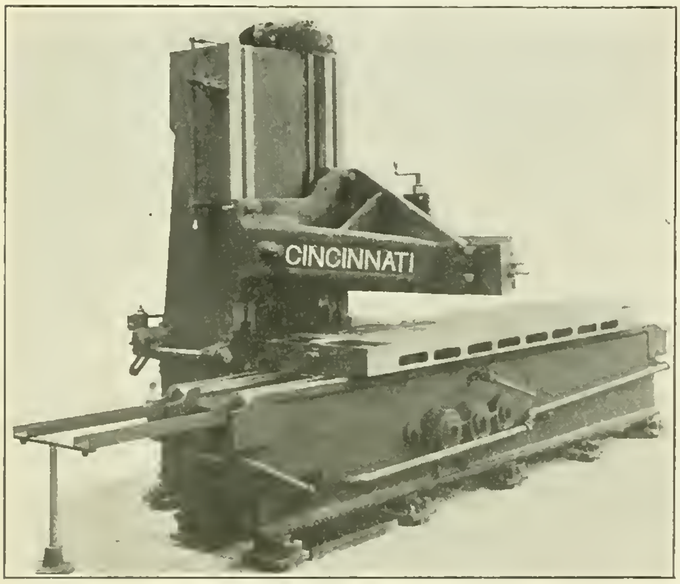
The valve and lever construction is such that the speed of the reverse gear crosshead is proportionally the same as the reverse lever, preventing "slamming" in reversing and "surging" when the slack is taken up. The pull on the reverse lever need be no greater than can be exerted by one hand, sufficient to open the valves, the power of the gear moving



Plan and Elevations of Gear, Showing, in Cross Sections, Details of the Floating Cylinder the lever. The air consumption is reduced to that required to fill the increment of volume from which the gear is adjusted. This reverse gear can be readily applied to locomotives with either high or low-hung reach rods, and it is especially designed to work with automatic control of cut-off.

Continuous service for three years without attention of any kind is the record established by one installation of All-Service gear. This gear is in service on high-speed Atlantic type passenger locomotives where convenience of adjustment and stability of cut-off are particularly essential. Several gears have been in use a shorter period and as yet have required no adjustments.

Open-Side Planer Adapted for Railroad Shop Work



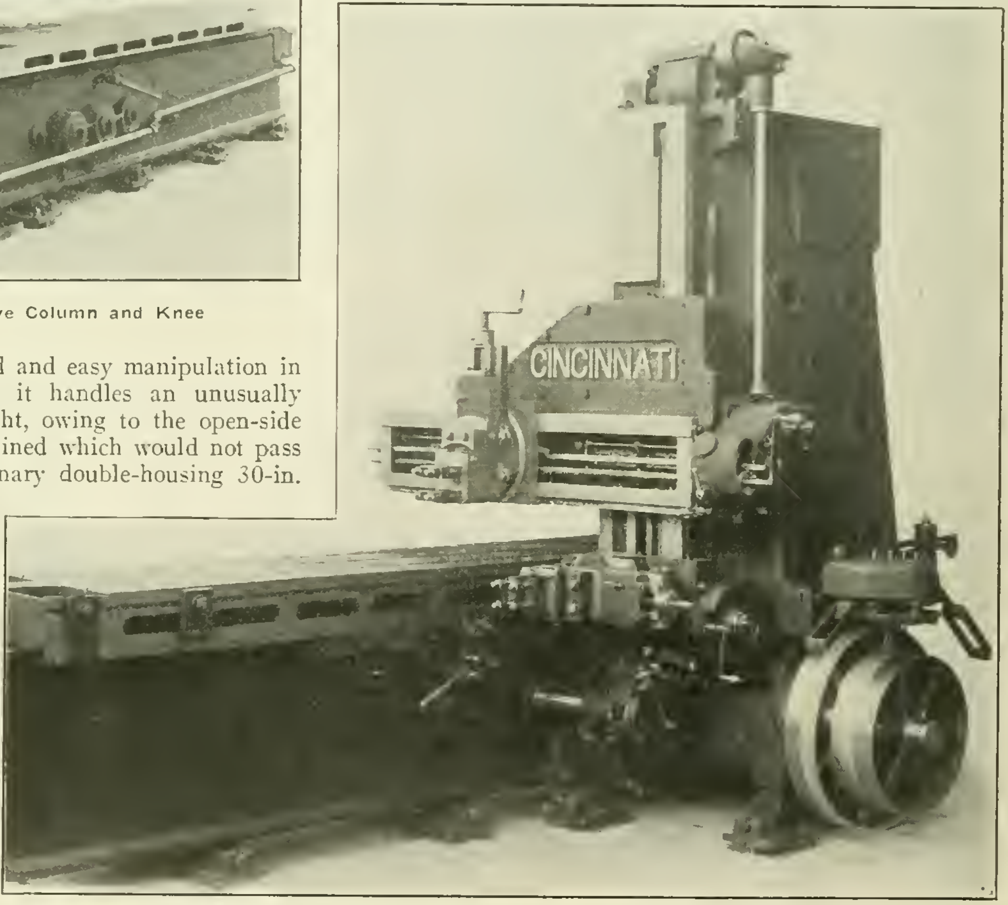
Rear View Showing Massive Column and Knee

ESSENTIAL features of modern planer design are included in the 30-in. by 30-in. open-side planer, illustrated, which has recently been added to the line of machines made by the Cincinnati Planer Company, Cincinnati, Ohio. This planer is well adapted for work in railroad shops because of its power, generally rugged construction, variable cutting speeds, and rapid and easy manipulation in all working parts. In addition it handles an unusually wide range of work for its weight, owing to the open-side feature enabling parts to be machined which would not pass between the housings of an ordinary double-housing 30-in. planer. When planing work very much wider than the table, the use of a supplemental rolling table is recommended.

Referring to the front-side view, the rigidity and convenience of this design will be evident. The extra-capacity box table is gibbed down to prevent tilting when carrying an over-hanging load. The table also fits down between guides to prevent being pushed sideways while cutting. The rear view clearly shows the massiveness of design and the unusual depth and width of the column. The knee, supporting the rail, is also rigid.

The patented Cincinnati Tu-Speed drive is used with this machine, giving two cutting speeds and a constant return. Where a greater number of speeds are needed, variable speed reversible, or non-reversible d.c. motor drive can be furnished. Rapid power traverse is provided for the rail head, placing it quickly in position without fatigue to the operator. This arrangement is fool proof in its operation and ready for use at all times. Forced lubrication is supplied to the vees directly under the tool point by means of a pump and piping system, partially shown in the rear view. From here it is distributed over the entire length of the bed to either end, then returning to the oil tank by the pipes shown. This feature is especially desirable when the table is making short strokes, or is heavily loaded.

Herringbone gears are used for the first gear reduction on the pulley. The bull wheel revolves with the shaft in bearings of ample proportions, and accurately-cut gear teeth throughout promote smoothness of operation. The cross rail is bolted and doweled securely to the knee, being raised and lowered by means of a patented power-elevating device, operated through frictions controlled by a lever on the right side of the column. A feature of the head is the round tool block and slide which avoids projecting corners on angular work. The head is carefully scraped to the rail and is graduated for swiveling up to 90 deg. It has automatic feeds and rapid power traverse in all directions and can be operated from either side of the machine.



Front-Side View of New Cincinnati 30-In. by 30-In. Open-Side Planer

The side head has a long narrow guide for the saddle on the column, and the handle for vertical movement follows the head. Independent adjustable power and hand vertical feed are provided and the side head can be run down below the top of the table when not in use. The counterbalance system is self-contained and there is a releasing latch for the tool block. Micrometer dials are furnished on all down feeds and cross feeds. These dials are graduated in thousandths, a great convenience in obtaining depths of cut accurately and rapidly. The feed device is a new design with the trigger and spring mechanism enclosed.

The shifting mechanism transfers the belts quickly and practically without noise when running at high speeds. Wide belts and proper speeds insure abundant power and accurate strokes. Quick reverse aluminum pulleys are used and greatly reduce the power required at the moment of reverse, also increasing the efficiency of the planer. All loose pulleys are provided with new and improved self-oiling bronze bushings.

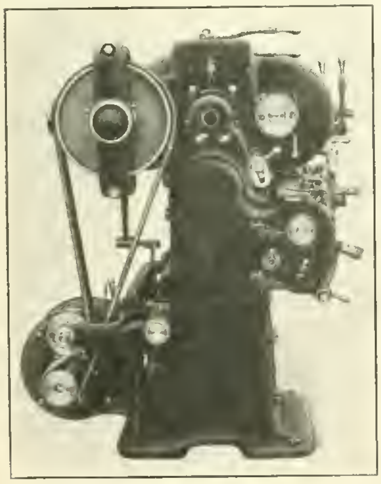
This planer, with a table 8 ft. long and a 13-ft. bed, will plane 31 in. under the knee and square down 31 in. in width. For motor drive, a 10-hp. motor with a maximum speed of 700 r.p.m. is required.

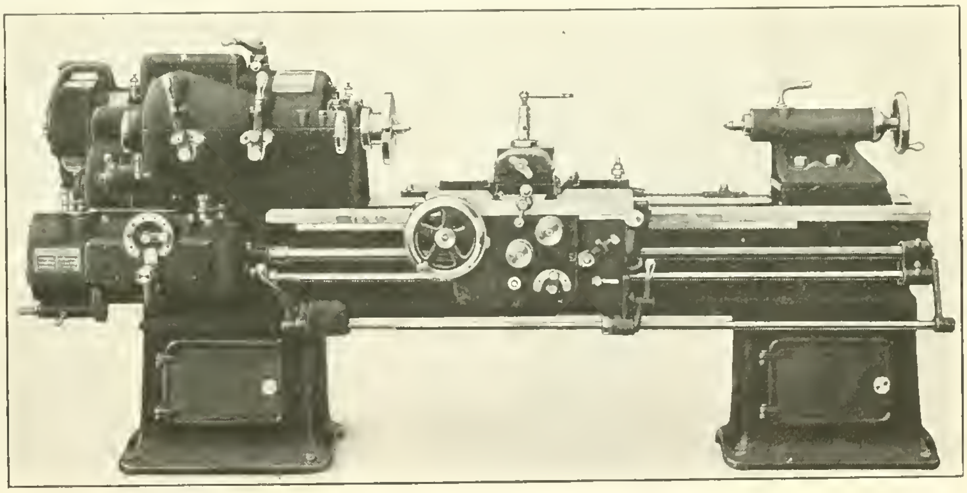
Twenty-Inch Coneless Engine Lathe

An important addition to the family of modern engine lathes has been made by the Boye & Emmes Machine Tool Company, Cincinnati, Ohio, in the 20-in. engine lathe illustrated. This lathe, known as the coneless rather than geared head type, is a compact motor-driven unit of extremely pleasing proportions. All working parts of the lathe are designed with sufficient weight and strength to resist stresses occasioned by taking heavy cuts with modern high-speed steel tools. Accuracy is secured by careful workmanship, and the location of all operating levers and hand wheels is such that the machine may be accurately described as a production tool. In this connection it should be noted that the main spindle can be started and stopped or reversed by either of two handles on the same controller rod, one handle being at the end of the head stock and the other at the right-hand end of the carriage.

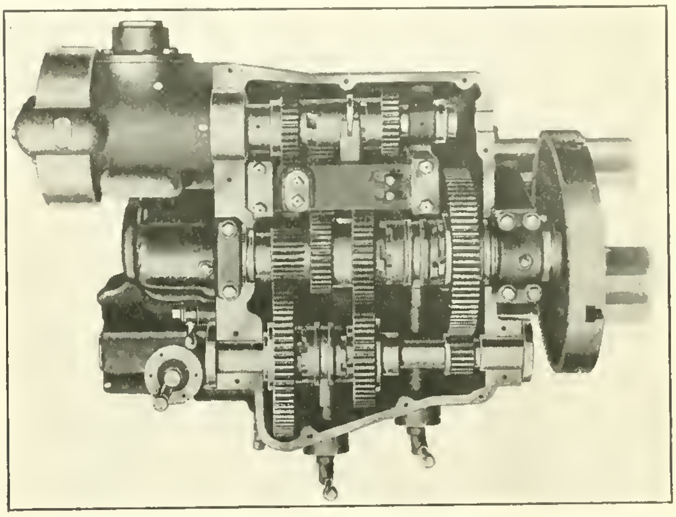
The head stock cover is made in a single piece and a view of the gearing with this cover removed is shown in one of the illustrations. This view shows the arrangement of the shafts, clutches, gears and levers for speed changing. All levers are either drop forgings or steel castings. The main spindle bearings are adjustable without removing the top cover. The head stock has a glass tube showing the oil level, which should be maintained at about one-half a glass. It is recommended that oil in the headstock be renewed every 60 days.

Twelve selective main spindle speeds are available on this lathe, 13 gears being used. These gears are always in mesh, running in an oil bath and it is impossible to engage conflicting gear ratios. The only frictions used are at the initial driving pulley shaft. The design of the tailstock is such that the compound rest may be swiveled parallel with the shears. Side set-over for taper turning is provided.


End View Showing Motor Drive


Boyle & Emmes 20-In. (Coneless) Engine Lathe—a Compact Production Tool

The apron is of the double plate type, affording bearings for both ends of the shafts, studs, etc. Longitudinal and cross feeds are engaged with frictions, and all feeds reverse in the apron. The mechanism is so arranged that longitudinal and cross feeds cannot be engaged when screw cutting. The lead screw is turned and ground before threading, which is done on special lathes. All threads shown on the index can be cut without the removal of gears, 40 standard threads, varying from 2 to 56 per in. being available. The construction permits of changing stud and intermediate gears, allowing odd threads, not shown in the index, to be cut. By transposing gears, metric pitches can also be cut.


Headstock with Cover Removed Showing Gearing Arrangement

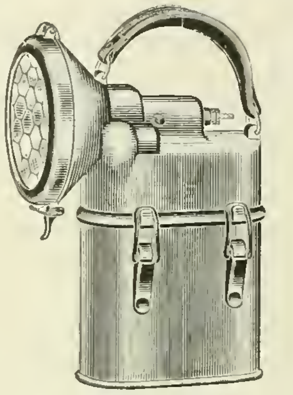
A special feature is the arrangement of the driving motor on a motor base plate attached to the cabinet leg. This motor base plate carries an idler pulley, running on SKF ball bearings, and providing proper belt tension. Any standard constant speed motor of from three to five horsepower can be used. The motor speed should not in any case exceed 1,200 r.p.m. With a 13-in. driving pulley, running at 350 r.p.m., the minimum main spindle speed is 10 r.p.m. and the maximum 332 r.p.m.

Convenient Type of Electric Dry Cell Lantern

IN the Excellite, developed by the National Marine Lamp Company, Forestville, Conn., the portable electric lamp has reached a high stage of development. It embodies features of safety, rapid and powerful illumination, and convenience of handling far exceeding the old fashioned oil lantern. A powerful ray of light, generated by two No. 6 dry cells contained in the aluminum casing, is made available, and an adjustable focus permits either a spread of light, or a piercing ray to be thrown a distance of six or seven hundred feet.

A push button switch, arranged to be instantly manipulated by the pointer finger and thumb of the hand carrying a lantern, greatly increases the convenience and quickness with which a full light can be obtained, besides leaving the other hand free for carrying other materials.

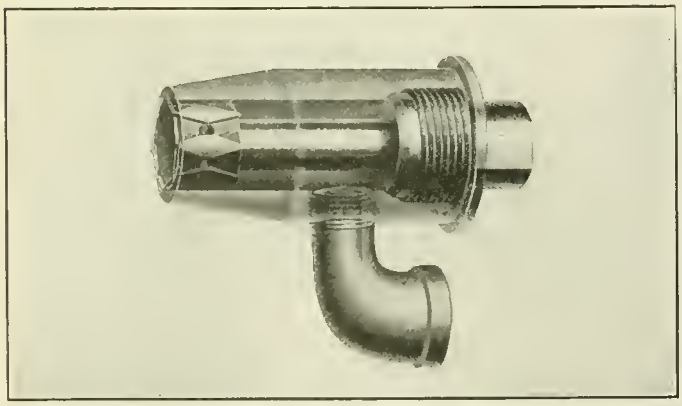
The Excellite is said to be absolutely fool proof and almost indestructible, having been dropped and thrown on hard materials without impairing the working of the light or damaging the lantern in any way. The bell-shaped reflector and small light bulb are amply protected in the aluminum casing by a ¼ in. wire-reinforced glass in the front. The lantern is also water-, moisture- and air-proof, since the aluminum casing completely encloses and protects all the vital parts. Recharging or installing new batteries requires about one minute's time, all connections between the light switch and battery terminals being instantly made when the top section of the lantern casing is set in place on the lower section. Four spring clamps, two sets on each side, hold the two sections of aluminum casing together. A soft fiber gasket between forms a leak-proof joint. Two extra light bulbs are furnished with the Excellite, these being held neatly in place by small spring cribs inside the top section of the casing.


Excellight Electric Lantern

Many uses for this hand electric lantern are readily apparent since it performs in a more efficient way the function of the old style lantern and in addition can be used with safety around all kinds of inflammable and explosive materials and gases.

Venturi Type Fuel Oil Burner or Atomizer

THE Venturi fuel oil burner illustrated is an improved type of atomizer made by the Hauck Manufacturing Company, Brooklyn, N. Y. It is said to atomize or break up completely oil or even tar into finely divided foglike particles by means of steam or compressed air. The burner consists essentially of a cylindrical casing with slots parallel to the bore axis. These slots form with the inner wall of the casing longitudinal ports or orifices through which the atomized oil is impelled into the furnace. Each port or orifice is a small Venturi tube constricted at its center and flared outwardly at the two ends. The throats or constricted parts of the orifices are connected with the interior of the bore by means of correctly-designed radial openings or apertures.


Hauck Venturi Type Oil Burner with Air or Steam Inlet at Bottom and Oil or Tar Inlet at Right End

The oil or tar is delivered under a pressure of 40 to 60 lb. per sq. in. to the bore, and then passed through the radial apertures to the orifices where it is collided against and blasted by the compressed air or steam. The compressed air or steam is delivered to the burner at about 80 to 100 lb. per sq. in. pressure. As it flows through the ports, its velocity increases rapidly and becomes a maximum at the orifice throats. Here it strikes and blasts the oil, atomizes it thoroughly and impels the atomized oil from the burner orifices.

The Hauck Venturi oil burner is designed to secure a thorough mixture of the air and atomized fuel oil at the mouth of the burner. It is correctly proportioned to the oil and steam or air pressures available. It is readily accessible for purposes of cleaning and inspection, and can be removed from the furnace without affecting the operation of any other burner served by the same piping system.

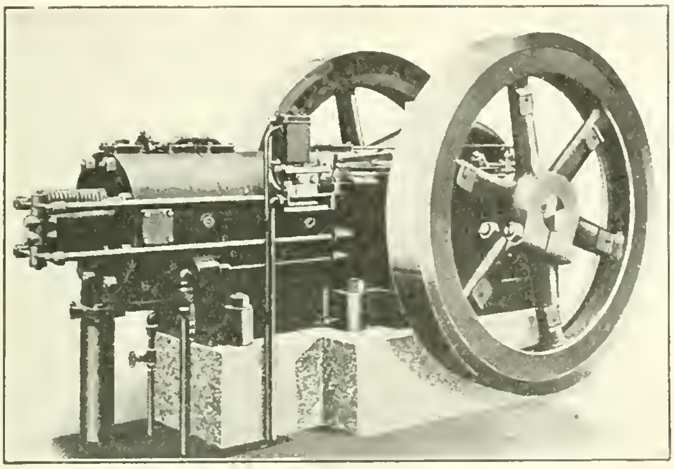
Reducing, neutral and oxidizing flames are obtained by manipulating the oil and air valves. The furnace atmosphere is thus closely controlled. With combustion taking place close to the burner nozzle, oxygen cannot come into contact with the steel. This results in less scaling. Decarburizing of the work is reduced and there is less spoilage and greater uniformity of product.

Close control of temperature is said to be accomplished with ease and certainty. The temperature of the furnace is controlled through two standard valves reducing labor and attention required to a minimum. Uniform combustion conditions and ready, exact and simple temperature control increase the efficiency of production. Fewer demands are made upon skill and judgment in the handling of the furnace and more time and attention can be devoted to the work itself.

The Hauck Venturi oil burner is adapted to a wide range of work, including use with all sorts of forging, annealing and heat treating furnaces; also heating and welding torches.

Direct-Injection Oil Engine Drives Compressor

THE Price horizontal direct-injection oil engine, manufactured by the Ingersoll-Rand Company, New York, employs the Price system of fuel injection which eliminates the need for a three- or four-stage 1,000-lb. pressure injection air compressor with intercoolers. A pump of single design provides the force for introducing the fuel into the combustion chamber. Two spray nozzles are employed, so arranged that their sprays impinge. The head and combustion chamber are shaped so that their surfaces are at all points parallel to the sides of the fuel sprays, thus preventing the fuel fog from coming in contact with a metallic surface where it would collect as drops and result in imperfect combustion.



Ingersoll-Rand 17-In. by 19-In. Type P Oil Engine

The Diesel engine has long been regarded as the most economical and efficient prime mover and the Price oil engine is to all intents and purposes a Diesel engine. The elimination of the air compressor, however, is said to increase the mechanical efficiency 10 to 12 per cent, holding the fuel consumptions to .38 or .39 lb. per brake hp. hr. The former figure means that 20 hp. hr. can be obtained from a gallon of standard fuel.

Ignition, as in the air injection Diesel engine, is obtained by the heat of compression. All parts of the head, combustion chamber, and cylinder which are exposed to the gases of combustion are completely water-cooled. No flames, coils or exterior heating devices of any sort are required either in starting or during operation.

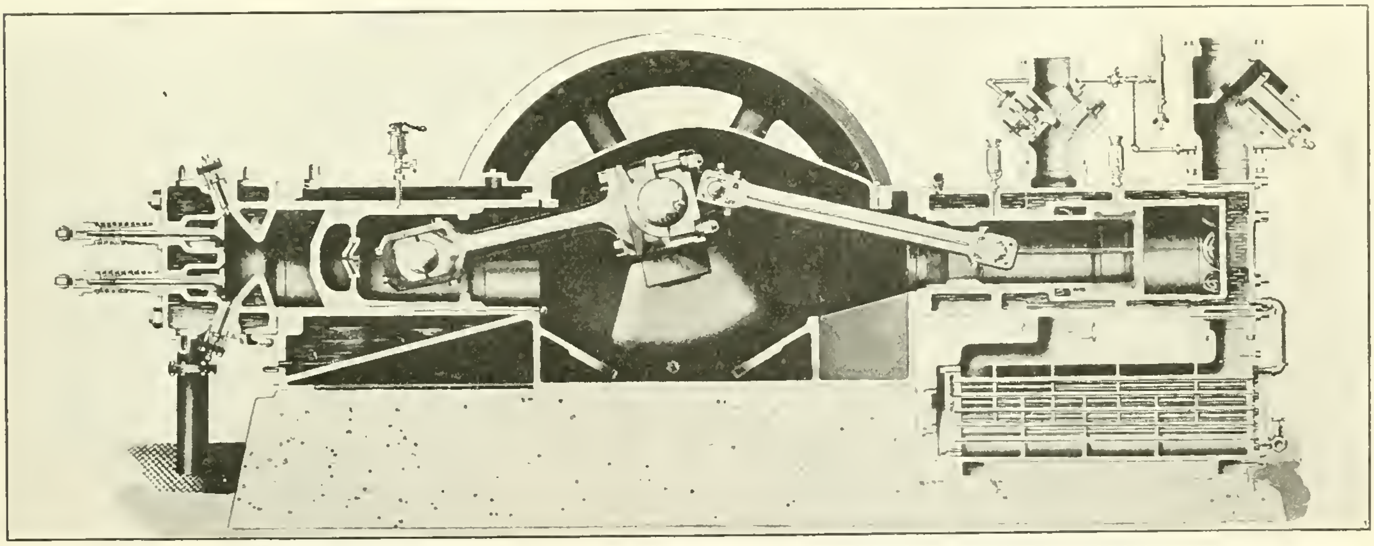
A number of the details of construction are worthy of mention. The exhaust and intake valves (the engine operates on the four-stroke cycle) are actuated by push rods from cams. The latter are housed in a compartment case in the engine frame, which protects them from injury and also permits of keeping them flooded with lubricating oil.

The crank case is closed by means of a cast-iron cover, the joint between the cover and the engine frame being machined and further sealed by means of a cord gasket. Every precaution is thus taken to prevent the waste of lubricating oil, one gallon being sufficient to lubricate the engine while delivering 4,000 hp. hr. The use of a trunk piston has shortened the overall length of the unit at the same time reducing the horizontal inertia forces. Even when developing full power, there is said to be no perceptible movement.

Important advantages claimed for the Price oil engine are simplicity, sturdy construction, accessibility of parts, fuel and lubricating oil economy and completeness of combustion.

Oil Engine Air Compressor Unit

One of the first applications of the Price direct-injection oil engine has been to drive a direct-connected air compressor unit. This unit, of which the 100-hp. engine forms the prime mover, has the air cylinder in line with the power cylinder but on the opposite side of the crankshaft. For 100 lb. pressure, a two-stage air cylinder is offered. The air intercooler is mounted below the air cylinder and forms a support for it. The general impression given by the unit is one of symmetry, compactness, and durability. For air pressures less than 100 lb., a single stage air cylinder is offered, which is connected to the oil engine frame by a distance piece. For both single and two-stage work, the air cylinder is double acting which has contributed to the exceptional balance of the machine.



Cross Section of Two-Stage Compressor Unit Driven by Direct-Connected Oil Engine

In the 50-hp. size, the air cylinder is vertical and is mounted on top of the engine, immediately above the crankshaft. By so doing, it has been made possible to mount the unit on a flat car or truck for use in portable work. This construction has not resulted in excessive height, this being kept less than 8½ ft.

The manufacturers have collected some important data on the cost of producing air with these oil engine driven units. Allowing for the greater first cost it is said that air can be compressed with fuel oil at six cents a gallon on a par with electric power at 1¼ cents per kw. hr. With the fuel at 12 cents a gallon, the equivalent cost of electric power is 1½ cents per kw. hr.

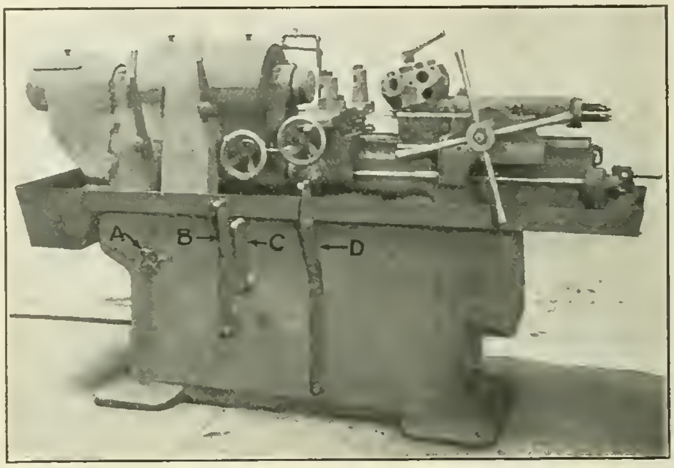
Motor-Driven Turret Lathe or Screw Machine

Made by the Wood Turret Machine Company, Brazil, Ind., the turret lathe or screw machine illustrated has been provided recently with a self-contained, electric driving unit. The machine is now mounted on a cabinet base with the motor on the rear cover plate inside of the cabinet. The removal of this plate takes the motor with it. A silent chain connects the motor with the main drive shaft in the center of the cabinet. A cone friction clutch of the full floating type is used, the drive passing through a change gear box with gears running in oil and giving six changes of spindle speed on a plain head machine. Twelve changes are available on a friction back-geared machine. Twice as many speeds are thus obtained as on the regular belt drive, with the additional advantage of a reverse for every forward speed, accomplished through a patented reverse gear running in oil.

Power from the gear box is transmitted by a 12-in. diameter pulley and belt to a 12-in. diameter pulley on the spindle. A suitable belt tightener is provided between. All controls are centralized in the operating position. Hand-wheel *A* controls the belt tightener. Hand levers *B* and *C* control the speed changes and hand lever *D* controls the starting, stopping and reverse.

The removal of the front cover (which is the entire front surface of cabinet) opens the cabinet, affording a full view of the motor-driven unit. Air holes in both ends of cabinet provide for ample air circulation for the motor.

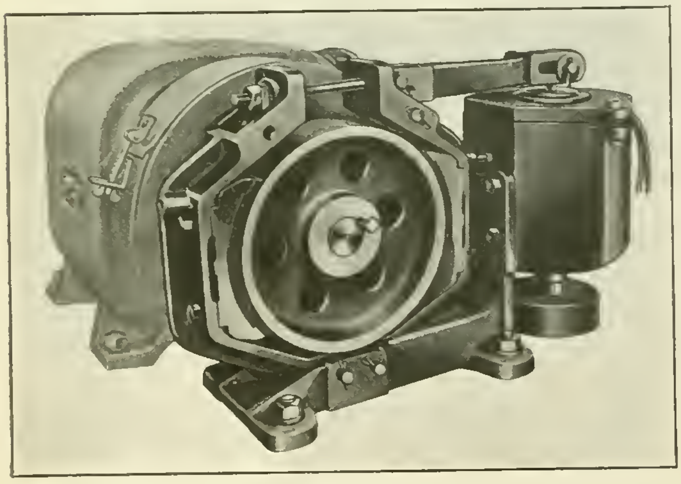
This turret lathe is said to have all the desirable features of belt-drive together with the best features of an all-geared head single pulley drive. The belt pull is down in the headstock instead of up against the main bearing caps, a type of drive coming into more common use owing to its convenience and economy. The machine can also be driven by belt as a single pulley drive by mounting a jack shaft on the rear cover plate in place of the motor. All revolving parts are guarded. The driving motor may be either d. c. or a. c. and either constant or variable speed.



Wood Turret Lathe with New Electric Driving Unit

Quick-Acting Powerful Solenoid Brake

A solenoid brake with important structural advantages for crane service has been developed recently by the Whiting Corporation, Harvey, Ill. This brake (Type C) is designed to be quick-acting, powerful, provided with interchangeable parts and easy to adjust. The brake arms are so pivoted that the shoes release equally at all points and there is no chance of the shoes dragging at the lower end. This is also a big advantage in applying the brake, as the shoes bear equally at all points, resulting in quick braking action and uniform wear. All parts for the same size brakes are interchangeable. Brake wheels and shoes are interchangeable with like parts on the Whiting Corporation's standard foot brake.



Whiting Type C Solenoid Brake for Crane Service

It is necessary to change shoes from time to time and this can be done by simply removing four cap screws and sliding the shoe out. The brake shoes are of cast iron, filled with asbestos composition which has been thoroughly tested as to durability and ability to resist heat. Under ordinary conditions, adjustment of the shoes is required only once a month.

In the Type C brake all parts subject to stress are steel castings. For direct current the plunger is of soft iron of large diameter, which gives a fast operating solenoid, even at light loads. The solenoid spool is of brass tubing with a vulcanized fiber sleeve over the tubing and fiber ends. The coils, wound with asbestos-covered wire of ample size, are designed to operate the brake at about 40 per cent full load current and remain open at 10 per cent or less of the full load current. The voltage loss in the coil in most sizes averages less than 4 and in no case more than 7 per cent.

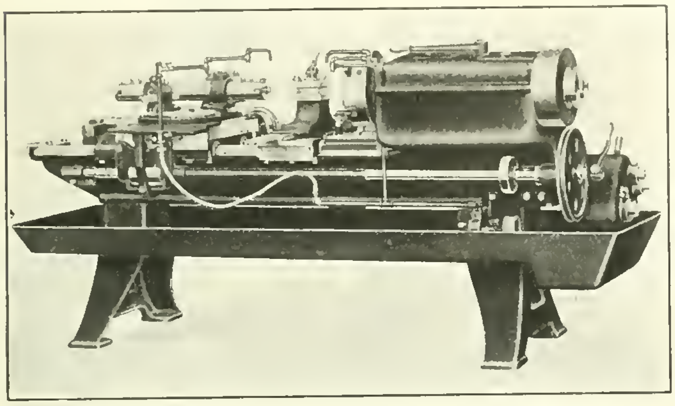
For alternating current the coils are wound with cotton-covered enameled magnet wire of ample size to carry the inrush current when the coil is energized. The plunger on the a.c. brake is of laminated iron of the proper thickness for the service intended.

Before putting the Type C brake on the market, it was put through a series of exhaustive tests. A 12-in. brake was mounted on a 25-hp., 550 r.p.m., direct current motor. In the complete test, the motor was stopped 50,000 times at a rate of 325 stops per hour, after which the brake is said to have showed no signs of wear except the usual shoe wear.

During this test a number of different lining materials were tested and the one selected showed the following characteristics: Material not affected when operating with the brake wheel at dull-red heat; average wear .0005 in. per 1,000 stops with motor running 1,800 r.p.m.

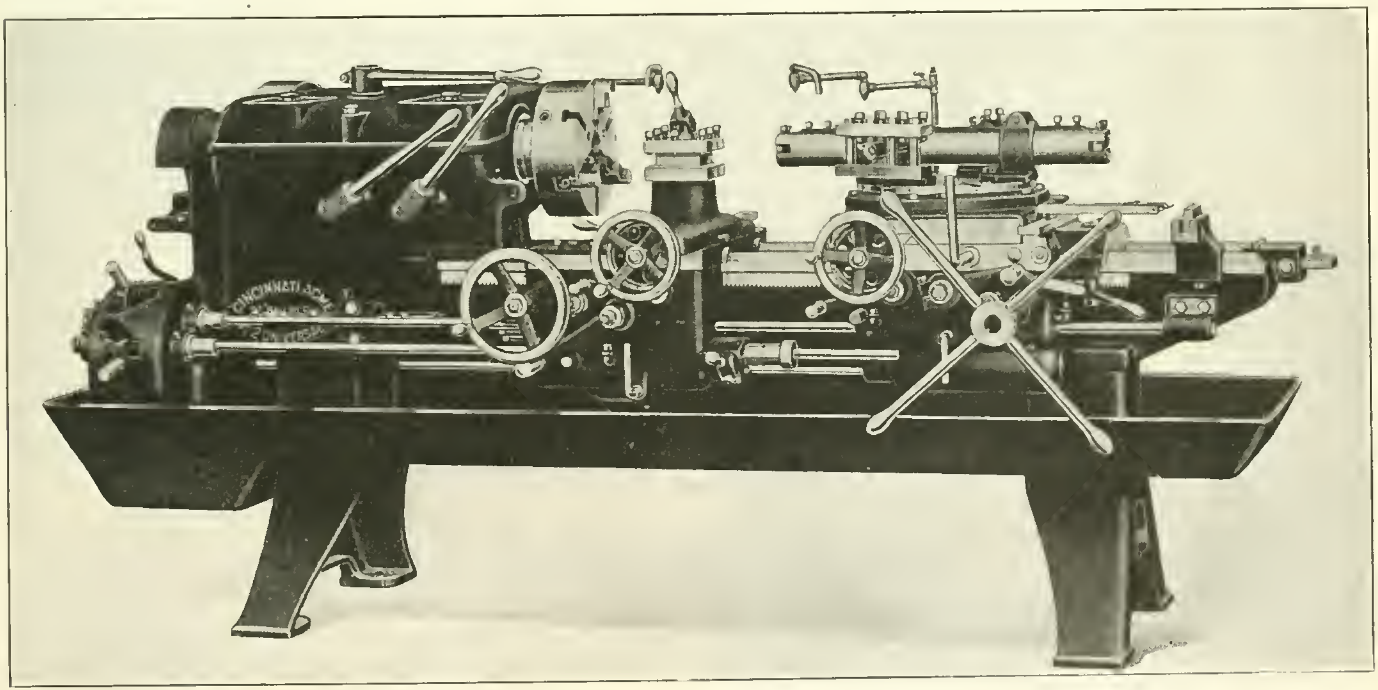
Fully Universal Flat Turret Lathe

The illustrations show a No. 2 Cincinnati Acme flat turret lathe, made by the Acme Machine Tool Company, Cincinnati, Ohio, and designed to be fully universal by the addition of such distincttive features as a cross sliding turret and side carriage. These features provide for the operation of a large number of tools at one time, also making the tooling arrangement more simple and inexpensive.



Rear View Showing Cutting Lubricant Pump and Piping

This machine, which will accommodate chucking work up to 20¾ in. in diameter, is designed for both bar and chucking work. For bar work either of two sizes of automatic chuck capacity can be furnished, 2½ in. or 3¼ in. The turret travel is 30 in. The square turret on the side carriage, together with the flat turret carriage, permits the maximum number of tools to be in operation at the same time, thus reducing cutting time to a minimum. The square turret may be used for undercutting, forming, facing and turning, while at the same time boring or turning with the flat turret. Independent feeds to each carriage provide separate power feeds to the square turret as well as to the flat turret.



No. 2 Universal Cincinnati Acme Flat Turret Lathe with Cross Sliding Turret and Side Carriage

An important feature of this machine is the centralized control, the time between operations being thereby reduced to a minimum. All control levers such as rapid traverse, cross and longitudinal power feed, spindle, speed levers, binder handles, etc., are directly in front of the operator. The all-geared head single-pulley drive provides 12 speed changes from 18 to 318 r.p.m. The stop and reverse lever is placed on top of the head stock as close to the operator's position as possible. By means of a patented gear-shifting device, it is possible to change from any one speed to another with one continuous movement of either of the speed change levers.

The side carriage spans the ways of the bed, eliminating overhang of the turret and tools. It is provided with six independent stops for the longitudinal movement. The square turret, mounted on the cross slide, can be indexed to four positions. The cross sliding turret revolves on a ground tapered stem of large diameter and is automatically locked in position. The cross slide moves on a long, narrow, dovetail guide with wide, flat bearing surfaces on either side, and has an adjustable taper gib to compensate for wear. The cross feed can be operated in both directions by hand or power.

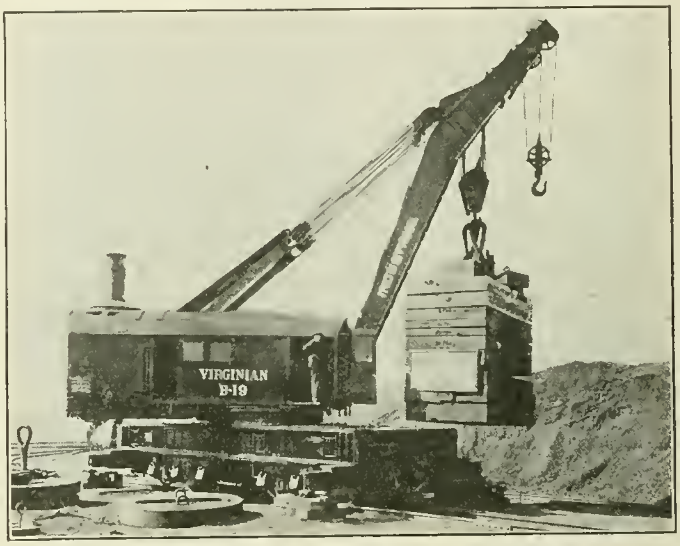
Power rapid traverse is provided in either direction (longitudinally) for the turret. The operation of the control lever automatically disengages feed and power to the turnstile handle, making a fool-proof arrangement and providing a stationary turnstile wheel while rapid traverse is in motion. Twelve longitudinal stops are provided, one independent stop for each turret position and six auxiliary stops. These are operated by the index knob at the right of the saddle. A 5-hp. constant speed motor, running at 1200 r.p.m., is required. It is recommended that the motor be mounted on the rear side of the head end leg, thereby making the drive self-contained and compact. The change from countershaft to motor drive or vice versa can be readily made at any time.

Largest Wrecking Crane Placed in Service

THE Virginian has recently placed in service for use on its lines a new wrecking crane which it is claimed has the distinction of being the largest machine of the kind ever built. Heretofore, as far as is known, the largest railroad wrecking crane was a 160-ton machine having a maximum capacity of 320,000 lb. with all out-riggers in service. As compared with this, the new crane has a capacity on the main hoist of 400,000 lb. at a 17-ft. 6-in. radius with all out-riggers in service, a capacity of 200,000 lb. at the same radius with end out-riggers only in service and a capacity of 85,000 lb. at the same radius without the out-riggers. On the auxiliary hoist, the capacities are 90,000 lb. at 24 ft. to 30 ft. radii with the end out-riggers only, and 60,000 lb. at a 24-ft. radius without out-riggers.

In designing the crane, the main problem met was securing the 200-ton capacity required by the heavy rolling stock on the Virginian without exceeding railroad clearances and a maximum allowable axle load of 65,000 lb. on account of bridges. The crane in running order weighs 356,500 lb. and is mounted on special six-wheel trucks, the maximum axle load in running order being 64,000 lb. The car has a wheelbase of 26 ft. 2 in. and itself is 34 ft. long. The maximum height of the crane is 15 ft. 9 in. and the greatest width, 10 ft. 6 in.

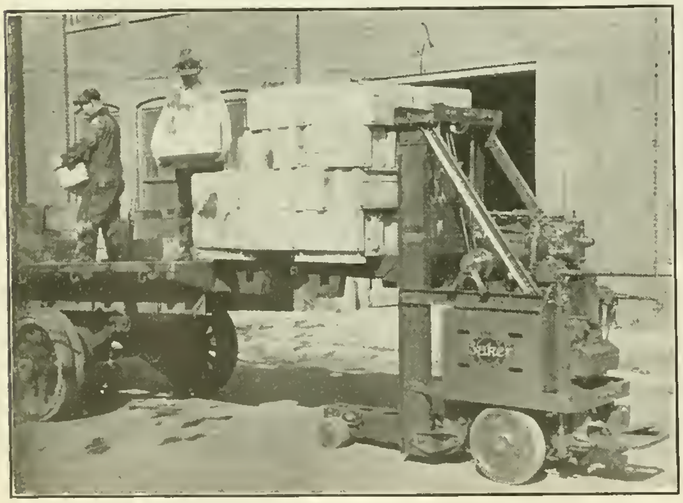
The machine is equipped with a 12-in. by 12-in. engine operating on steam from a 65-in., 160-lb. A.S.M.E. boiler, and a Westinghouse air pump is provided, with clasp brakes on each of the 12 wheels. These brakes may be operated by the operator of the crane or by the engineman of the locomotive. All clutches are operated by air. The machine is a product of the Industrial Works, Bay City, Mich., and is said to have passed through all tests recently applied with ease and smoothness.



The New Crane Has a Capacity of 400,000 Lb.

Elevating-Platform Truck With Six-Foot Lift

AN elevating platform truck, known as the Hy-Lift, capable of hoisting a 4,000-lb. load 6 ft. from the floor, has been placed on the market recently by the Baker R. & L. Company, Cleveland, Ohio. This truck is intended for hoisting purposes, but is often used on short hauls. It will practically double and sometimes triple the capacity of store houses for heavy material. It can be used for loading wagons or freight cars and, in machine shops without crane facilities, is valuable for lifting heavy dies or parts to and from the machines.



Baker Hy-Lift Truck Efficiently Transports and Elevates Material

The new Baker truck is of rugged construction throughout, being interstandardized with previous models as regards motor, transmission, universal joints, wheels, tires, controller, etc. It is also equipped with the Baker duplex compensating suspension, described on page 257 of the April, 1921, issue of the *Railway Mechanical Engineer.* A two-cable hoist, either of the cables being strong enough to carry more than the rated full load, is used, and the advantages of the cable system of hoisting is especially important in this case where a long steel screw would be subject to dirt, abrasion and severe bending strains. This standard truck lifts 72 in. but trucks can also be furnished with 48-in. or 60-in. lift if desired.

The truck is arranged with a two-wheel drive and a four-wheel steering mechanism, providing for turning in a minimum outside circle of 107 in. With a load of 4,000 lb., the maximum speed of the truck is 4½ miles per hour, and without load, 6 miles per hour. The brakes are operated by a foot pedal and interlocked with an automatic switch and controller. The lifting speed without load is 11 ft. per min.; with 2,000 lb. load, 7 ft. per min.; with 4,000 lb. load, 5 ft. per min. The plate steel platform is hinged at the point of attachment to the roller head so that the tapered outer end of the platform tips if it catches when lowering the load. All parts of this truck are readily accessible for lubrication, adjustment or repair.

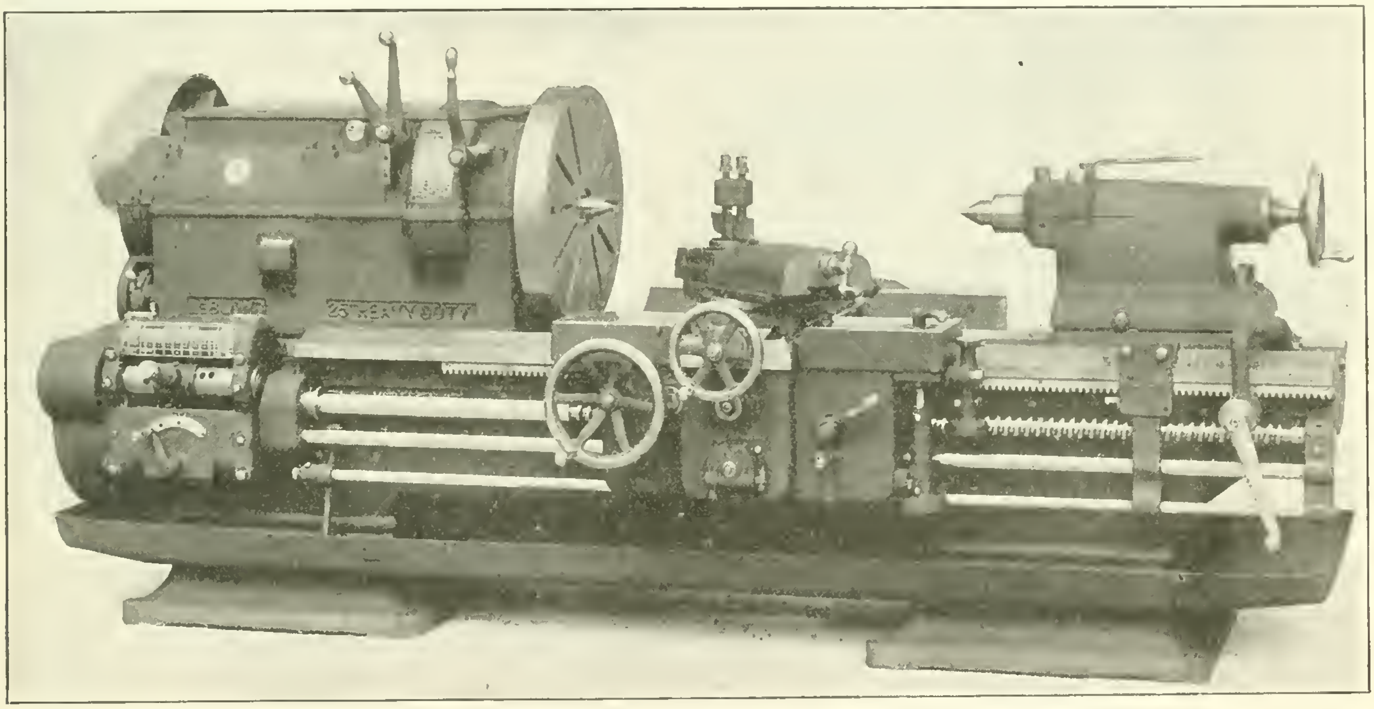
Heavy Duty Single Pulley Drive Lathe

A NEW heavy duty single pulley drive lathe, made in 25-in. and 27-in. sizes, has been brought out by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. Several distinctive features are embodied in this lathe, one of the most important being the arrangement of the selective geared headstock to provide 16 changes of speed by the simple manipulation of two levers. The speed changes are made selectively without the necessity of going through any intermediate speeds to obtain the desired speed. The drive is through an unusually large pulley with a high speed belt transmitting power from a 15-hp. motor. This motor is mounted on a hinged motor plate attached to the base of the lathe. The driving clutch is operated by a conveniently-placed lever at the front of the headstock and also by a lever on the carriage. It is of the powerful multiple disc type, running in oil.

The bed, headstock, carriage, and in fact all parts of the lathe have been designed for heavy duty. A new one-piece box section apron provides a definite increase in strength and rigidity with an important reduction in operating parts. By a special patented construction, both feeds are engaged with a single positive jaw clutch engaging the bevel gear, where it has light duty to perform. The feed control is said to be unusually sensitive and a positive trip lever is provided as shown on the front of the apron. The feed is driven by an independent feed rod and reversed by means of a shifting double bevel gear.

Another feature of the new lathe is the improved quick change gear mechanism of generally heavier design and greater driving power coupled with ease of operation. The range of threads and feeds has been selected to cover the usual requirements, and threads from ¾ to 46 per in. can be cut. The lead screw is new and considerably larger than those used previously. The thread is of special U. S. S. form, 1 in. pitch and 2 3/16 in. in diameter. It is finished in a special lathe fitted with a precision master screw. A chasing dial is provided for catching all threads without reversing the lead screw.

The heavy bed type taper attachment is designed for the heaviest taper turning and boring. It is mounted on a substantial bracket carried on heavy shears on the back of the bed and can be moved to any position along it. The taper guide bar, adjusted by a set over knob, is clamped in position by heavy bolts on each end. Should geared motor drive be desired for this lathe, the motor can be mounted on top of the head stock.



Le Blond Heavy Duty Lathe of Modern Design, Made in 25-In. and 27-In. Sizes

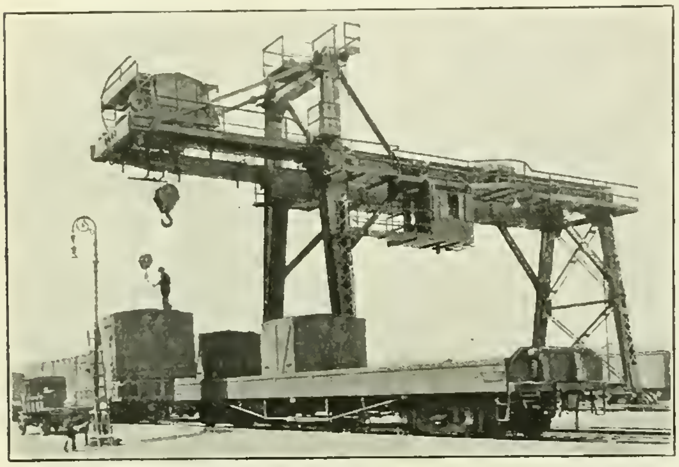
Gantry Crane for Handling Heavy Freight

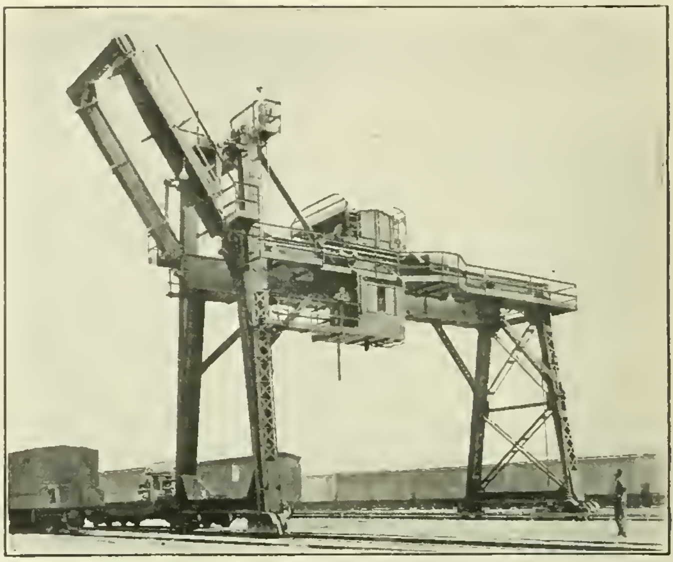
AN electric gantry crane has been erected by the Niles-Bement-Pond Company in a busy freight yard near New York, as shown in the illustrations. This crane, embodying modern features of construction throughout, covers three tracks with two driveways, approachable from either direction, with trackage space for 15 cars at the crane. With a lifting capacity of 40 tons, the crane furnishes ample facilities for handling heavy freight, such as structural iron, building materials, machinery, boilers, steel freight containers, transformers, etc. An auxiliary hoist is provided, having 10 tons capacity.

The span, center to center of the runway rails, is 49 ft. 3 in. With the cantilever extension at one end, the effective reach of the main hoist is increased 19 ft. 6 in. and the effective reach of the auxiliary hoist 21 ft. 11 in. The lift of the hook above the runway rails is 23 ft. The main and auxiliary hoist motors are each 50 hp. The trolley and bridge motors are 10 and 50 hp. respectively. The speeds with maximum full load are: Main hoist, 10 ft. per min.; auxiliary hoist, 40 ft. per min.; trolley, 100 ft. per min., and bridge, 80 ft. per min.

The cantilever extension is of the elevating type, being motor-operated from the cage, and is readily elevated to clear any obstruction. Platforms are furnished on both girders running the entire length, including the cantilever extension. A platform is also placed at the top of the shear legs for access to the cantilever elevating mechanism and one on each side of the trolley, which is enclosed for outside service, as is also the cage. The top of the trolley housing is arranged so that any part can be opened on hinged joints, allowing easy access to the trolley mechanism for oiling, etc., or the entire house can be easily removed. The cross platforms are easily lowered on hinged joints, allowing unobstructed access to main and auxiliary hoist drums and gears.

The trolley frame is a self-contained built-up steel structure, with all the mechanism and motors mounted. The trolley is designed to incorporate such improved features of construction as complete lubrication, large wearing surfaces, ample strength and rigidity, self-contained units, easy accessibility and easy handling. The cage is of plate steel construction, special provision being made for mounting the controlling apparatus with concealed wiring. The back of the switchboard is reached through large doors, which, when opened, expose the entire board, allowing ready access to all wiring connections. The crane travels on eight wheels, four at each end, two wheels at each end being driven through carefully guarded gearing.


New 40-Ton Niles Gantry Crane Unloading Container Car Section


Gantry Crane with Cantilever Extension Placed In Raised Position

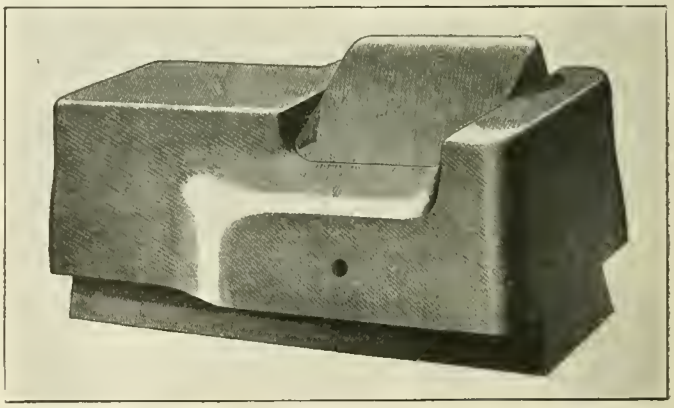
The installation of cranes of this type insures the prompt unloading and placing on trucks of all classes of heavy freight from any one of 15 cars available in the shortest possible space of time, thereby solving in a large measure freight congestion at terminal warehouses. There is an important saving of time and cost in handling heavy freight, and in addition it is moved more promptly to the consignee's premises.

Combination Hammer Die for Drawing Tapers

A COMBINATION hammer die for drawing tapers has been brought out by Beaudry & Co., Inc., Boston, Mass. This die can be furnished for any make or size of trip, air or steam hammer and by its use one man can in one heat draw almost any taper that can be handled under a hammer. As will be seen from the illustration, one end is provided with a tilting face so supported that it moves freely on a fixed axis, and the operator, by merely shifting the position or angle of the work and striking a light blow, automatically adjusts this tilting face to any desired angular position with relation to the top hammer die. Thus any desired taper can be given the work and any shaped piece can be completely finished and smoothed up, point and all, without subsequent hand finish.

Any scale falling between the tilting face and die holder is worked into a pit through grooves and forced out through a hole in each side of the die holder so that the tilting face works freely at all times. The fixed plain part of the die face can be used for general forging the same as any ordinary die. The die holder is cast of gun iron, while the tilting face is forged from 60 point carbon steel.

The die should prove extremely valuable for such work as forging flat, cape, diamond point and track chisels, calking tools, railroad spikes, slice bars, drift pins, brake levers, drift pins, wrenches, wedges, shims, keys, gibs and other similar parts.


Beaudry Combination Taper Hammer Drawing Die

GENERAL NEWS

The Norfolk & Western announces that an agreement has been completed with the newly formed association of its shop employees.

A bill to abolish the Railroad Labor Board by repealing sections 300 to 316 of the Transportation Act was introduced in the Senate on December 16 by Senator King of Utah.

Examiners Borland and Mullen, of the Interstate Commerce Commission, have concluded hearings in the general air brake investigation and briefs are to be filed by February 10.

Employees of the Chesapeake & Ohio, to the number of about 600, are to receive bonuses, a fixed sum for each day, for their voluntary service in doing emergency work during the shopmen's strike of last summer.

The Northern Pacific Shop Workers' Association is the latest addition to the ranks of the "company unions" not allied with National organizations. The new union is reported to have agreed with the company on wage scales and working conditions.

Renewed complaint about the condition of railroad equipment as a result of the shop strike was made to President Harding on November 25 by William H. Johnston, president of the International Association of Machinists, and B. M. Jewell, president of the Railway Employees Department of the American Federation of Labor. They also protested that several railroads were still violating orders of the Labor Board regarding contracting shop work.

The Transportation Brotherhoods' National Bank opened for business at Minneapolis, Minn., on December 19. This bank is owned by members of the brotherhoods of railroad enginemen and trainmen and is the sixth bank in the United States owned and operated by members of railroad labor unions. The president of the bank is Warren S. Stone, chief of the locomotive engineers, and the executive vice-president is W. P. Kennedy, general chairman, on the Chicago, Milwaukee & St. Paul Railway of the Brotherhood of Railroad Trainmen.

Employees of the Pennsylvania Railroad have bought, through the Mutual Beneficial Association, 27,000 shares of the stock of the railroad company, and about 1,500 shares were thus bought by employees during one week recently. J. K. Linn, treasurer of the Mutual Beneficial Association, Philadelphia, through whom the purchases are made, says that he recently received from one limited territory nearly 1,000 names of employees desiring to buy stock, most of them ordering a single share each. The stock is bought in the open market and the Mutual Beneficial Association keeps the shares for a time so as to allow the buyers to pay in instalments.

Senator G. W. Pepper, of Pennsylvania, to whom the representatives of the American Federation of Labor, speaking for former Pennsylvania Railroad shopmen, have appealed for aid, recently had a long conference with Vice-president W. W. Atterbury, and on Monday, November 27, at the invitation of General Atterbury, conferred at his office in Philadelphia with chairmen of the new associations of shopmen which have been organized since the strike, representatives of the former shopmen also taking part. This tripartite conference, after three hours' deliberation, was adjourned to a date to be selected by Senator Pepper. Reporting this conference, General Atterbury reiterates the determination of the railroad company to continue its present arrangement with its shopmen, unless the shopmen themselves desire a change; and says that he asked their representatives to confer with the Senator because, "I simply wanted them to share with me the burden of convincing people that what we have jointly set up on this railroad is fair and mutually satisfactory."

St. Louis Southwestern to Spend $5,000,000

The St. Louis-Southwestern has announced a $5,000,000 improvement program, including the purchase of 15 locomotives, 500 box cars, 500 automobile cars and 200 convertible cars; also, the conversion of locomotives used in Texas from coal to oil burners.

M. & N. A. Strikers Lose All Rights

Former employees of the Missouri & North Arkansas who went on strike about two months ago following their refusal to accept the wage offered by the road under the decision of the Labor Board, have lost all rights as employees of the road, according to a ruling of the Federal Court at Harrison, Ark., in which the temporary injunction against picketing was made permanent. All relationship that the former employees may have sustained to the company has ceased, according to the decision. The temporary injunction which is now made permanent was issued in July, and covered all the road's property in Arkansas.

Wage Statistics for September—Over $3,000,000 in Bonuses

The total number of employees reported by Class I railroads for the month of September, 1922, was 1.708,591, an increase of 114.517, or 7.2 per cent, over the preceding month, according to the monthly statistical bulletin issued by the Interstate Commerce Commission. The total compensation was $238,735,394, an increase of $13.758,750, or 6.1 per cent. The largest increase in employment appears in the maintenance of equipment and stores group, which was 96,505. The total number of employees falling within that group was 410.278, or 85 per cent of the average number employed during the 12 months preceding the strike. The number of persons employed as machinists, blacksmiths, or boilermakers was 69 per cent of the average for the year ended June 30, 1922.

As in August, the overtime made by shop employees was abnormally heavy, representing 25.57 per cent of their total compensation. In June, 1922, or the month just prior to the strike, this percentage was 2.62.

Reports from 181 roads employing 98 per cent of the total number of employees indicate that during the month the employees received bonuses amounting to $3,689,907 for loyal service performed during the strike, which amount is not included in this summary.

"Boring From Within"

Plans for amalgamating the 16 existing railroad labor organizations were discussed at a three-day convention at Chicago, which ended on December 11. A manifesto was adopted and a committee of 50 appointed to carry on the work advocated at this meeting. Reports indicate that of the 360 persons present the majority were former shop employees who are still on strike.

The leaders of the larger railway labor organizations did not participate in this meeting and several of them warned the members of their organizations not to attend. The presence of William Z. Foster and other advocates of the "one big union" idea, indicated that the purpose of the convention was to perfect plans for "boring from within" the existing organizations in order to bring about their dissolution.

New Freight Cars in 1922

The railroads of the United States from January 1 to November 1, 1922, had 47,802 more new freight cars, either ordered and under construction, or installed in actual service, than during the entire year 1921, according to reports received by the Car Service Division A. R. A.; that is to say, a total of 117,238 cars. During the year 1921 the total was 69,436.

Of the total for 1922, 50,196 were box cars, of which, up to November 1, 19,352 had been installed. Coal cars ordered totaled 49,383, of which 26,812 were actually installed.

There was also an increase of 716 in the number of locomotives installed or on order. Locomotives installed up to November 1 totaled 866, while orders had been placed for 1,232, making a total of 2,098, as compared with 1,382 in the 12 months of 1921.

Power Press Code and Head and Eye Safety Code Approved by the A. E. S. C.

The frequency of two of the most serious and most common types of industrial accidents should be greatly reduced through the application of two safety codes which have just been approved by the American Engineering Standards Committee. The Safety Code for Power Presses, Foot and Hand Presses, which has been approved as "Tentative American Standard," is the first national safety code on this subject to be prepared in America. The Safety Code for the Protection of Heads and Eyes of Industrial Workers, which has now received the A. E. S. C. approval as "American Standard" had been approved by the committee some time ago as "Recommended American Practice."

The high speed punch or forming press is one of the most dangerous machines in industry. This code consists of two parts —the first part describing standard requirements and the second consisting of a discussion of press hazards and protective methods and devices.

A statement from the National Committee for the Prevention of Blindness calls attention to Dr. Earl B. Fowler's estimate that there are in the United States approximately 15,000 persons who have been blinded by industrial accidents and that this is almost 15 per cent of the blind population of the country. In one state alone, Pennsylvania, 652 industrial workers lost one eye each and 18 lost both eyes in accidents during a single year.

Because of this serious situation the U. S. Bureau of Standards with the co-operation of the War and Navy Departments began in 1918 the preparation of a head and eye safety code. Several years ago this code was submitted for the approval of the American Engineering Standards Committee and it has since then been the subject of investigation, criticism, and revision.

The subjects covered in the Head and Eye Safety Code are: Protectors for Chippers, Riveters, Caulkers, etc., Protectors for Scaling, Grinding, etc., Protectors for Exposure to Dust and Wind, etc., Protectors for Babbitting, etc., Protectors for Handling Corrosive Chemicals, Dipping, Brush Coatings, etc., Protectors for Sandblasting, Protectors for Exposure to Glare, Protectors for Oxy-Acetylene Welding, Furnace Work, etc., Protectors for Electric Arc Welding and Cutting, Operating Rules, and Tests for Frames and Glass.

Electrification—Installation and Operating Costs

Steam Road Electrification was the title of an address presented by A. H. Armstrong, chairman electrification committee, General Electric Company, before the New York Electrical Society on Tuesday, December 19, at the Engineering Societies' building in New York. Mr. Armstrong stated that the saving in coal effected by electric operation should offset the additional cost of the electrical equipment. Electrical operating facilities exclusive of locomotives, he stated, cost just about as much as the electric locomotives themselves, while steam locomotive operating facilities, not required when a road is electrified, cost about one-half as much as the locomotives. Electrification, he said, in a given case, should save about 20 per cent in operating costs as compared with steam, 12 per cent of which was effected by reduced maintenance costs.

Mr. Armstrong also elaborated upon the better known advantages of electric operation, such as increased track capacity, improved terminal facilities, improved operation, etc. He also pointed out the fact that the great majority of steam road terminals were of a necessity on the outskirts of cities, and he stated that electrified terminals centrally located would minimize truck competition.

French Railway Labor Act Revised

The bill providing for a revision of the working day on French railroads effects small economies in the operation of the roads, which are now working under a heavy deficit, according to Commerce Reports. A distinction is made between active labor and mere presence on the job. In the former class the 8-hour day still obtains, while in the latter the length of the day varies according to the nature of the work. Each employee must put in 2,504 hours of work a year, with extra pay for overtime. The indefinite nature of this provision for overtime payment is expected to neutralize the good features of the bill.

Allowance is made for a reduction of 30,000 in forces and a decrease of 250,000,000 francs in the annual pay roll, while the eight-hour day law increased the operating forces by 110,000 and the pay roll over 1,000,000,000 francs.

Short Line Association Establishes Purchasing Agency at Chicago

The Consolidated Purchasing Agency of the American Short Line Railroad Association, which was organized in June, 1921, with James W. Cain as manager of purchases, was removed from Washington to Chicago, on December 1, 1922, and is now located in the Railway Exchange building. This change was necessitated by the increased volume of business being handled by this department of the association, which can best be taken care of from a more central point. Chicago was chosen in order that the agency might be able to keep in constant contact with manufacturers and secure the best class of used cars and locomotives direct from the trunk lines.

The membership of the American Short Line Railroad Association consists of slightly less than 500 different railroads, which in combination represent over 25,000 miles of main line tracks and an investment of over $1,000,000,000. These roads vary from small logging lines a few miles in length up to interstate carriers of several hundred miles, and include Class 2 and Class 3 roads.

While the consolidated purchasing agency assumes no financial responsibility, being unincorporated and without working capital, it acts as an agency for combining the purchases of these different railroad companies and for negotiating prices on a volume basis instead of the retail basis on which the individual small railroad has heretofore purchased its supplies. There has been no attempt to cover all purchases, but instead the agency has proceeded conservatively and confined its efforts during the first year to those materials which were either standard or susceptible of standardization. For example, purchases of rails have been made in 500-ton lots and distributed to member lines in less than 500-ton shipments, which gave them the same advantage as the purchaser of 500 tons and over. Likewise, spikes and bolts are purchased in carload lots, and even though a small road may need only 25 kegs it derives the benefit of the carload price. Besides purchasing, the agency aids in the sale of materials which the short lines do not need and arranges the exchange of equipment among the roads. To expedite the work of the agency a department of new equipment and materials, one of second hand equipment and one of industrial development was formed.

During its existence the agency has proved its value to the short lines, not only in purchasing and exchanging, but in the selection of equipment best suited to the most efficient operation of these lines. As a result the scope of the organization has reached such proportions that it is necessary to develop a more extensive organization. Accordingly plans are being considered wherein three regional offices will be opened during this year, one in the east, one in the south and one on the Pacific coast, which will facilitate the distribution of materials shipped in carload lots and reconsigned.

After an investigation covering the greater part of a year, augmented by answers to questionnaires sent to all member lines throughout the United States and Canada, the consolidated purchasing agency made recommendations and placed orders for over a quarter of a million dollars' worth of gasoline railway motor car equipment, representing some 20 cars, which are showing excellent results on the different lines and which are replacing steam passenger trains.

Through the activities of the manager of purchases, a finance corporation is now being organized under direction of the association, whereby member lines and others may acquire motor car equipment under a lease purchase plan, making it possible for the equipment to pay for itself through the saving effected.

Work is also progressing satisfactorily in the direction of arranging for standard designs of cars and locomotives, whereby substantial economies may be effected. It will also be possible by using standard designs to arrange financing on a basis that could not be done where a variety of different designs were contemplated. Through the consolidation of the requirements of these lines, the quantity will be sufficient to justify liberal prices and terms.

Just as fast as these different problems are worked out, others will be taken up, such as combining the fuel requirements in different districts, grouping the insurance, and possibly evolving policies giving more complete coverage than heretofore: conversion of coal burning equipment to oil, where the combined locomotives are sufficient to justify lower prices and enable financing of the equipment; and other such innovations which make for economy.

"Railway Engineering and Maintenance"

Effective January 1, 1923, the name of the Railway Maintenance Engineer will be changed to Railway Engineering and Maintenance. At the same time, the number of editorial pages will be increased to permit the inclusion of more information relative to the design, construction and maintenance of railway bridge, building and water service facilities.

Since the establishment of the Maintenance of Way section in the Railway Age in 1911 and its development into the Railway Maintenance Engineer in 1916, there has developed a closer contact between engineering and maintenance, until today they are merged on many railroads. This increasingly intimate relationship has been apparent in the Roadmasters' Association, the Bridge and Building Association and the American Railway Engineering Association. It has also been reflected in the editorial contents of the Railway Maintenance Engineer and its circle of readers, until today this paper is read by nearly every railway officer of technical or practical training in charge of the construction and maintenance of roadway and structures. The new name has been adopted in order to indicate more accurately the nature of the editorial contents and the character of the readers of this publication.

The additional attention which will be given to bridge, building and water service problems is a recognition of the increasing importance of these phases of railway construction and maintenance. By increasing the number of editorial pages these developments will be treated more adequately without detracting in any way from the space now devoted to the problems of track construction and maintenance, or eliminating any other features now appearing in the publication.

Petition in Court Against Railroad Labor Board

The Railway Service & Supply Corporation, which contracted with the Cleveland, Cincinnati, Chicago & St. Louis to repair freight cars and locomotives at the road's shops at Beech Grove, Ind., and Brightwood, Ind., has petitioned the Federal District Court of Chicago for a writ of certiorari in order to obtain a court ruling on the action of the Railroad Labor Board in declaring these contracts to be violations of the Transportation Act and of decisions of the Labor Board. Petitioner points out that under the contracts the road is saving from $115,000 to $125,000 annually on the repair of locomotives and approximately $11,000 a year on repair of cars. All of the legal arguments which have been advanced before the Board and directed against that body's right to rule against such contracts are cited, and petitioner avers that the Board's decision "unjustly and unlawfully interferes with and prejudices relations established by petitioner with its employees and the railway company" and "any unlawful interference [with these relations] will deprive the petitioner of the full benefit of time, efforts, industry and large sums of money expended in perfecting the efficiency of its organization employed by it in operating the shops, to the great and irretrievable loss and damage of the petitioner." The application also calls attention to the fact that if the Board's ruling is allowed to stand "petitioner has good reason to fear that the railway company will terminate the contract" and "it will deter other railroads from seeking the services of the petitioner and from entering into similar contracts, all to the petitioner's great and irreparable damage." The Board is charged with exceeding the authority conferred upon it by the Transportation Act, and with infringing upon the judicial power of the courts and the legislative powers of Congress. The fact that the contractor was not represented at or notified of the hearings in the case is cited by the petitioner as depriving it of its rights of property and contract.

Labor Board Decisions

Proof of Authority for Representation Required.—On April 18, 1922, the chief executive of the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers claimed, before the Labor Board, that the organization represented a majority of the maintenance of way employees and railway shop laborers on the Wabash, Chester & Western. The railway contended that there was no controversy between it and its employees; that on that railroad there was no organization of the employees referred to and that the complainant organization did not represent anyone on that road; and it refused to deal with them. The Labor Board decided that the road should arrange to hold a conference with the representatives of the maintenance of way organization; and if they can produce evidence that the employees on this road have designated that organization to represent them, negotiations shall be conducted in an effort to agree upon rules and working conditions covering the employees involved.—*Decision No.* 1357.

Payment for Yard Crews Helping Trains Out of Terminals.—Prior to April 1, 1920, yard crews were helping trains out of yards and beyond yard limit boards at various terminals on the Minneapolis & St. Louis as a part of their regular assignment, compensation therefor being covered by yard rates without arbitraries or special allowances. After that date yard crews were allowed a minimum of one hour at road rates of pay, in addition to the day's pay for yard service, for each time such service was required of them, in accordance with an interpretation of paragraph b, Article 20, of supplement 24 to General Order No. 27. After the receipt of decisions rendered by the Labor Board of Adjustment No. 1, indicating that no change in the manner of payment for such services was contemplated in paragraph b, of Article 20, this allowance was discontinued. Members of the trainmen's organization then appealed to the Labor Board, contending that this allowance should be continued. The Labor Board decided that paragraph b applied only when yard engineers assist trains beyond the switching limits.—*Decision No.* 1285.

Engine Watchmen Entitled to Meal Period.—The Gulf Coast Lines employ three engine watchmen at Anchorage, La., each of which is assigned to work 8 hours a day, exclusive of the meal period, which makes a spread of 8 hr. and 20 min., from the time they report for duty until they are released. The employees contended that these men should be allowed 20 min. or more for a meal period without deduction in pay since they did not leave the premises of the road for lunch, nor neglect any of their duties; there was sufficient time in which to eat while waiting for steam or for an engine to fill with water or oil. They contended further that the carrier has no right to hold them on duty an extra 20 min., without extra compensation. The carrier contended that it was within its rights by arranging the shifts in this manner and requiring a 20-min. overlap. The Labor Board decided that in accordance with section a-2, Article V, of Decision No. 501, the employees should be granted a meal period not to exceed 20 min., without deduction in pay and being required to lap shifts or make up this time.—*Decision No.* 1345.

Extended Leave of Absence Sustained.—A bridge and building foreman on the Chicago, Indianapolis & Louisville was granted two months' leave of absence to serve as general chairman of the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers. At the end of this period he decided to retain this position permanently and the railway demoted him to carpenter, contending that an employee in a supervisory capacity should not act as general chairman representing the employees. He was further notified that if he expected to remain in the service of the carrier as a carpenter, he would have to work enough time to keep his name on the payroll. The employees appealed to the Labor Board, which decided that it has been a recognized and time-honored practice with practically all carriers having working agreements with their employees to grant leaves of absence (ofttimes indefinite with full retention of seniority rights) to general chairmen representing large groups of employees in order that they might perform the duties incumbent upon that position. The Labor Board decided that the carrier was not justified in refusing this man further leave and free transportation and that he should be restored to the seniority roster in accordance with his standing prior to his demotion.—*Decision No.* 1342.

Supreme Court to Review Pennsylvania-Labor Board Case

The United States Supreme Court on November 20 granted a writ of certiorari on the application of the Pennsylvania Railroad providing for a review of the decision of the court of appeals in the controversy as to the authority of the Railroad Labor Board to issue orders governing the method of employee representation on committees formed for conferring with the management on questions pertaining to rules and working conditions.

Selection of Employee Representation.—In accordance with Decision No. 119, the Pere Marquette entered into negotiations with a committee representing the United Brotherhood of Carpenters and Joiners of America which was recognized by the carrier as the duly recognized representatives of the workmen in the bridge and building department. In these conferences certain artworking rules and agreements were agreed upon, while certain others were not agreed upon and were submitted to the Labor Board for decision. Later the road entered into negotiations with the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, in the course of which a disagreement arose regarding the scope of the rules so negotiated. The Maintenance of Way Brotherhood contended that it represented all employees in the maintenance of way department, while the carrier took the position that the bridge and building employees were represented by another committee and should therefore be eliminated from the scope of the rules under consideration. Later the carrier placed in effect the provisions of Decision No. 501 for all employees referred to therein, including those of the bridge and building department, in lieu of the rules agreed upon in the conference with the committee of the United Brotherhood of Carpenters and Joiners of America. Representatives of the employees took the position that the road should not have applied Decision No. 501 to the employees in the bridge and building department in lieu of the rules that had been agreed upon. In its opinion the Labor Board took the position that it will not decide questions as to the jurisdiction of organizations nor as to representation of employees. It sustained the carrier in the application of Decision No. 501 to the employees of the bridge and building department and stated that the inclusion of these employees shall not preclude them from selecting representatives of their own choosing.—*Decision No.* 1358.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. F. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, first Tuesday in May.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Sectional meeting, February 8 and 9, City Club, Chicago.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting January 9. A paper on Kiln Drying of Lumber will be presented by F. O. Forey, Chemical Engineer, Robert Hunt Company, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting January 11. The subject to be discussed will be More Tons per Mile and per Car; How the Mechanical Dept. Can Help the Operating Department Save Money. J. J. Bernet, President of the Nickel Plate will open the discussion. Annual reports; installation of officers.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting January 9. A paper entitled "Is the Steam Locomotive Out of Date?" will be presented by L. G. Coleman, assistant general manager in charge of mechanical department, Boston & Maine.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Fruenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandalt 605 North Michigan Ave., Chicago.

SUPPLY TRADE NOTES

Irene P. Schofield, secretary, Universal Boring Machine Company, Hudson, Mass., died on December 3.

R. C. Jerome, vice-president and general manager of the Jerome-Edwards Metallic Packing Company, Chicago, has left the service of that organization.

F. W. Doty, Pacific Coast representative of the railroad and government department of Johns-Manville, Incorporated, New York, died at San Francisco on November 9.

The Willamette Iron & Steel Works, Portland, Ore., has begun the manufacture of gear type locomotives designed for use on logging railways. The company expects to build one locomotive a month.

The Gibb Instrument Co., Detroit, Mich., makers of electric welding equipment, has removed its plant and offices to Bay City, Mich. The purpose of this move is to provide increased manufacturing facilities.

R. M. Chissom, formerly chief clerk to the purchasing agent of the Chicago, Indianapolis & Louisville at Chicago, has been appointed special representative in the railroad department of the Lehon Company, Chicago.

D. S. Hutchcraft, formerly vice-president of the Indiana Air Pump Company, Indianapolis, Ind., has been appointed district manager in charge of the Chicago Pneumatic Tool Company's recently established branch office at Tulsa, Okla.

A. P. Dennis, who has been officially connected with the Standard Coupler Company, New York, since its organization, has resigned as vice-president and treasurer. E. F. Pride, secretary and assistant treasurer has been elected treasurer and C. T. Lynch has been elected secretary.

The Ingersoll-Rand Company and the A. S. Cameron Steam Pump Works, New York, have opened a branch office at 718 Ellicott Square building, Buffalo, N. Y. This new office is equipped to render full service to those interested in the numerous products manufactured by these companies.

Ray G. White, formerly Chicago branch manager of B. M. Jones & Co., Inc., has recently been appointed eastern railway sales agent for the McInnes Steel Company, Ltd., Corry, Pa., manufacturers of hammered crucible tool steels. Mr. White has opened up a temporary office at 56 Murray street, New York City.

The Minnesota Supply Company with offices in the Pioneer building, St. Paul, Minn., has been appointed northwestern representative for the Flannery Bolt Company, Pittsburgh, Pa. Blake C. Hopper, formerly with the American Steel Foundries, has been elected secretary-treasurer of the Minnesota Supply Company.

B. H. Tripp, formerly San Francisco manager of the Chicago Pneumatic Tool Co., has associated himself with F. C. Severin, formerly of Niles-Bement-Pond Company and Betts Machine Company in the sale of new and used machinery, with offices at 2220 Chestnut street, Philadelphia, Pa., and 25 Church street, New York City, under the name of Severin-Tripp Machinery Company.

The General Electric Company, Schenectady, N. Y., has set aside a fund of $400,000, the income from which will be available for encouraging and rewarding service in the electrical field by giving prizes to its employees. As an expression of appreciation to Charles A. Coffin, who retired in May, 1922, from the active leadership of the General Electric Company, the board of directors named it the Charles A. Coffin Foundation.

Alfred B. Carhart has resigned as vice-president and sales manager of the Crosby Steam Gage & Valve Company, to become president and general manager of the Precision Instrument Company, Inc., Newark, N. J. Mr. Carhart was for more than ten years works manager of the Crosby factory. He is a mechanical and electrical engineer and a graduate of Princeton

University. The Precision Instrument Company, Inc., has acquired control of the Precision Instrument Company, of Newark, N. J., and the present executive officers will retain their connection with the company. The company's New York City office will be at 114 Liberty street, and the factory will later be moved to New York.

J. J. McCarthy, treasurer and chairman of the board of directors of the Chicago-Cleveland Car Roofing Company, Chicago, died in Chicago from pneumonia on November 25. Mr. McCarthy was born at Burlington, Vt., on April 8, 1842, and moved to Chicago with his parents in 1845. His first railway experience was acquired with the Chicago & North Western in 1855. He was engaged in the banking business from 1856 to 1881 in Chicago, being associated with the Tinkeham Banking Company, George C. Smith & Co. and the Bank of Montreal, consecutively. During the Civil War he was in the service of the Army of the Potomac in the Quartermaster's Corps, being stationed at Harper's Ferry. In 1881, he organized the Chicago Car Roofing Company, which later became the Chicago-Cleveland Car Roofing Company. At the time of the Chicago fire, when the currency of the banks of that city could not be reached because of the fire, Mr. McCarthy went to New York and secured the first currency that was put into circulation immediately following the fire. Mr. McCarthy was said to be one of the two oldest residents of Chicago.

J. J. McCarthy

Peter A. Frasse & Co., Inc., New York City, has been appointed exclusive eastern distributor for the electric carbon, alloy and tool steels in bars, billets and die blocks manufactured by the Sizer Steel Corporation with plants at Buffalo, N. Y., and Solvay (Syracuse) N. Y., combined with the equipment of the Frasse Steel Works, Inc., Hartford, Conn., for cold finishing and heat treating. The Frasse Steel Works has been appointed the exclusive New England distributor for the Sizer Steel Corporation.

The Reed-Prentice Company, Worcester, Mass, has purchased outright the good will, business and certain assets of the Becker Milling Machine Company, Hyde Park, Mass., and the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., and will manufacture the products of these two companies henceforth in its own plant at Worcester. The products will carry their former names, but the manufacturing will be all concentrated in the Reed-Prentice plant and the selling will be done by their present and enlarged, sales force.

E. T. Fishwick, formerly sales manager of the Worthington Pump & Machinery Corporation, New York, has been elected vice-president in charge of sales to succeed F. H. Jones, resigned. William Goodman, assistant to vice-president, has been elected vice-president in charge of engineering and manufacturing to succeed J. E. Sague, resigned. Both Mr. Jones and Mr. Sague will remain with the corporation in a consulting capacity. James C. Barnaby, plant engineer of the Staten Island Shipbuilding Company, is now in charge of certain eingineering work in the Diesel oil engine division of the Worthington Pump & Machinery Corporation.

E. D. Lynch, of the railway department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been transferred to the New Haven, Conn., office, to fill the vacany made by J. P. Alexander's removal to the Boston, Mass., office. R. W. Everson, sales manager of the Mexican branch of the Westinghouse Electric International Company, has been appointed district manager of the Atlanta, Ga., office of the Westinghouse Lamp Company, to succeed Julien Binford, Jr., resigned. A. G. Crocker has been appointed special power representative in the Detroit, Mich., office of the Westinghouse Electric & Manufacturing Company.

Herbert H. Hewitt, president of the Hewitt Rubber Company, Buffalo, N. Y.; the Magnus Company, Inc., New York; the Reading Car Wheel Company, Reading, Pa., and the St. Thomas Brass Company, St. Thomas, Ont., died at his home in Buffalo on December 19. Mr. Hewitt had been in poor health for two years. He was born on January 19, 1855, at Detroit, Mich., and entered the employ of the Pullman Company when he was about 20 years old and later became manager of that company. He subsequently went to Buffalo where he established the Buffalo Brass Company and the Union Car Works. The latter company later became the Buffalo Car Works of the American Car & Foundry Company. Mr. Hewitt was the inventor of several railroad appliances and served as president of the Magnus Company since its organization in 1899.

Frank N. Phelps was recently placed in charge of railroad sales of Baker industrial tractors and trucks, manufactured by the Baker R & L Company, Cleveland, Ohio. Mr. Phelps was born at Boston, Mass., on December 14, 1878. He received a mechanical engineering education at Massachusetts Institute of Technology and has been identified with the electric vehicle industry since 1911, when he took over the sale of Baker road trucks in New England. Mr. Phelps now becomes special railroad representative of the same company as noted above.

F. N. Phelps

Daniel M. Brady Honored

The directors of the Brady Brass Company, New York, tendered a luncheon at the India House, New York, on December 6, in honor of their president, Daniel M. Brady. The dinner was given in recognition of the fact that he has just completed a half century of service in the railway industry and two score years in the metal trade. There were a large number of guests, all business friends of Mr. Brady. Hon. Morgan J. O'Brien presided as toastmaster and addresses were made by Henry A. Bishop of Bridgeport, Conn.; John F. Fowles, vice-president of W. R. Grace & Co., and C. S. Trench, editor of the American Metal Market. Mr. Bishop made a presentation speech, Mr. Brady being the recipient of a gold watch, suitably engraved for the occasion, from the stockholders of the company.

Bethlehem Steel Corporation Absorbs the Midvale and the Cambria Companies

The board of directors of the Bethlehem Steel Corporation at a special meeting on November 24 authorized contracts for the purchase of the plants and other assets of the Midvale Steel & Ordnance Company and of the Cambria Steel Company, excepting the ordnance plant and other business located at Nicetown, Pa., and assets appurtenant thereto.

Through the acquisition of the properties of the Midvale and Cambria companies, the Bethlehem Company will acquire plants at Coatesville and Johnstown, Pa., and Wilmington, Del., and important developed iron ore properties in Michigan and Minnesota, as well as developed coal properties in Pennsylvania. It will also give to Bethlehem important lines of steel products which it does not now manufacture, such as steel freight and mine cars, steel wheels, boiler tubes, agricultural implement parts, etc. The Bethlehem Company's present annual ingot capacity of 4,800,000 tons will be increased to 7,600,000 tons by the Midvale-Cambria purchase.

Standard Stoker Company

The management of the Standard Stoker Company, Inc., New York, has been changed. Frank L. Connable, of New York, vice-president of E. I. du Pont de Nemours Company, who was president of the Standard Stoker Company, is now chairman of the board; W. A. Larner, of New York, vice-president of Peyton-du Pont Securities Company, is now president; Eugene du Pont, of Greenville, Del., a director of E. I. du Pont de Nemours, remains as vice-president of the Standard Stoker Company, and T. W. Keithley, of Wilmington, Del., formerly secretary, is now secretary and treasurer. The directors include F. L. Connable, W. C. Peyton, of New York, who is president of Peyton-du Pont Securities Company; W. A. Simonton, director of traffic of E. I. du Pont de Nemours Co., Wilmington, Del.; G. W. Keithley, Eugene du Pont and W. A. Larner. W. R. Williams, of Richmond, Va., has been appointed general manager with headquarters for the present at Erie, Pa., and Frank P. Roesch, who was western manager, has been appointed sales manager with headquarters at Chicago.

W. R. Williams

William R. Williams was born in Bristol, Va., on November 16, 1866, and was educated in the schools of Richmond, Va. He later, for ten years, attended Virginia Mechanics' Institute, a night school, part of the time teaching mathematics and drawing. At the age of 15 he entered the employment of the Old Dominion Iron & Steel Company at Belle Island, Richmond, serving for six years and when he left that company was chief of works' office. He later went to the Richmond Locomotive Works, and was secretary of the company when it was consolidated with the American Locomotive Company. He remained with the latter company two years as local purchasing agent—a total length of service with the locomotive companies of 18 years. In 1905, in co-operation with Joseph Bryan, formerly president of the Richmond Locomotive Company, he organized the Richmond Forgings Corporation. Mr. Williams served as vice-president of the new company until his recent appointment as general manager of the Standard Stoker Company. In July, 1920, he was appointed assistant secretary of war by President Wilson and served until March 4, 1921, when he was reappointed by President Harding and served for one month, returning to the Richmond Forgings Corporation.

Frank P. Roesch

Frank P. Roesch was born in Alsace, France, and came to this country immediately after the close of the Franco-Prussian War. After graduating from high school he entered the service of the Chicago, Rock Island & Pacific as machinist apprentice at Trenton, Mo., and while serving his apprenticeship studied mechanical engineering under the tuition of his father. Upon the completion of his apprenticeship he went west, working as a machinist in various shops until he resigned a foremanship to take a job as fireman, being later advanced to locomotive engineman. In 1899 he was promoted to traveling engineer on the Colorado & Southern and later was general traveling engineer of the Colorado & Southern System-Atchison, Topeka & Santa Fe, joint lines. In February, 1902, he was appointed master mechanic of the Chicago & Alton at Slater, Mo. He later served as general manager of the Hicks Locomotive & Car Works until the plant was sold in 1906, when he resigned to become master mechanic of the Southern Railway at Birmingham, Ala., and later was transferred to Spencer, N. C. In 1908 he was appointed master mechanic of the El Paso & Southwestern at Douglas, Ariz., where he remained until August, 1918, when he was appointed regional fuel supervisor, Northwest Region, U. S. R. A., and at the close of the railroad administration he became identified with the Standard Stoker Company, as its western manager.

Mr. Roesch has been a frequent contributor to the various railway technical journals since 1898. He is an authority on subjects pertaining to locomotive operation, combustion, etc., and is a past president of the Traveling Engineers' Association.

TRADE PUBLICATIONS

Boiler Feed Water Treatment.—The Dearborn Chemical Company, Chicago, has issued a booklet entitled, "35 Years' Progress Boiled Down," in which the scientific treatment of waters for steam use are briefly summarized.

Miscellaneous Equipment.—The Western Tool & Manufacturing Company, Springfield, Ohio, has issued catalogue No. 19 illustrating its line of expanding mandrels, tool holders, lathe dogs, C clamps, shop furniture, emery wheel dressers, and vises.

Locomotive Starter.—A booklet describing and illustrating the Street locomotive starter has recently been issued by Clement F. Street, Greenwich, Conn. Photographs and drawings are included showing the locomotive starter as applied to the trailer axle, and also diagrams showing the increase in starting tractive force obtained by the application of the starter.

Coxe Stoker.—Bulletin CB1 and a small booklet entitled, "Service," have recently been issued by the Combustion Engineering Corporation, New York. The bulletin, covering the performance of the Coxe stoker on western and midwestern bituminous coals, contains a number of test reports, each of which is accompanied by corresponding curves; also a number of illustrations of successful installations.

Technical Information on Micarta Gears.—In order to acquaint gear users with the advantages of Micarta gears, the Westinghouse Electric & Manufacturing Company has issued a 20-page booklet, entitled "Salient Facts on Silent Gears." The booklet describes the advantages of the use of Micarta gears and pinions and gives photographs and data describing some of their applications, tables of gear data, etc., enabling the gear user to judge whether or not they are applicable to his machinery.

Subway and Elevated Systems.—The principal characteristics of several great rapid transit systems from an electrical engineering viewpoint are presented in Bulletin 44018 issued by the General Electric Company. The facilities for power production, transformation, transmission and utilization are outlined briefly for each of the systems in the cities of Boston, Chicago, New York and Philadelphia.

The General Electric Company has taken a most important part in the manufacture of various types of apparatus for use on all of these systems. Exhaustive engineering studies and tests have been conducted by trained engineers to insure the selection of the proper equipment for the most reliable and efficient operation.

In the spring of 1893 the "Intramural Railway" was constructed at the World's Fair at Chicago and equipment was furnished by the General Electric Company for its operation. In 1895 the Metropolitan West Side Elevated Railway in Chicago was equipped on the same general plan and later in the year the Lake Street Elevated (Chicago) and Brooklyn Bridge (New York). In July 1897 a train of six motor cars was successfully operated in the presence of engineers of the South Side Elevated road and less than a year later 120 cars were in operation in Chicago, and the use of steam locomotives had been abandoned.

EQUIPMENT AND SHOPS

Locomotive Orders

The Chicago Milwaukee & St. Paul has ordered 75 2-8-2 type locomotives from the Baldwin Locomotive Works.

The Central of New Jersey has ordered 10, 8-wheel switching locomotives from the American Locomotive Company.

The Lehigh Valley has ordered 30 locomotive tenders from the American Locomotive Company.

The Chicago, Burlington & Quincy has ordered 50 2-8-2 type and 10 2-10-2 type locomotives from the Baldwin Locomotive Works.

The Northern Pacific has ordered 20 4-6-2 type, 25 2-8-2 type and 4 2-8-8-2 type locomotives from the American Locomotive Company.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 5 4-6-2 type locomotives from the American Locomotive Company. These locomotives will have 25 in. by 26 in. cylinders and a total weight in working order of 269,000 lb.

The Denver & Rio Grande Western has ordered 10 4-8-2 type and 15 Mallet type locomotives from the American Locomotive Company. The 4-8-2 will have 28 in. by 30 in. cylinders and a total weight in working order of 377,000 lb. Of the Mallets which are all of the 2-8-8-2 type, 10 will have 25 in. and 39 in. by 32 in. cylinders and a total weight in working order of 531,000 lb. and five will have a total weight in working order of 230,000 lb.

Passenger Car Orders

The Chicago, Rock Island & Pacific has ordered 50, 70-ft. steel suburban cars from the Standard Steel Car Company.

The Philadelphia & Reading has ordered 45 steel suburban passenger coaches and 5 steel suburban combination passenger and baggage cars from the Bethlehem Shipbuilding Corporation, Harlan Plant.

The Long Island has ordered 40 motor cars, 20 electric trailer cars, 20 trailer coaches for steam suburban service, 10 coaches for steam service and 2 combination baggage and mail cars from the American Car & Foundry Company.

The Southern Pacific will order 15 steel coaches for main line through service, 60 steel coaches for local service, 10 steel diners, 11 steel buffet baggage cars, 35 steel combination mail and baggage cars and 10 steel baggage cars.

The New York Central has ordered 35, 70-ft. steel coaches with 4-wheel trucks from the Pullman Company; 20 combination passenger and baggage cars and 10 coaches from the Pressed Steel Car Company; 30 multiple unit steel passenger motor cars for suburban service, 20 coaches and 10 baggage cars from the Standard Steel Car Company and 40 baggage cars and 20 coaches from the American Car & Foundry Company.

Freight Car Orders

The Gulf Refining Company, Pittsburgh, Pa., has ordered 150 tank cars from the Standard Steel Car Company.

The Pere Marquette has ordered 500 hopper cars of 50 tons' capacity from the Ralston Steel Car Company and 1,500 box cars from the Western Steel Car & Foundry Company.

The Northern Pacific has ordered 1,000 box cars from the American Car & Foundry Company, 1,000 from the General American Car Company, and 1,000 from the Western Steel Car & Foundry Company.

The St. Louis Southwestern has ordered 500 box cars from the American Car & Foundry Company, 500 automobile cars from the Mt. Vernon Car Company and 200 convertible cars from the Rogers Ballast Car Company.

The Union Pacific has ordered 1,000 refrigerator cars from the Pullman Company, 1,000 from the General American Car Company, 1,030 from the Pacific Car & Foundry Company, 1,500 from the Standard Steel Car Company, and 500 from the Mt. Vernon Car Company.

The Union Tank Car Company has ordered 1,000 tank cars of 10,000 gal. capacity from the Standard Steel Car Company, 1,000 from the American Car & Foundry Company, 500 from the General American Tank Car Corporation and 500 from the Cambria Steel Company.

The Chicago, Milwaukee & St. Paul has placed orders with the Bettendorf Company for 3,000 gondola cars; the Western Steel Car & Foundry Company for 2,000 box and 1,000 gondola cars; the General American Car Company for 500 automobile cars and the Pullman Company for 1,000 gondola cars.

Machinery and Tools

The Norfolk & Western has ordered from the Niles-Bement-Pond Company two right line 8-ft. radial drills.

The Pennsylvania has ordered from various builders about 35 tools, including lathes, grinders and horizontal borers.

The Missouri, Kansas & Texas has ordered a 10-ft. full pneumatic plate flanging clamp from the Niles-Bement-Pond Company.

The Southern Pacific has ordered a Niles end-driven axle lathe, a piston rod grinder, and a quartering machine from the Niles-Bement-Pond Company.

Shops and Terminals

Southern Pacific.—This company contemplates the expenditure of $250,000 in shop buildings and machinery at El Paso, Tex.

St. Louis-San Francisco.—This company has awarded a contract for a 300-ton concrete coaling station at Ft. Smith, Ark., to Roberts & Schaefer Company, Chicago.

Chicago, St. Paul, Minneapolis & Omaha.—This company has awarded a contract to the Ogle Construction Company, Chicago, for a 150-ton frame coaling station at Emerson, Neb.

Missouri Pacific.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a one-story brick boiler house 47 ft. by 50 ft. at Coffeyville, Kan.

Chicago, Burlington & Quincy.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the laying of 18,000 ft. of 16 in. pipe for its water treating plant at Galesburg, Ill.

Cleveland, Cincinnati, Chicago & St. Louis.—This company has awarded a contract to the Ogle Construction Company, Chicago, Ill., for the construction of a 400-ton, three track, concrete coaling station at Hillsboro, Ill.

Great Northern.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 500-ton fireproof, three track, automatic electric roller skip type locomotive coaling plant at Havre, Mont.

Chicago, Rock Island & Pacific.—This company has awarded a contract to the T. S. Leake Construction Company, Chicago, for a one-story addition, 40 ft. by 275 ft., to its machine shop and for the construction of a woodworking mill, 60 ft. by 128 ft., at Cedar Rapids, Iowa.

Union Pacific.—This company has completed plans for the immediate construction of shops and yards at Los Angeles, Cal., to cost approximately $1,750,000. The new terminal will include an enginehouse, locomotive shops, freight car shops, coach shops, yards and related facilities.

Illinois Central.—This company has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for a 300-ton coaling station at Macomb, Miss., and a contract to W. J. Zitterel & Co., Webster City, Iowa, for the construction of a water station at Calumet, Iowa.

Chicago, Indianapolis & Louisville.—This company has awarded a contract to the Ogle Construction Company, Chicago, for the rebuilding of a coaling station of 300 tons' capacity at South Hammond, Ind., to replace one which was recently destroyed by fire. The company also will construct a one-story frame shop 45 ft. by 200 ft., at Lafayette, Ind., to cost approximately $8,000, to replace one recently destroyed by fire.

New York, New Haven & Hartford.—This company will install a new turbine generator in its Cos Cob power station to take care of an increased load due to the placing in service of 12 new high speed passenger locomotives. The new generator is a 9,000 kw., single phase, 25-cycle unit.

Union Railroad.—This company, which is an affiliated line of the United States Steel Corporation, has awarded a contract to the Roberts & Schaefer Company, engineers and contractors, Chicago, for a 100-ton capacity, two-track, reinforced concrete, automatic electric, Simplex roller skip type coaling and sanding plant, at Bessemer, Pa.

Louisiana & Arkansas.—This company, through its agents, Harrington, Howard & Ash, consulting engineers of Kansas City, Mo., has awarded a contract to the Herman & McCain Construction Company, Little Rock, Ark., for the building of a one story, brick and reinforced concrete locomotive shop to cost approximately $150,000, at Minden, La. The shops of the company were previously at Stamps, Ark.

PERSONAL MENTION

General

J. F. Sheahan has been appointed mechanical engineer of the Atlanta, Birmingham & Atlantic with headquarters at Atlanta, Ga.

A. W. Kirkland has been appointed superintendent of motive power of the Atlanta, Birmingham & Atlantic with headquarters at Fitzgerald, Ga.

H. L. Hanna has been appointed mechanical engineer of the New York, Chicago & St. Louis with headquarters at Cleveland, Ohio, succeeding T. A. Lawes, retired.

C. S. Patton, superintendent of motive power (system) of the Seaboard Air Line, has been appointed superintendent of motive power, Northern district, with headquarters at Norfolk, Va.

G. T. DePue, mechanical superintendent of the Ohio region of the Erie, with headquarters at Youngstown, Ohio, has been transferred to the Chicago region, with headquarters at Chicago, Ill.

J. J. Hanlin, assistant superintendent motive power (system) of the Seaboard Air Line, has been appointed superintendent of motive power, Southern district, with headquarters at Savannah, Ga.

L. D. Freeman, assistant superintendent of motive power (system) of the Seaboard Air Line, has been appointed assistant to the manager of the mechanical department with headquarters at Portsmouth, Va. Master mechanics will hereafter report directly to the manager of the mechanical department on matters concerning classified repairs and to superintendents of motive power of their respective districts on other mechanical matters. Shop superintendents and other officers hitherto reporting to the superintendent of motive power (system) will report to the manager of the mechanical department.

Master Mechanics and Road Foremen

C. E. McCloskey has been appointed master mechanic of the Gulf Coast Lines, with headquarters at Kingsville, Tex.

E. M. Brockmayer has been promoted to road foreman of engines on the Detroit-Canadian division of the Pere Marquette with headquarters at Detroit, Mich.

W. H. Graves, locomotive engineer, has been promoted to road foreman of engines of the St. Louis Southwestern with headquarters at Pine Bluff, Ark., succeeding A. Townsend.

E. H. McFadden, assistant superintendent of shops of the St. Louis Southwestern at Pine Bluff, Ark., has been promoted to master mechanic, with the same headquarters, succeeding J. W. Blakeburn, deceased.

D. Davis, assistant master mechanic of the Lehigh Valley with headquarters at Easton, Pa., has been promoted to master mechanic with headquarters at Coxton, Pa., succeeding W. B. Woolever, resigned.

C. H. Holdredge, assistant general air brake inspector on the Southern Pacific, with headquarters at Los Angeles, Cal., has been promoted to district road foreman of engines, with headquarters at the same place, succeeding A. M. Meston, who has resigned.

W. S. Tasker, general foreman of shops on the Atchison, Topeka & Santa Fe at Clovis, N. M., has been promoted to master mechanic of the Panhandle division, with headquarters at Wellington, Kan., succeeding A. Dinan, retired on pension.

W. R. Lane has been appointed road foreman of engines of the Missouri division and L. L. Lasswell of the Illinois division of the Atchison, Topeka & Santa Fe, with headquarters at Shopton, Iowa. C. C. Reynolds has been appointed district road foreman of engines of the Los Angeles division, with headquarters at Los Angeles, Cal. P. J. Maloney has been appointed road foreman of engines of the first district of the Albuquerque division, with headquarters at Albuquerque, N. M., and the jurisdiction of W. Daze will be confined to the second district of the Albuquerque division with headquarters at Winslow, Ariz.

Shop and Enginehouse

A. Townsend, road foreman of engines, of the St. Louis Southwestern at Pine Bluff, Ark., has been promoted to assistant superintendent of shops at the same point, succeeding E. H. McFadden.

D. A. Cassiday has been appointed day enginehouse foreman of the Baltimore & Ohio, with headquarters at Hazelton, Pa., succeeding A. McCormick, transferred. F. C. Ryan has been promoted to night enginehouse foreman at Hazelton, succeeding Mr. Cassiday, and C. Stephenson has been appointed boiler foreman, succeeding Mr. Ryan.

Obituary

W. Queenan, assistant superintendent of shops of the Chicago, Burlington & Quincy with headquarters at Aurora, Ill., died November 28 after a short illness.

John T. Chamberlain, for a number of years master car builder of the Boston & Maine, died on December 12 at Medford, Massachusetts. Mr. Chamberlain was born at Eckington, England, on May 21, 1849, and came to this country with his parents shortly thereafter, locating at New York City. At the age of 18 he went to Kent, Ohio, to learn car building. In 1870 he entered the service of the Boston & Albany in its Allston (Boston) shops. In 1888 he left the Boston & Albany to go to Wichita, Kan., as superintendent of the Burton Stock Car Company. Two years later he returned to New England as master car builder of the Boston & Maine. He served in this position until the time of his retirement in 1907. Mr. Chamberlain was president of the Master Car Builders' Association in 1901.

J. T. Chamberlain

L. L. Dawson, who was superintendent of motive power of the Ft. Worth & Denver City, with headquarters at Childress, Tex., until his retirement in 1918, died on December 11 at Champaign, Ill. He was born on February 5, 1863, in London, England. He came to the United States when a boy and entered railway service in February, 1880, as a machinist apprentice in the shops of the Illinois Central at Champaign, Ill. He received various promotions until he was made foreman of the shops at Champaign, in May, 1892. He was promoted to general foreman of shops at Louisville, Ky., in January, 1897, and a year later he was promoted to master mechanic at Memphis, Tenn. He held this position for several years until his appointment as superintendent of motive power of the Ft. Worth & Denver City, which position he held at the time of his retirement.

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Competition on Car Inspection

One of the most important branches of the work of the car department is the inspection of cars to ascertain whether they are in need of repairs or whether they are fit for a certain class of freight. The expense of performing this work is a fairly large item and the inspection has such a direct effect on the safety and economy of operation, that it is a matter which requires constant attention. In order to bring out information regarding the methods used in handling the inspection of freight cars on various roads, the *Railway Mechanical Engineer* offers a first prize of $50 and a second prize of $35 for the best articles dealing with this subject that are received before March 30, 1923. The articles may be of a general nature or may cover some special phase of car inspection, such as the methods of inspection in train yards, locating defects in wheels and trucks, inspection of cars for grain loading, etc. The articles will be rated according to the practical value of the methods described and the ideas presented, and not on the basis of literary merit. In addition to the prizes mentioned above, any other articles that are published in the *Railway Mechanical Engineer* will be paid for at regular space rates. Articles entered in this competition should be mailed to the Managing Editor, *Railway Mechanical Engineer,* Woolworth Building, New York City, early enough to reach our office before March 30.

The Value of Exchanging Ideas

The rapid growth of civilization has been almost directly proportional to man's success in devising ways and means to communicate with his fellows. First verbally, then by writing and printing, then by the telephone and telegraph, and finally by radio, men learned to exchange opinions and ideas, thereby contributing in no small measure to the rapid development of national life and industry. Until the comparatively recent invention, enabling messages to be broadcasted by radio to thousands, if not millions, of people, the printed word was most effective in reaching a wide circulation. Nor has this form of communication lost its power, and thinking people realize, therefore, the important function of a technical paper like the *Railway Mechanical Engineer* in disseminating knowledge which will not only help its readers in their work, but keep them posted regarding the latest news and developments in their particular line.

Most men realize the importance of this work, but unfortunately some do not. The latter frequently fail to read technical papers and profit by the information so readily available. They never submit their experiences for publication and thereby increase the general store of knowledge. It is reported that in a specific case a railroad man, who should have known better, made the remark that his road had tried out a certain piece of apparatus at a cost of $8,000 and he did not propose to make the results of those tests available to other railroad men who would thereby get the information without cost. "Let them find out for themselves," he is quoted as saying. If Columbus, for example, had taken this attitude, where would we be in 1923?

Railroad men should not only exchange ideas verbally among themselves, but they should read the books and technical papers most closely allied with their work, contributing regularly for publication such ideas regarding the work as they think will be of general interest and value. The importance of this practice is aptly indicated in the words of A. W. Shaw: "You have an idea. I have an idea. We swap. Now you have two ideas, and I have two ideas." There is no way of getting around this logic. In few other human transactions can two people give each other something and yet each have more than at first.

Balance the Grinding Wheels

In view of their relatively small experience with grinding machines, some railroad shop men probably do not realize the necessity of balancing the grinding wheels with the greatest care. This should be done whether the wheels are used on common floor grinders or on the heaviest surface grinding machine. It should be done whenever a new wheel is first applied as a check on the manufacturers' balancing, and it should be done at intervals during the life of the wheel, since cases have been known where a perfectly balanced new wheel became out of balance when half worn out. While vibration can be caused by other defects, such as loose bearings, building vibration, revolving parts out of balance, lack of proper steady-rests, etc., unbalanced grinding wheels are probably the most common cause of vibration and chatter marks on work which is being ground. The unbalanced wheel is wasteful of power, produces rough work and will eventually break with possible serious results, if the vibration becomes severe enough. Obviously these reasons are of sufficient importance to warrant the most careful attention to grinding wheel balance.

The most natural place for an operator to look when he discovers chatter marks on ground work is at the spindle bearings of the grinding machine. While these bearings should be under constant surveillance, it must be remembered that the wheel spindle requires sufficient play in the bearings to permit a film of oil to be retained for purposes of lubrication. If the spindle bearings are unduly tightened in an attempt to prevent chatter marks caused by an unbalanced wheel, the spindle will bind and heat.

If chatter marks are not caused by loose bearings, improperly adjusted steady-rests, or building vibration, the grinding wheel should be carefully checked for balance, preferably mounted on its spindle. The common method is to support the wheel spindle on parallel, horizontal ways along which the spindle can roll if it is not correctly balanced. If the wheel is out of balance, correction can be made by chipping out a certain amount of material at the right point on the wheel. In large hole wheels a lead insert is sometimes provided and the wheel can then be balanced by drilling out or adding a slight amount of lead as needed.

In still other large hole wheels balancing can be accomplished by means of an adjustable lead tubing on a wire enclosed within the keyed driving flanges. In view of the importance of correctly balanced grinding wheels in attaining smooth work and reducing the possibility of danger to operators it will pay to make arrangements for the systemmatic and careful check of grinding wheel balance.

Advantages of Outside End-Sills

When cars were built entirely of wood, many were constructed with the end-sills extending beyond the body, because this so-called outside or platform end-sill facilitated repairs. It also had an important advantage in operation because it made it easy for the trainman to go from one side of the car to the other. Since the adoption of steel underframes, end-sills do not require frequent repairs and the outside sill has largely gone out of use. It is still an open question, however, whether this construction is not desirable even under present conditions. The men who work in the yards frequently have to go from one side of a train to the other and it is also necessary for trainmen to cross over at times in road service. While ladders are provided so that men can go over the top of the cars, this method is so inconvenient that they will usually step across on the couplers. There are no handholds required near the center of the car and there is no place that gives a good footing so it is often dangerous to cross between the cars unless they have platform end-sills. There are certainly some advantages in outside end-sills from the operating standpoint but it is largely a matter of judgment whether the additional cost of such construction is justified, for it would necessarily require a slightly longer underframe. As a rule, car designers consider that standard safety appliances make cars convenient and safe for switchmen and trainmen and little attention is given to features of construction that might make a car more attractive to the men on the road. In some cases the operating department is very insistent on the use of platform end-sills and if the transportation men were consulted in the matter it is probable that they would be found practically unanimous in favor of such construction.

Standardization by Preferred Sizes

At the recent meeting of the American Society of Mechanical Engineers a paper was presented on the subject of size standardization by preferred numbers. This is a matter which has not been given much attention in this country, but seems to offer possibilities for simplification and for elimination of waste that should be carefully considered in buying railroad equipment. The authors point out that the choice of sizes used in industry and commerce in most cases is arbitrary, and that slight variations in the sizes finally decided upon are, as a rule, of little importance. For instance, in designing a bearing, the area is first determined, which leads to the choice of suitable diameters and lengths. Suppose the length is selected arbitrarily and the corresponding diameter is found to be 1.70 in., or approximately 1-45/64. The designer must now decide whether he shall reduce the size to 1-11/16 in., or whether he shall increase it to 1-23/32, or to get a more common size, to 1¾ in. Different men have different ideas as to the permissible variation from calculated dimensions and the result is an almost limitless number of sizes.

If certain dimensions are accepted as preferred values, and spaced to fit ordinary requirements, choices may be made in these preferred sizes and a considerable degree of standardization accomplished with little effort. This idea has already been applied to some extent—for instance, in driving wheel centers, although in this instance the size intervals are not logical. The most satisfactory arrangement is to have each size increased in a definite ratio over the one before. For instance, a preferred number system which has been adopted in Germany has several ratios in which each size increases over the preceding size by approximately 60 per cent, 26 per cent, 12 per cent, 6 per cent, and 3 per cent. A series of preferred sizes increasing in geometric progression may be too great a departure from the existing system to be adopted at the present time, but the idea of standardizing the minimum number of sizes in order to facilitate interchangeable manufacturing is readily applied, and merits thorough consideration.

Machining Shoes and Wedges

One of the most important jobs in all locomotive shops is machining shoes and wedges. Formerly this operation was almost always done on the planer, which was a slow and troublesome process. Sometimes the castings were set up three different times to finish the channel and the two sides. Regardless of the method used, it is difficult to finish the channel properly. Shoes and wedges that are to be machined on a planer should be set with the flanges up and a multiple cutter used to finish the four faces at the same time. Even with this method, the time lost while setting up and removing the work and during the return stroke of the table is excessive.

The best method of finishing shoes and wedges is, unquestionably, to use a milling machine. Either the planer type or the knee type can be used. The cutters can readily be arranged to mill the channel and the outside of the flanges at the same time, and since the cutters enter the castings under the scale, they do not become dull as quickly as planer tools. If shoes and wedges are set up in gangs on a planer type milling machine, they can be attached or removed from the fixture while the machine is cutting, thus reducing the idle time of the machine to a minimum. The one thing to be guarded against in milling shoes and wedges is damage to the cutters. Both the solid type and the inserted type cutters are costly, and if they are spoiled the economy of the method is offset by the cost of replacing them. Bronze shoes and wedges often contain small amounts of sand which soon dull the cutters, making it impractical to finish them by milling. However, where either cast iron or cast steel shoes and wedges are used, if the metal is of the proper composition and the castings are reasonably clean, a high cutting speed can be used, and milling will be found by far the best method for finishing these parts.

Modern Shop Machinery Needed

While the railroads have inquired for and actually purchased a large number of new machine tools in the past few months, repair shops and enginehouses are still greatly deficient in modern machine equipment. This lack of up-to-date machinery handicaps the railroads, as pointed out in an article published elsewhere in this issue. The article discusses at some length the present machine deficiency, indicating the causes which have brought it about and suggesting some of the things which can be done to remedy it.

There is no question that the many obsolete and inefficient machines now used in railroad shops and enginehouses result in excessive repair costs and cause equipment to be held out of service, while waiting and undergoing repairs, longer than should be necessary. This has a direct and deleterious effect on revenue-earning capacity and therefore on net earnings. Owing to the fact that the machine department is usually the limiting factor in shop output, the condition of machine equipment is doubly important, a fact not always fully appreciated. It may safely be said that money spent by the railroads for shop machinery in recent years has been insufficient to replace machines as fast as they became worn and out-of-date. Cars and locomotives, in the meantime, have increased in both number and size so that under present conditions the machine shop is more than ever the "neck of the bottle" of shop production.

The present condition of shop machinery can be readily realized from the fact that in shops of some of the most prosperous railroads, the machine tools are on an average 20 years old. These machines lack the power to push high-speed steel tools to anywhere near their capacity, and in consequence the cutting speeds and feeds must be reduced, with resultant increased labor costs. Labor costs are also increased by the difficulty, physical effort and inconvenience in operating old machines as compared to modern productive tools. It is highly important that the subject of machine shop equipment be given deeper study and thought than ever before by railroad men responsible for shop and enginehouse costs. In too many cases new equipment has been purchased without providing facilities, particularly machine equipment, for repairing it. As indicated in the article, a move toward overcoming this condition will be the preparation of intelligent machine tool programs or budgets showing just what new machines are needed and how much it is costing the railroads to get along without them.

Is Paint Spraying Dangerous?

It has long been the contention of painters' labor organizations that the use of paint-spraying equipment is dangerous to operators, and, in fact, bills to prohibit paint spraying are presented to the various state legislatures practically every year. An unusually strong effort is being made this year in California, Minnesota, Wisconsin and New York to secure the passage of legislation prohibiting the spraying of paint. The railroads have more than a passing interest in this matter. It is true that without proper safeguards the use of paint-spraying equipment is distasteful, if not dangerous. Proper ventilation must be provided to carry away fumes and, particularly in the case of paints having a lead base, protective covering is needed for the operator's mouth and nose. Lead paints must be handled with caution, however, even if applied with a brush, since it appears that lead in the human system acts as a poison whether inhaled or taken internally by a workman who eats lunch without properly cleaning his hands.

Protective devices have been developed and have proved effective in guarding the health of those who operate paint-spraying machines. Objections on this ground are therefore unfounded and, while the proposed legislation against paint spraying is disguised as a health measure, there is little doubt that the real objection on the part of the painters' labor organization is due to the fear which the handworker too often has of labor-saving machinery and devices. This fear was evidenced by opposition to the first sewing machine and the opposition to paint-spraying is just as foolish, and shows just as great a misunderstanding of the economics of the case.

Paint-spraying equipment greatly speeds up painting operations, reduces costs, and in the end will benefit not only painters but the entire community. Some hand painters may, and probably will, be released to other gainful occupations, but they and their neighbors will in the long run enjoy a higher standard of living in proportion to the labor saved. Manufacturers of paint-spraying equipment are vigorously opposing anti-spraying legislation, and the railroads should stand ready to assist in this opposition, providing affidavits as needed to prove the savings effected by paint spraying and the absence of ill effects with the use of suitable protective devices.

THE QUESTION BOX

Reboring Cylinder Head Counterbore

Question.—I should like to have suggestions as to the best method for reboring of the counterbore for the piston rod packing in a locomotive back cylinder head, with an air motor and boring bars. I am especially interested in the method of feeding the tool. An attachment to go on a cylinder reboring machine would not answer the purpose, as no such device is available in this shop.—C. J. McDaniel.

[The *Railway Mechanical Engineer* will be glad to receive suggestions from any reader regarding the most satisfactory device for doing this work, and will pay the regular space rate for description and blue-print which are published in answer to this inquiry.]

New Books

Proceedings of the International Railway Fuel Association, 1922. *J. G. Crawford, Secretary, 702 East 51st street, Chicago. 352 pages, 6 in. by 9 in. Bound in leather.*

The proceedings of the fourteenth annual convention of the International Railway Fuel Association which was held in Chicago, May 22 to 25 inclusive, 1922, contains much of permanent value. Among the many committee reports which were presented and discussed the following were the most important: Locomotive Feed Water Heaters; Front Ends, Grates and Ashpans; Firing Practice and Coal Storage. Many able individual papers were also presented. Among these may be mentioned the following: Effect of Tonnage Rating and Speed on Fuel Consumption, J. E. Davenport; Firing Oil-Burning Locomotives, E. H. Baker; Educational Work in Fuel Economy, D. C. Buell; Locomotive Fuel—The Life Blood of Transportation, G. M. Basford; Effect of Circulation on Locomotive Boiler Efficiency, F. G. Lister and Colloidal Fuel, L. D. Bates. Fuel conservation questions from many angles formed the subject of other addresses and discussions.

Grinding Wheels, Machines, Methods. *By members of the executive and technical staffs of the Norton Company, Worcester, Mass., 387 pages, 5 in. by 7½ in., bound in cloth. Published by the Norton Company.*

This book is a notable contribution to the literature on grinding. It does not purport to give the last word in modern grinding practice because the art of grinding is continually in the process of expansion and refinement. It does, however, give a great amount of information regarding present practice in the manufacture of abrasives and the art of grinding. The subject matter is presented in a comprehensive, attractive form, being well illustrated and clearly written. Apparently no important phases of grinding are omitted, so the book forms a very complete text book on the subject. Many of the chapters will be found of great practical value for reference by all grinding machine operators including those in railroad shops. For example, the chapters on Selection of Grinding Wheels, Tool and Cutter Grinding, Machines for Precision Grinding, Efficient Production of Cylindrical Work, Steady-Rests, Internal Grinding and Care and Safe Use of Grinding Wheels may be mentioned. In fact, the entire book is replete with valuable general and detailed information on grinding. The book should be read by all grinding machine operators, being retained for reference after reading. Machine shop foremen should also read it for suggestions as to operations more economically performed by grinding than by present methods.

A Recent Design of 2-10-2 Type Locomotive for the Colorado & Southern

Large Orders for Equipment Placed in 1922

Locomotive Orders Best Since 1918; Freight Cars Eight Times 1921; Passenger Cars Almost Equal Total of Preceding Four Years

THE year 1922, especially the latter half, was noticeable for the placement of many large orders for greatly needed equipment. This movement was not confined to any section, but was participated in by practically every important railroad and also by many small ones.

That the marked revival in the purchase of cars and locomotives is not temporary, but is indicative of the intention of the railways to pursue a liberal policy in adding to their equipment as their earnings increase is evidenced by the plans which a number of roads have already made for the new year. Thus, the Illinois Central has appropriated $9,445,000 for the purchase of 190 locomotives; the Union Pacific has set aside $5,280,000 for 80 locomotives; the Norfolk & Western $4,600,000 for 46 locomotives; the Central Railroad of New Jersey $1,800,000 for 36 locomotives; the Chicago, Rock Island & Pacific $2,600,000 for 40 locomotives; the Pere Marquette $800,000 for 20 locomotives; the St. Louis Southwestern $740,000 for 15; the Western Pacific $330,000 for 6, and the San Antonio & Aransas Pass $75,000 for 3.

Among other roads the Baltimore & Ohio will receive 50 locomotives; the Atlantic Coast Line 45; the Denver & Rio Grande Western 25, and the Nashville, Chattanooga & St. Louis, 15. While much of this equipment has already been ordered, payment will be made this year and is, therefore, included in the 1923 budgets.

Similarly large expenditures are being made for the purchase of freight cars. The Norfolk & Western included in its budget $19,000,000 for 8,000 cars; the Illinois Central $16,323,000 for 7,700 cars; the Western Pacific $5,275,000 for 2,000 refrigerator cars, and the Chicago, Rock Island & Pacific $4,775,000 for 2,500, and the Union Pacific $4,225,000 as its share of the cost of 3,000 refrigerator cars for the Pacific Fruit Express; the Atlantic Coast Line will secure 4,300 cars; the Philadelphia & Reading 3,100 cars; the Baltimore & Ohio 3,000; the Cotton Belt 1,200; the Nashville, Chattanooga & St. Louis 1,000, and the Denver & Rio Grande Western 950.

Among the appropriations for passenger cars are those of the Central Railroad of New Jersey of $2,400,000 for 118; the Norfolk & Western $1,000,000 for 20; the Illinois Central $760,000 for 33, and the Chicago, Rock Island & Pacific $950,000 for 50 cars; while the Philadelphia & Reading will buy 115; the Baltimore & Ohio 84; the Atlantic Coast Line 50, and the Nashville, Chattanooga & St. Louis 15 cars.

The following equipment has been ordered by the Chesapeake & Ohio of which only a small part has been delivered: 58 locomotives, approximate cost $4,586,000; 5,620 freight cars, approximate cost $8,561,000 and 68 passenger cars, approximate cost $1,444,000. The 1923 budget of the Illinois Central included $26,500,000 for new cars and locomotives.

The above is not offered as a complete summary of the work contemplated on even the limited mileage from which reports have been received. Rather, it is offered as indicative of the plans which the roads as a whole are making as they are entering the new year. As such it demonstrates that the railways are planning more improvements than they have had in contemplation at this season in any recent year. From present indications 1923 should be an active year.

Locomotives Orders

Locomotives ordered in 1922 for service in the United States and Canada totaled 2,636 or 10 times the figure of 274 reported for 1921. These figures are the largest since 1918. The totals for 1916 and 1917 were also larger than in 1922.

The export business for 1922 was insignificant in comparison with that of recent years as will be noted from Table I. The only export orders of any size were 8 of the 4-8-2 type for the Argentine State Railways, 6 of the 4-6-2 type for the Chosen Railway (Korea), 10 electric locomotives for the Mexican Railway, 25 of the 2-8-2 type for the Patagonian Railway, 25 of the 2-8-0 type for the Polish State Railways and 10 of the 2-8-2 type for the Sorocabana Railway of Brazil. Considerable electric locomotive equipment was also ordered for the Norde Railway of Spain and the Paris-Orleans Railway of France.

TABLE I—ORDERS FOR LOCOMOTIVES SINCE 1915

Year	Domestic	Canadian	Export	Total
1915	1,612	....	850	2,462
1916	2,910	....	2,983	5,893
1917	2,704	....	3,438	6,142
1918	2,593	209	2,086	4,888
1919	214	58	989	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,568	68	143	2,779

Prior to 1918, Canadian orders included under "Domestic."

The more important orders for the United States and Canadian railroads are shown in Table II which includes 60 roads. The balance was divided into small orders for a number of other roads, including 162 for industrial concerns.

The types of locomotives ordered is shown in Table III. Of the 2,486 locomotives for railroads service, 291 were for switching service. Of these, 73½ per cent or 214 were of the 0-8-0 type and 25½ per cent or 74 were of the 0-6-0 type.

There were 1,573 locomotives of the types usually employed for freight service. The largest proportion, 1,231 or 78 per cent were of the 2-8-2 type. There were also 73 of the 2-8-0 type. Of the 10-wheel connected types there were 261 or 16½ per cent, 157 being of the 2-10-2 and 104 of the 2-10-0 type. While the 2-8-2 is the predominent type for main line freight service, the Philadelphia & Reading; Lehigh & New England; Western Maryland; Toledo, St. Louis & Western and Norfolk Southern ordered the 2-8-0 type. The Pennsylvania ordered 100 of the 2-10-0 type, while the conditions on portions of the Atchison, Topeka & Santa Fe; Chicago, Burlington & Quincy; Colorado & Southern; Illinois Central; Oregon Railway & Navigation and Union Pacific made the use of the 2-10-2 type advisable.

Orders were given for 116 Mallet locomotives, the majority being for road service. Among the roads specifying this type were the Chesapeake & Ohio; Norfolk & Western; Denver & Rio Grande Western and Union Pacific.

Table II—Important Locomotive Orders in 1922

Type	0-6-0	0-8-0	2-8-0	2-8-2	2-10-0	2-10-2	Mallet	4-6-0	4-6-2	4-8-2
A. G. So.	..	..	..	10	..	..	..	..	..	..
A., T. & S. F.	..	..	..	15	..	26	..	..	10	8
At., C. L.	..	..	..	..	..	..	..	..	45	..
B. & O.	..	..	..	85	..	..	..	..	15	..
B. & A.	..	..	..	8	..	..	..	..	..	..
B. & M.	..	22	..	..	..	..	..	..	..	..
Can. Nat.	..	..	..	45	..	..	..	..	..	16
Cent. of N. E.	..	20	..	..	..	..	..	..	..	..
C. of Ga.	..	..	..	18	..	..	..	..	..	2
C. R.R. of N. J.	5	10	..	10	..	..	..	..	5	..
C. & O.	..	..	..	..	..	..	50	..	6	2
C. & El.	..	..	..	10	..	..	..	..	6	..
C. & N. W.	40	..	..	78	..	..	..	..	32	..
C. B. & Q.	..	..	..	82	..	10	..	..	..	8
C. M. & St. P.	..	..	..	100	..	..	..	..	..	..
C. R. I. & P.	..	..	..	30	..	..	..	..	..	10
C. N.-O. & T. P.	..	6	..	25	..	..	..	..	..	..
C. C. C. & St. L.	..	15	..	50	..	..	..	..	15	..
C. & S.	..	..	..	..	..	5	..	..	3	..
D. L. & W.	..	..	..	40	..	..	..	..	15	..
D. & R. G. W.	..	..	..	..	..	..	15	..	..	20
Erie	..	..	..	40	..	..	..	..	20	..
Ga. Ry.	..	..	..	5	..	..	..	..	..	..
Gr. Tr.	..	..	..	8	..	..	..	..	..	..
T. C.	..	15	..	100	..	25	..	..	..	..
Ind. Union	..	5	..	..	..	..	..	..	..	..
L. & N. E.	..	..	7	..	..	..	..	..	..	..
L. V.	..	..	..	35	..	..	..	..	..	..
L. I.	..	6	..	..	..	..	..	..	..	..
La. & St. L.	..	..	..	..	..	..	..	..	..	15
L. & N.	..	10	..	52	..	..	..	..	8	..
Maine C.	..	..	..	..	..	..	..	8	..	..
M. C.	..	10	..	11	..	..	..	..	5	..
M. & W.	..	..	..	5	..	..	..	..	..	..
M., St. P. & S. S. M.	..	..	..	..	..	..	..	..	5	..
M. K. & T.	..	10	..	40	..	..	..	..	5	..
Mo. P.	..	..	..	46	..	..	..	..	..	4
M. & O.	..	..	..	10	..	..	..	..	..	..
N. C. & St. L.	..	..	..	12	..	..	..	..	..	3
N. Y. C.	..	50	..	122	..	..	..	..	30	..
N. Y. C. & St. L.	..	..	..	15	..	..	..	..	4	..
N. Y., N. H. & H.	..	20	..	..	..	..	..	..	..	..
N. & W.	..	..	..	..	..	..	30	..	..	12
N. S.	..	..	5	..	..	..	..	..	..	..
N. P.	..	..	..	25	..	..	4	..	20	..
Nw. Pac.	..	..	..	..	..	..	..	5	..	..
O. W. R. R. & N.	..	..	..	..	..	15	3	..	..	..
P. R. R.	..	..	..	..	100	..	..	..	15	..
P. & P. U.	6	..	..	..	..	..	..	..	..	..
P. M.	..	20	..	..	..	..	..	..	..	..
P. & R.	..	..	25	..	..	..	..	..	5	..
S. L. & S. F.	..	..	..	35	..	..	..	..	..	15
S. P.	..	..	..	..	..	..	..	..	9	..
So. Ry.	..	6	..	15	..	..	..	..	..	..
T. C.	..	..	..	8	..	..	..	..	..	..
T. & P.	8	..	..	..	..	..	..	..	8	..
T., St. L. & W.	..	..	5	..	..	..	..	..	..	..
U. P.	..	..	..	..	..	73	10	..	..	39
W. M.	..	..	10	..	..	..	..	..	..	..
W. P.	..	..	..	6	..	..	..	..	..	..

Of the types usually employed for passenger or express service there were orders for 480 locomotives; of these 299 or 62 per cent were of the 4-6-2 type and 158 or 33 per cent of the 4-8-2 type. Orders included only 4 of the old American type and none of the Atlantic type. Orders for the 4-6-2 type were placed by many roads, the largest being 45 for Atlantic Coast Line; 32 for Chicago & Northwestern; 30 for New York Central; 20 each for Northern Pacific and Erie and 15 each for Baltimore & Ohio; Big Four; Delaware, Lackawanna & Western and Pennsylvania. Orders for the 4-8-2 type included 39 for Union Pacific, 20 for Denver & Rio Grande Western, 16 for Canadian National, 15 for St. Louis & San Francisco, 15 for Los Angeles and Salt Lake, 12 for Norfolk & Western and 10 for Chicago, Rock Island & Pacific.

A large proportion of the orders were placed in the latter part of the year. Largely for this reason the records of locomotives built showed only 1,303 for domestic and 231 for foreign use, a total of 1,534, which is lower than that of any year since 1897. However, in addition to new locomotives the builders handled a large volume of repair work for the railroads which was placed on account of the shopmen's strike.

Table III—Types of Locomotives Ordered in 1922

Type	Railroad	Industrial	Export
0-4-0	2	42	22
0-6-0	74	46	2
0-8-0	214	0	0
0-10-0	1	0	0
2-6-0	4	6	3
2-6-2	4	19	4
2-8-0	73	3	29
2-8-2	1,231	11	46
2-10-0	104	0	0
2-10-2	157	0	0
Mallet	116	0	0
4-4-0	4	0	2
4-4-2	0	0	0
4-6-0	19	0	0
4-6-2	299	0	9
4-8-2	158	0	8
Miscellaneous	7	4	4
Geared	0	19	0
Electric	29	0	14
Total	2,486	150	143

The condition of locomotives on the railroads was at the worst in September, 1922, when 29.9 per cent of the freight locomotives on line were in unserviceable condition. Since then the condition has steadily improved and is now nearly normal.

Freight Car Orders

Freight cars ordered in 1922 for service in the United States and Canada reached a total of 180,900, the largest total reported since 1912, and eight times the 1921 figure.

The freight car buying movement began somewhat earlier in 1922 than did the buying movement for locomotives and was heaviest during the latter part of the year. Important orders were placed by practically every large railroad.

Freight car production for 1922 totaled 66,747 for the United States and Canada and 1,226 for export. The grand total of 67,973 was much lower than the number ordered. The buying in 1921 was abnormally light and but little work was carried over into 1922 while a considerable portion of the orders placed in 1922 will not be delivered until 1923.

Table IV—Orders for Freight Cars Since 1915

Year	Domestic	Canadian	Export	Total
1915	109,792	......	18,222	128,014
1916	170,054	......	35,314	205,368
1917	79,367	......	53,191	132,558
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972

Prior to 1918, Canadian orders included in domestic.

In addition to the construction of new cars the builders handled a considerable volume of repair business in 1922.

Export orders in 1922 totaled only 1,072 and production 1,226. This is a low point which was equalled only twice in the last 25 years, namely in 1914 and 1908. The largest number built for export in any one year was 61,813 in 1919, and the largest number ordered was 53,547 in 1918.

Throughout 1922 the bad order car percentage averaged about 14 per cent. At its worst on August 1 the total number of unserviceable cars was, according to the Car Service Division reports, 345,013 or 15.3 per cent of the total cars on line. The total has since been substantially reduced; on December 1, the number was 226,288 or 9.9 per cent. The normal percentage should be about 5 or 5.5 per cent.

The types of freight cars ordered in 1922 was shown in Table V. In this connection it will be of interest to refer to Table VI which gives the number of freight cars of various classes which were in service on Class 1 railways on January 1, 1922. A comparison of these tables shows that the total freight cars ordered during 1922 was 7.7 per cent of the number in service at the beginning of the year. These orders when delivered will materially strengthen the situation especially as regards refrigerator and tank cars.

TABLE V—TYPES OF FREIGHT CARS ORDERED IN 1922

Type		Number	Per cent
F	Flat and Logging	3,048	1.7
G	Gondola	36,876	20.4
H	Hopper	34,487	19.1
R	Refrigerator	22,987	12.7
S	Stock and poultry	4,683	2.6
T	Tank	5,485	3.0
V	Ventilated box	1,250	0.7
X	Box	67,337	37.2
	Ballast and dump	980	0.5
	Not classified	2,960	1.6
N	Caboose	807	0.4
	Total	180,900	100

Of high capacity cars, 140,000 lb., the Baltimore & Ohio ordered 1,000 gondolas, the Denver & Rio Grande Western 700 gondolas, the Norfolk & Western 6,000 hoppers, the Philadelphia & Reading 2,000 hoppers and 1,000 gondolas and the Pittsburgh & Lake Erie 3,000 hoppers and 2,018 gondolas.

The pressing need of new freight train equipment is strikingly brought out by the fact that during the four years of 1918, 1919, 1920 and 1921 only 239,663 new freight cars were installed on Class 1 railways whereas 243,156 cars were retired, a net reduction of 3,493 cars. There was an increase of 9,225 cars in 1918 and an increase of 32,745 cars in 1919, but these slight gains were more than wiped out by a decrease of 39,153 cars in 1920 and a further decrease of 6,310 cars in 1921. A recent report of the Interstate Commerce Commission shows 32,138 fewer freight cars in service in October, 1922, than at the same time a year before.

TABLE VI—FREIGHT CARS IN SERVICE JANUARY 1, 1922, CLASS 1 RAILWAYS

Type	Number	Per cent
Flat	102,839	4.4
Coal	935,061	39.9
Refrigerator	63,855	2.7
Stock	81,677	3.5
Tank	10,106	0.4
Box	1,038,222	44.3
Miscellaneous	83,940	3.6
Caboose	29,087	1.2
Total	2,344,787	100

Passenger Car Orders

Orders for equipment for passenger trains placed in 1922 totaled 2,469 cars for service on railroads in the United States and Canada. This was a considerable improvement over the figures for recent years as will be noted from Table VII. The types of the cars ordered are given in Table VIII. In addition to these cars orders were placed for over 60 gasoline rail-motor cars on 35 railroads. This list, however, is probably not complete. The increasing favor with which this type of equipment is being received in all parts of the country for branch line service is one of the noticeable features of the year.

TABLE VII—ORDERS FOR PASSENGER EQUIPMENT CARS SINCE 1916

Year	Domestic	Canadian	Export	Total
1916	2,544	......	109	2,653
1917	1,124	......	43	1,167
1918	109	22	26	157
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488

Prior to 1918, Canadian orders included in Domestic.

As was the case with locomotives and freight cars the production of passenger cars in 1922 fell far below the numbered ordered. During the year the passenger cars built totaled 891 which included 676 for the United States, 71 for Canada and 144 for export.

TABLE VIII—TYPES OF PASSENGER EQUIPMENT CARS ORDERED IN 1922

Type	Number
Coach, combination passenger, etc	1,337
Sleeping, parlor, chair, etc	248
Dining	71
Baggage, express, mail	486
Express refrigerator	270
Milk	19
Horse	19
Private, business, miscellaneous	9
Steam and storage battery	4
Total	2,469

Shop and Terminal Construction in 1922

ONE class of facilities whose inadequacies were most evident during the heavy traffic of 1917 and again during the recent period of heavy business is that required for the maintenance and repair of locomotives and cars. This need is particularly pressing now because of the accumulation of repair work to be done. Furthermore, there is a growing realization of the necessity for securing more service from locomotives, which calls for the reduction of delays while awaiting repairs. As a result many of the railways have placed appropriations for improvements to these facilities near the top of their budgets.

Among the first projects which the Atchison, Topeka & Santa Fe undertook following federal control was a large erecting shop at Albuquerque, N. M., which was completed during the year and which involved the expenditure of more than $3,000,000. This road has since authorized the construction of other facilities at that point and at San Bernardino, Cal., which are now under way. The Pennsylvania announced recently that it will build two large shops at Altoona, Pa., while it also has extensive improvements of a similar character under way at other points.

Among the roads which will add to their facilities for the repair of cars, the Great Northern will expend $152,000 for buildings at St. Cloud, Minn., and Great Falls, Mont., while the Union Pacific will add to its car shops at Pocatello, Idaho, at a cost of $135,000.

The Union Pacific will spend $1,750,000 at Los Angeles while the Pere Marquette contemplates the expenditure of $1,000,000 at Detroit. The Illinois Central has appropriated $766,000 for additional mechanical facilities at two points, while the Great Northern will spend over $400,000 at St. Cloud, Minn. The Norfolk & Western will spend $500,000 for additional facilities at two points and the Chicago, Rock Island & Pacific $250,000 at one engine terminal.

Other work for which appropriations have been made includes approximately $1,000,000 on the Southern Pacific Lines for additions at Houston, El Paso and Jacksonville, Tex., and LaFayette, La., and $140,000 on the Western Pacific. The Erie will complete its erecting shop now under construction at Hornell, N. Y., and will build a new power house at Jersey City, N. J.

The Chicago, Burlington & Quincy is expending $2,300,000 for new shops at Denver, Col.; the Missouri Kansas & Texas $1,500,000 for a locomotive repair shop at Waco, Tex., and the Western Maryland $400,000 for a locomotive repair shop at Port Covington, Md. Other roads which are making large additions to their shop facilities are the Louisville & Nashville, the Ulster & Delaware and the Gulf & Ship Island.

In addition to shop improvements new or enlarged engine terminals are being constructed at a number of points.

Closely allied with this is the provision of adequate shop tool equipment, the necessity for which is being realized to an increasing degree in recent years. Among the appropriations for this purpose are $536,000 on the Illinois Central; $500,000 on the Erie; $300,000 on the Norfolk & Western; $194,000 on the New York, Chicago & St. Louis; $150,000 on the Rock Island and a similar amount on the Delaware, Lackawanna & Western; $104,000 on the St. Louis Southwestern; $100,000 on the Pere Marquette; $50,000 on the Denver & Salt Lake and a similar amount on the Great Northern. Other roads which will spend smaller amounts for this purpose include the Ann Arbor ($25,000); the Chicago Great Western ($33,000); the San Antonio & Aransas Pass ($25,000), and the Union Pacific ($30,000).

Water treating facilities have not been overlooked and liberal expenditures for this purpose are contemplated by a number of roads. Among the projects which have been mentioned specifically, the Wheeling & Lake Erie contemplates the construction of a new treating plant.

Partial List of Construction in 1922

Alaskan Railroad.—Roundhouse at Curry (Mile 249); extension of machine shop at Anchorage to double its size; erection of new power house at Anchorage.

Atchison, Topeka & Santa Fe.—New boiler shop at Albuquerque, N. M., cost $400,000.

Atlantic Coast Line.—New 25-stall enginehouse and 100-ft. turntable at Southover, near Savannah, Ga., cost $140,000 (completed).

Baltimore & Ohio.—Engine terminal improvements at Washington, D. C., cost $187,000 (60 per cent completed).

Chicago, Burlington & Quincy.—New shops at Denver, Col., cost $2,300,000 (25 per cent completed).

Cleveland, Cincinnati, Chicago & St. Louis.—New 5-stall engine terminal at Sheff, Ind., cost $200,000 (completed). New 6-stall engine terminal at Ansonia, Ohio, cost $170,000 (completed).

Great Northern.—New engine terminal at Minneapolis Junction, Minn., cost $647,400 (90 per cent completed). Terminal yard and engine facilities at Wenatchee, Wash., cost $1,001,400 (95 per cent completed). New enginehouse, store buildings, tracks, etc., at Skykomish, Wash., to cost $165,900 (80 per cent completed).

Gulf & Ship Island.—New concrete, brick and steel-frame machine shop, enginehouse, boiler shop, blacksmith shop and cinder conveyor, cost $225,000 (75 per cent completed).

Illinois Central.—New yards, shops and engine terminal facilities at Homewood, Ill., cost $8,200,000 (30 per cent completed).

Kansas City Southern.—Improvements to power plant at Pittsburg, Kan., including a 500-kw. direct-connected, engine-driven generator, a 3,000-cu. ft. air compressor, a 350-hp. water-tube boiler and equipment for coal handling, crushing and pulverizing, etc., cost $165,000 (75 per cent completed).

Lake Superior & Ishpeming.—Fireproof building, 500 ft. long, divided into a car repair shop, coach shop and paint shop, at Marquette, Mich., cost $250,000 (5 per cent completed).

Louisiana & Arkansas.—New shops at Minden, La., cost $400,000.

Louisiana Railway & Navigation.—Enginehouse and car repair buildings at Pineville, La., cost $500,000 (20 per cent completed). Enginehouse and machine shops at New Orleans, La., cost $150,000 (10 per cent completed).

Louisville & Nashville.—Yard and mechanical facilities at Loyal, Ky., cost $746,000 (completed). Enginehouse, machine shops and other buildings at Loyal, Ky., cost $464,000 (completed).

Missouri, Kansas & Texas.—Locomotive repair shop at Waco, Tex., cost $1,500,000 (25 per cent completed).

Missouri Pacific.—Installation of boiler washing facilities at various points on system, cost $138,000 (10 per cent completed).

New York Central.—Installation of one 1,500-kw. and one 500-kw. direct-current, turbo-generator at 50th street service plant, New York City, cost $122,000 (90 per cent completed). Remote control sub-station at 110th street, New York City, cost $265,000 (80 per cent completed). Installation of 20,000-kw. turbo-generator at Port Morris, N. Y., cost $881,500 (80 per cent completed). New coal trestle at Belle Isle, N. Y., cost $168,000 (89 per cent completed).

Northern Pacific Terminal of Oregon.—New 1,200,000-cu. yd. hydraulic fill, 8-stall brick and tile enginehouse, cinder pit, turntable, water station, oil fuel station and various other buildings constructed at Guild's Lake freight yard, cost $400,000 (completed).

Oregon Short Line.—Additions to storehouse and changes in present buildings at Pocatello, Ida., cost $153,000 (10 per cent completed). Extension to steel car shop at Pocatello, cost $130,000 (90 per cent completed). Installing 15-ton, 85-ft. span traveling crane in store yard at Pocatello, cost $100,000 (90 per cent completed).

Pittsburgh & West Virginia.—New classification yard and reinforced coaling station, etc., at Avella, Pa., cost $25,000 (completed).

Southern Pacific.—Machine shop at El Paso, Tex., enlarged, cost $240,700 (completed). Engine terminal improvements at various points on the system.

Ulster & Delaware.—Extending present locomotive erecting shop, building new boiler house, installing electric crane and providing other new equipment at Kingston, N. Y., cost $150,000 (60 per cent completed).

Union Pacific.—Coaling station at Carter, Wyo., cost $111,028 (35 per cent completed).

Virginian.—Five-stall extension of enginehouse and alterations to old house at Elmore, W. Va., cost $129,000 (completed).

Western Maryland.—Locomotive repair shop, 100 ft. by 300 ft., at Port Covington, Md., cost $400,000 (completed).

* * *

On the State Railways in Jugo-Slavia

Francis J. Cole

FRANCIS J. COLE, who was until recently chief consulting engineer of the American Locomotive Company, died on January 11, at his winter home in California. By Mr. Cole's death the railway field lost a man who was generally recognized as one of the leading locomotive designers of his day. From his eighteenth birthday when he became an apprentice machinist in the Mount Royal shops of the Northern Central Railroad, Baltimore, Md., until his retirement approximately one year ago, his whole life was devoted to this field.

Mr. Cole was the son of an English Episcopal clergyman, who came to the United States and settled on a farm in Virginia, Francis being a young boy at the time. Farm life, however, did not appeal to him and he became an apprentice machinist as noted above. After serving his time, he accepted a position as draftsman under William H. Harrison on the Baltimore & Ohio, at Newark, Ohio. Being young, ambitious and continually seeking advancement he shortly left the Baltimore & Ohio to become a draftsman on the West Shore, at Frankfort, N. Y., under R. H. Soule, superintendent of motive power. John Player, Mr. Cole's immediate superior, was the mechanical engineer. Also it was here that Mr. Cole became associated with J. E. Sague, who was one of the other draftsmen and with W. F. Dixon, who was a special apprentice.

Francis J. Cole

The impression of his usefulness that he had left with the B. & O. at Newark was such that after a short time of employment at Frankfort, he was offered the position as chief draftsman of the B. & O. at Newark, Ohio. Here he further established his ability, resulting in his transfer to the Mount Clare shops as chief draftsman. Later, about 1890, when G. B. Hazlehurst became general superintendent of motive power, Mr. Cole was appointed mechanical engineer in charge of the design of all mechanical equipment, including cars and locomotives. His exceedingly efficient work in standardizing the design of both the locomotives and cars on this road attracted national attention. Also while on the B. & O. he published a series of articles on locomotive design, which were widely used and generally recognized as the best data available.

In the course of time Mr. Dixon, who had been an apprentice on the West Shore during Mr. Cole's short employment with that road, had become mechanical engineer of the Rogers Locomotive Works at Paterson, N. J. In the fall of 1895, when Mr. Dixon accepted an offer to go to Russia to build a locomotive works, he recommended to Reuben Wells that Mr. Cole succeed him and in 1896 Mr. Cole became mechanical engineer of the Rogers Locomotive Works.

The Rogers Works was temporarily closed in 1899. During this time Mr. Cole accepted under Mr. Sague the position of assistant mechanical engineer of the Schenectady Locomotive Works.

Later when the American Locomotive Company was formed, Mr. Sague becoming mechanical engineer, immediately appointed Mr. Cole as his assistant, and later when Mr. Sague became assistant vice-president, he appointed Mr. Cole as mechanical engineer of the company. This position was held by Mr. Cole until later in life, when wishing to be relieved of some of the arduous duties, he was appointed chief consulting engineer. This position he retained until his recent retirement.

Mr. Cole was a quiet unassuming man, who never spoke of himself or what he did. He had a vein of persistence which generally led to getting his own way, reinforced by the fact that his own way was generally right. He was a close and thorough student with an inborn determination to arrive at exact facts in all his investigations; all resulting in his becoming internationally known as an eminent authority on the mechanical design and performance of the steam locomotive. His name is written high in the annals of American locomotive building.

His best known work was during his connection with the American Locomotive Company, when he was a leading factor in standardizing the locomotive designs and methods of the different plants which were organized under one management to form this corporation.

In the adoption of the superheater Mr. Cole took a prominent part. His work on boiler ratios was a radical departure from former methods and today are universally used. He also will be remembered for his four cylinder compound of former days; and more recently as the designer of Number 50,000, the Cole trailing truck and an innumerable number of details all tending toward refinement of design. He was a bold designer, though a safe one and could never be accused of fostering anything in the way of freakish construction.

He was a prominent member of the American Society of Mechanical Engineers, the American Railway Association, the American Society of Testing Materials and many others.

About two years ago he built a winter home in Pasadena, Cal., and within the past year retired from active business. For the past four weeks he had not been feeling at his best though not thought to be seriously ill. However, after four days of more serious illness he passed away in his sleep at his winter home in Pasadena.

He was a devoted husband, a true and loyal friend to those who were fortunate enough to know him intimately, and of a character whose life and example are only for the good.

LUMBER MILLS OF BRITISH COLUMBIA report that 90 per cent of their output is now being purchased by China and Japan. The Prairie Provinces were formerly the chief outlet for this province's lumber. So insistent is the demand from the Orient that most of the Coast mills are said to be sold out a month ahead.

Freight Train Resistance and Tonnage Ratings

Part I

Method of Determining Adjustment Factor and Applying It Under Various Operating Conditions

By Richard J. McCarty, Jr.
Division Superintendent, Delaware & Hudson

FOR many years after railroads came into existence they were run by empirical methods alone, which, although not scientific, produced the desired results. Continued experience, however, brought out the fact that certain relations exist between various features of train resistance which could be used to increase the efficiency of the locomotives, and as competition increased and the necessity for cheaper operation became more important, these relations were further developed and applied with the result that certain laws governing the movement of trains were established. The purpose of this article is to explain these laws and show how their application results in more economical train operation.

Elements of Train Resistance

In order to start a train, a locomotive must exert a drawbar pull of sufficient force to overcome the total resistance of the train to motion, an analysis of which is given in Table I:

TABLE I

A—Mechanical Resistance,
  (1)—Static Friction (Friction of rest.)
    (a) Journal friction.
    (b) Flange friction (Except on curves.)
    (c) Air friction.
    (d) Other sliding friction.
    (e) Rolling friction.
  (2)—Kinetic Friction (Friction of Motion.)
    (a) Journal friction.
    (b) Flange friction (Except on curves.)
    (c) Air friction.
    (d) Other sliding friction.
    (e) Rolling friction.
B—Resistance due to acceleration.
C—Resistance due to grades.
D—Resistance due to curves.

Of the different elements of mechanical resistance, journal friction is by far the most important; so much so that all other items put together make only a small part of the total. Therefore in the further handling of the subject it will be unnecessary to consider separately the component items of mechanical resistance.

The static friction of any given car or train is considerably greater than the kinetic friction and kinetic friction is greatest at the instant motion takes place, but decreases rapidly as the speed increases up to a point between five and ten miles per hour depending upon conditions, after which kinetic friction increases as the speed increases. For this reason the resistance of a car to motion is greater than the resistance of the car to continued motion after having been started, from which it is clear that unless some means were adopted to overcome the greater resistance of static friction as compared to kinetic friction, a locomotive would be unable to start a full tonnage train which otherwise it could successfully handle. This is done in railroad practice by the provision of slack in the draft gears of the cars which enables a locomotive to start a train, one car at a time.

Static friction being restricted to one car at a time by the operation of the slack, it become a very small proportion of the total static and kinetic friction, and as the number of cars set in motion increases, the proportion of static friction decreases. Also the slack permits of a comparatively quick acceleration, one car at a time, which greatly overcomes the high resistance of kinetic friction at extremely slow speeds. Therefore, it is proper to continue the discussion without further regard to static friction and also without regard to the values of kinetic friction at speeds below that resulting from the operation of the slack.

Acceleration

A certain amount of force is required to give a train motion and the excess force over that required to overcome the mechanical resistance of the train, which is the force of acceleration, is what produces the motion. As long as the excess, or force of acceleration exists there will be an increase in speed. If the speed of a train is 5 miles per hour and the total drawbar pull exactly balances the mechanical resistance the speed will remain at 5 miles per hour without any additional force whatever. In other words, after a train has been given a certain velocity it requires a force necessary only to overcome the mechanical resistance in order to maintain that velocity. Of course, when grades and curves are involved, it is necessary to overcome grade and curve resistance in addition.

From the moment the first car is started the force of the locomotive is working to overcome mechanical resistance and to give the train motion, and when the last car is set in motion the force required to move the train is at the maximum. Then assuming that the full tractive force of the locomotive is applied, there would be a constant acceleration were it not for the fact that as the speed of the train increases the kinetic friction decreases. This being so, the decreasing amount of force required to overcome the mechanical resistance results in an increasing amount of force available for acceleration, and therefore the train acquires speed with an increasing acceleration until the speed of minimum friction is reached.

Before any values can be given for acceleration it is necessary to know in what distance or in how much time the desired speed should be acquired. Operating conditions have a great deal to do with this, and on that account it is hardly possible to establish a standard value. In this connection, however, it is important to bear in mind the fact that in actual practice that part of the tractive force overcoming mechanical resistance decreases as the speed increases from extremely slow speeds up to the speed of minimum friction, while that part of the tractive force producing acceleration increases the second proposition resulting from the first and, also as the piston speed increases beyond its speed of maximum effectiveness the total drawbar pull decreases. Therefore, except in cases where unusually quick starts are required, it is not necessary to further consider this item with respect to specific values, in working out a tonnage rating formula.

Grade and Curve Resistance

Resistance of grades is the result of gravity which is the force that must be overcome when a body is lifted. When a car or train moves up-grade it is being lifted, and the amount of force required depends on the rate of grade. This is the problem of the inclined plane in which the sustaining force is to the weight as the height of the plane is to the length, or specifically stated, the resistance of grades is overcome at the rate of 20 lb. per ton for each one percent of grade.

Resistance of curves is very difficult to determine and it varies with the degree of curvature, length of curve, elevation of outer rail and kind of equipment. All figures for curve resistance do not agree but the average value, which is much used, is 1.4 lb. per ton for each degree of curve for steam locomotive and 0.8 lb. per ton for each degree of curve for freight cars. It is frequently the practice to disregard light degrees of curvature, which practice under ordinary conditions can be followed out for curves under two degrees. Also when curvature is compensated, curve resistance may be disregarded altogether.

If any curve over two degrees is as long or longer than any full tonnage train the resistance of 0.8 lb. per ton should apply to the entire train, but if not, the resistance of 0.8 lb. per ton should apply to only that part of the train that is on the curve.

In computing ratings, it is frequently the practice to convert the curve resistance in pounds per ton into the equivalent grade and add the equivalent to the actual grade. In the further handling of this subject curve resistance will be considered as being included in grade resistance and when no grade resistance is used it will be understood that straight and level track is being considered.

Summary of Resistances

In order to further develop the subject it will be necessary to summarize the foregoing description of the various resistances that are involved in train operation with a view of setting forth only such items as need be specifically considered in developing various formulas and explaining the relations that exist between the various fundamental items.

For reasons, previously given, all mechanical resistance, as shown in Table I, can be grouped and further considered as a single unit of resistance.

On account of the operation of the slack and the rapid decrease of mechanical resistance of cars as the speed increases up to the speed of minimum friction, which has been explained, the item of resistance due to acceleration can be disregarded.

For simplicity curve resistance is usually converted into equivalent grade resistance and considered as a part of the grade resistance.

Therefore, all further consideration of the subject may be properly based on only two items of resistance as follows: (1) Mechanical resistance, (2) Grade resistance.

Locomotive Resistance

Obviously the first step in determining the pulling capacity of a locomotive is to ascertain how much of the power is used within itself before any drawbar pull is obtained. In any train the total resistance of both locomotive and cars is overcome by the cylinder tractive force of the locomotive. For analytical purposes this force will be represented by formula as follows:

Cylinder tractive force $= F = f' + LG + f$ .... (1)

in which f' = Total mechanical resistance.
L = Total weight of engine and tender in tons.
G = Grade resistance in lb. per ton.
f = Balance available for drawbar pull.

The mechanical resistance of steam locomotives is generally taken as 25 lb. per ton for the weight on the drivers and for the engine trucks the same rate in pounds per ton as a car of the same axle load. Mechanical resistance of tenders should be computed loaded at the rate in pounds per ton given for a car of the same weight.

When high speeds are involved it is necessary to make special allowance for head-end air resistance but as this item in ordinary freight service is of no practical importance it may be dropped in the further consideration of this particular subject.

Grade resistance is the same as for car resistance previously explained but in adding curve resistance special values pertaining to the resistance of locomotives on curves must be used as shown under the heading "Resistance of Curves."

From equation (1), $f = F - f' - LG$. .... (2)

This equation may be developed into a formula of practical value in connection with any given class of locomotive so that the drawbar pull on any grade may be easily derived. For example, the E 57 class of 2-8-0 type locomotives of the Delaware & Hudson have the following specifications:

Cylinder tractive force at 250 ft. per min. piston speed	56,900 lb.
Diameter of drivers	57 in.
Stroke	30 in.
Weight on front truck	12.75 tons
Weight on drivers	118.18 tons
Weight on trailing trucks	......
Weight of tender in service	69.63 tons
Total weight	200.56 tons

Cylinder tractive force of locomotives is generally based on a piston speed of 250 ft. per minute and therefore if the train speed required on any ruling grade results in a piston speed of more than 250 ft. per minute, a reduction in the tractive force takes place which can be easily adjusted by applying the proper speed factor to the conditions under consideration. Speed factors in tabulated form are published in various books pertaining to locomotive construction and operation.

It will be assumed that the desired train speed is 10 miles per hour, which gives a piston speed of 295 ft. per minute. The speed factor at this piston speed is 0.954 which applied to the cylinder tractive force of 56,900 lb. gives 54,283 lb. available at 10 miles per hour. Therefore, this locomotive on straight and level track at 10 miles per hour would have the following cylinder tractive force and mechanical resistance:

Cylinder tractive force	54,283 lb.
Resistance—	
Front truck at 3.7 lb. per ton	47 lb.
Drivers at 25 lb. per ton	2,955 lb.
Trailing truck	.....
Tender at 3.1 lb. per ton	216 lb.
Total resistance	3,218 lb.

Then by substitution, equation (2) should read

$$f = 54.283 - 3,218 - 200.56\ G \quad \text{(3)}$$

$$\text{or } f = 200.56\ (254.6 - G) \quad \text{(4)}$$

By substituting the grade resistance in pounds per ton for any given grade in place of G, the drawbar pull for the class of locomotive in question is easily found. When this is done it is then necessary to determine the proper tonnage rating for that amount of drawbar pull, from which the ratings for other classes of locomotives can readily be found by multiplying that rating by a value that represents the ratio of the cylinder tractive force of any other given class of locomotive to the cylinder tractive force of the class of locomotive selected as a basis. In this way it is necessary to make detail calculations for only one class of locomotive on any given district to find all the other ratings. This brings up the question of car and train resistance which will now be explained.

Car and Train Resistance

The first element to consider in this connection is "Mechanical Resistance."

Master Mechanic's Proceedings of 1914 gives the mechanical resistance of freight cars at 5 miles per hour as shown in Table II.

TABLE II

Mechanical Resistance of Freight Cars at 5 Miles per Hour

Wt. of cars and contents		Mech. resist. per ton		Mech. resist. per car	
Tons	Per cent Incr.	lb.	Per cent Decr.	lb.	Per cent Incr.
20	Basis	6.8	Basis	136	Basis
25	25	6.0	11.7	150	10.3
30	50	5.4	20.6	162	19.1
35	75	4.8	29.4	168	23.5
40	100	4.4	35.2	176	29.4
45	125	4.0	41.2	180	32.3
50	150	3.7	45.6	185	36.0
55	175	3.5	48.5	193.5	42.3
60	200	3.3	51.5	198	45.6
65	225	3.2	52.9	208	52.9
70	250	3.1	54.4	217	59.5

From Table II, the following corollaries may be deducted:

1—The mechanical resistance of cars in pounds per ton decreases when the weight increases, but in less proportion.

2—The mechanical resistance of cars in pounds per car increases when the weight increases, but in less proportion.

Therefore, from 1 and 2.

3—The number of actual tons a given drawbar pull can move will increase when the average weight of the cars increases, while the number of cars will decrease.

These facts are of the greatest importance as will be seen in their application to practical purposes.

If the mechanical resistance of all cars in pounds per ton were the same, in order to find a tonnage rating for any given tractive force it would be necessary only to divide the available drawbar pull by the total of the following items of resistance in pounds per ton.

(1) Mechanical Resistance.

(2) Grade Resistance (Including curve resistance).

But in view of the fact that at any given speed the mechanical resistance of cars of different weights are not in proportion to their weight, tonnage ratings worked out by this method alone will not produce a constant amount of total resistance for each rating regardless of car weights. Therefore, it is clear that actual tonnage ratings must be arranged so that any train of a certain rating will have the same total resistance as any other train of the same rating, regardless of whether the cars making up the trains are light weight cars or heavy weight cars. There are several ways of doing this but the principle is the same in all cases. The adjusted tonnage method, being extensively used, will be taken as a basis in further developing the subject.

Adjusted Tonnage Method

In this method there is taken as a basis a given amount of drawbar pull, from which is found, either by test or calculation, the tons and cars of light cars and the tons and cars of heavy cars that can be handled over any given district. These amounts are then equated, from which a rating is obtained that will produce approximately the same amount of total resistance regardless of car weights.

The values of mechanical resistance as used hereafter are all based on those given in Table II. Tables III and IV give a comparison of two trains of the same total resistance but of unequal weight.

TABLE III

Two Trains of Same Total Resistance but of Unequal Weight

Straight and level track—Speed 5 miles per hour.

Items Resistance in lb.	Lighter Car Train	Heavier Car Train	Difference
Tons per car	20	60	40
Mech. resist. per ton	6.8	3.3	—3.5
Grade resist. per ton	..	..	..
Mech. resist. per car	136	198	62
Grade resist. per car	..	..	..
Actual tons	1.980	4,080	2,100
No. of cars	99	68	—31
Total mech. resist.	13.464	13,464	.....
Total grade resist.	..	..	..
Total all resist	13.464	13.464	.....
The above trains on Adjusted Tonnage Rating Basis:			
Adjustment	67.74	67.74	.....
Actual tons	1,980	4,080	+2,100
Potential tons	6,706	4,606	—2,100
Adjusted tons	8,686	8,686	.....

TABLE IV

Two Trains of Same Total Resistance but of Unequal Weight

Grade 1 per cent—Speed 5 miles per hour.

Items Resistance in lb.	Lighter Car Train	Heavier Car Train	Difference
Tons per car	20	60	40
Mech. resist. per ton	6.8	3.3	—3.5
Grade resist. per ton	20.0	20.0	...
Mech. resist. per car	136	198	62
Grade resist. per car	400	1,200	800
Actual tons	502.4	577.9	75.5
No. of cars	25.12	9.63	—15.49
Total mech. resist.	3,416	1,907	—1,509
Total grade resist.	10,048	11,557	+1,509
Total all resist.	13,464	13,464	.....
The above trains on Adjusted Tonnage Rating Basis:			
Adjustment	4.87	4.87	.....
Actual tons	502.4	577.9	75.5
Potential tons	122.3	46.8	75.5
Adjusted tons	624.7	624.7	.....

From these two tables it will be seen that regardless of conditions, a given drawbar pull will move more tons and less cars of heavier cars than of lighter cars.

In order to make an analysis of general application the values given in Table IV will be converted into algebraic expressions as shown in Table V.

TABLE V

Algebraic Expressions for the Values of Table IV

Applicable to straight and level track or any grade

Items	Lighter Car Train	Heavier Car Train	Difference
Tons per car—incl. load	W	(W+w)	w
Mech. Res. in lb. per ton	E	(E—e)	e
Grade Res. in lb. per ton	G	G	..
Mech. Res. in lb. per car	R	(R+r)	r
Grade Res. in lb. per car	D	(D+d)	d
Actual tons	T	(T+t)	t
No. of cars	C	(C—c)	c
Total Mech. Resistance	TE	(T+t) (E—e)	tG
Total Grade Resistance	TG	(T+t) **G**	t**G**
Total All Resistance	f	f	..

Although this table is based on the specific values as given in Table IV the formulas that are developed below are true for any other values that might be substituted provided that the total resistances of the trains are equal, and provided that the mechanical resistance in pounds per ton of a heavier car is less than that of a lighter car but not as much less as it would be if it were inversely in proportion to their weights.

From Table V the following fundamental equations are obtained:

LIGHTER WEIGHT CARS:

$$\begin{aligned} T &= CW \quad \dots\dots\dots\dots (5) \\ f &= T\,(E + G) \quad \dots\dots\dots\dots (6) \\ &= C\,(R + D) \quad \dots\dots\dots\dots (7) \\ &= CW\,(E + G) \quad \dots\dots\dots\dots (8) \end{aligned}$$

HEAVIER WEIGHT CARS:

$$\begin{aligned} (T + t) &= (C - c)\;(W + w) \quad \dots\dots\dots\dots (9) \\ f \quad &= (T + t)\;(E - e + G) \quad \dots\dots\dots\dots (10) \\ &= (C - c)\;(R + r + D + d) \quad \dots\dots\dots\dots (11) \\ &= (C - c)\;(W + w)\;(E - e + G) \quad \dots\dots\dots\dots (12) \end{aligned}$$

The fundamental equations give in cars and car weights a comparison of the tons of a lighter car train and a heavier car train respectively, as follows:

Lighter car train $= CW$ ....From (5)
Heavier car train $= (C - c)\;(W + w)$ ....From (9)

Equating these two ratings which are equal in total resistance but unequal in tons.

$$CW + t = (C - c)\;(W + w) \quad \dots\dots\dots\dots 13)$$

in which (t) represents the difference in tons of the two trains. In order to express these ratings in the same terms it is necessary to find an amount in tons that added to each car weight will equalize the difference in mechanical resistance that caused the difference in the tons of the two trains.

Let (x) represent the amount required.
Then from (5) and (9) $C(W + x) = (C - c)\;(W + w + x)$ ....(14)

From which $$x = \frac{t}{c} \quad \dots\dots\dots\dots (15)$$

Therefore, from (14) and (15)

$$C\left(W + \frac{t}{c}\right) = (C - c)\;\left(W + w + \frac{t}{c}\right) \quad \dots\dots (16)$$

$$T + C\frac{t}{c} = (T + t) + (C - c)\frac{t}{c} \quad \dots\dots\dots (17)$$

in which

$$T \text{ and } (T - t) = \text{Actual tons} \quad \dots\dots\dots\dots (18)$$

$$\frac{t}{c} = \text{Adjustment} \quad \dots\dots\dots\dots (19)$$

$$C\frac{t}{c} \text{ and } (C - c)\frac{t}{c} = \text{Potential tons} \quad \dots\dots\dots\dots (20)$$

$$C\left(W + \frac{t}{c}\right) \text{ and } (C - c)\;\left(W + w + \frac{t}{c}\right) = \text{Adj. tons} \quad \dots (21)$$

Equations (14) and (15) mean that if there is added to the weight of each car of each train an amount of tons equal to the difference in the tons of the two trains divided by the difference in the cars, the sum of the car weights plus the adjustments of one train will equal the sum of the car weights plus the adjustments of the other train. This amount is the adjusted rating and it will produce trains of the same mechanical resistance regardless of car weights within certain limits which will be taken up in proper order.

By using in equations (16) and (17) the values given in Table IV the following is obtained:

From (16) $25.12 \times (20 + 4.87) = 9.63 \times (60 + 4.87)$ ....(22)
From (17) $502.4 + (25.12 \times 4.87) = 577.9 + (9.63 \times 4.87)$ ....(23)
or for both (16) and (17) $624.7 = 624.7$

Although the two trains in question are of different weight, the adjusted ratings, as will be seen, are the same for both.

Tables III and IV indicate that in any two trains of the same adjusted tonnage rating, the difference in actual tons is always equal to the difference in the potential tons. That this is true in all cases, may be shown as follows:

From (16) $$CW + C\frac{t}{c} = (C - c)\;(W + w) + (C - c)\frac{t}{c} \quad \dots (24)$$

Then $$(C - c)\;(W + w) - CW = C\frac{t}{c} - (C - c)\frac{t}{c} \quad \dots (25)$$

From which $$t = t \quad \dots\dots\dots\dots (26)$$

The principle of an adjusted tonnage rating is, that as the number of cars increase the number of adjustments or the potential tons increase, and as the potential tons increase, the actual tons decrease. Therefore, the function of the adjustment is to balance the tons, the number of cars and the total resistance.

(To be continued)

* * *

Two-Cylinder Pacific Type Locomotive for the Midi Railroad of France

The Chemins de Fer du Midi has recently placed in service 20 two-cylinder, superheated, 4-6-2 type locomotives built by the Societé Alsacienne de Constructions Mechanique, Belfort, France. Locomotives formerly used were of approximately the same weight and capacity, but of the four-cylinder compound type. A change was made to the two-cylinder, single-expansion, superheated type because of greater simplicity and lower cost of maintenance, tests having shown that the efficiency would be practically the same. The boiler was changed from the Belpaire to the straight top type, the number of 5¼-in. flues with superheater elements increased from 24 to 28 and the number of 2¼-in. tubes decreased from 145 to 123. The evaporative heating surface and grate area remained practically the same, but the volume of gas passed through the large flues was increased from 40 per cent to 47 per cent, with about a 20 per cent increase in superheating surfaces. The boiler pressure was dropped from 227 lb. to 185 lb. The new locomotives weight 196,420 lb. in working order, with 118,720 lb. on the drivers, and have a rated tractive force of 32,900 lb. The cylinders are 25 in. by 25⅝ in. and the driving wheels are of 76⅜ in. diameter. The evaporative heating surface is 2,179 sq. ft., the superheated surface 791 sq. ft., and the grate area 43 sq. ft. These locomotives are hauling express trains having an average weight of 254 tons with an average coal consumption of 47 lb. per mile.

The Design of Engine and Tender Drawbars

Some Comments on the Existing Practice with Suggestions for a More Logical Basis of Design

By H. J. Coventry

IN view of the fact that the safety of life and property depends so largely upon avoiding failure of the drawbar between engine and tender, it is rather surprising to find so little definite and no unanimous opinion as to the basis of design, or any agreement as to a proper allowable stress on the material.

That drawbars do break sometimes and with fatal results is sufficient warrant for further inquiry as to whether our fundamentals of design are on correct lines, more especially in view of the large and steadily rising tractive force of present day power.

A report on Drawbar and Safety Connections to the American Railway Master Mechanics' Association in 1903 appears to be the first step taken to obtain uniformity of design. The recommendation is made that the area of cross section of the bar body should be a value in square inches, found by dividing the tractive force by a factor (stress) sufficiently low to give a factor of safety that would cover all possible conditions. That is

$$A \text{ sq. in.} = \frac{T}{f}$$

The value of f was to be taken at 4,000 lb. per sq. in. maximum, and the material to be hammered wrought iron, of 45,000 lb. per sq. in. ultimate tenacity. Later we find 4,500 lb. per sq. in. recommended as the factor, and this is confirmed in the report to the A. R. A., Section III, 1920, on this subject. From the variance of discussion on the report at the time of presentation it would appear that opinion was not emphatic or unanimous. A recent inquiry among prominent railroads as to their practice for drawbar design, and any formula used elicited the following replies:

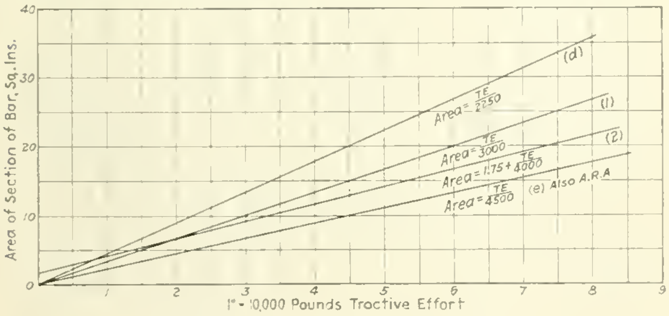

Fig. 1—Graphical Comparison of Drawbar Formulas

Railroad a—No formula, go by precedent.

Railroad b—No formula.

Railroad c—No formula.

Railroad d—Formula $A = \frac{T}{2,250}$ Material—Iron of 45,000 lb. per sq. in.

Railroad e—Formula $A = \frac{T}{4,500}$ Material—Steel of 80,000 lb. per sq. in.

Locomotive builder 1—Formula $A = \frac{T}{3,000}$ or $A = \frac{\text{Total weight}}{18,000}$

Locomotive builder 2—Gave standard dimensions, no formula.

The formulæ given and one to approximate the practice of locomotive builder 2 are shown plotted in Fig. 1. It will be readily seen that to meet a tractive force of 70,000 lb., the minimum would be 15.5 sq. in. and the maximum 31.25 sq. in. in the body of the bar, while if the locomotive happened to be very heavy for its tractive force, an even greater area of bar would be called for as the larger value of the two equations under heading 1 is intended to be used. This wide range, and the absence in many cases of any definite method seems to indicate the need for a better and more logical basis of design.

The following is, therefore, suggested as an improvement, although the impossibility of deriving a complete theory to fit the complicated stresses to which a drawbar is subjected, and at the same time covering the unknown influence of the surrounding structure, is fully recognized.

It is assumed that the amount of slotting in the eye ends, draw pin arrangement, striking casting, etc., are such that the bar never has a compressive load put upon it. Such a condition should be, and can be avoided by proper design of the draft arrangement between engine and tender. Sufficient clearance should also be provided in the draw pin pocket to void the possibility of putting side bending stresses in the bar when the locomotive passes round the sharpest curve, or oscillates at high speed.

The practice of offsetting should not be tolerated owing to the rapid increase of stress for even small offsets for a given cross-sectional area. Also the tractive force transmitted by an offset bar is less than that delivered to it by the engine draw pin, the balance tending to lift or depress the tender according to whether the engine pin is higher or lower than the tender pin.

The amount of slotting in the eye should not be more than is absolutely necessary for the conditions, and the holes need not be more than 3/16 in. wider than the diameter of the pins.

If these conditions are complied with it can safely be said that the stresses induced in the bar are purely tensile, but of somewhat wide range. From the nature of the case it seems reasonable that the stress would range from that produced by twice the tractive force, seeing that the load is a live one, to anything above, according to the degree of shock. The degree of shock is proportional to the total amount of slotting or slack in the eyes. While the actual amount of slack between the engine and tender is sometimes maintained at a minimum by wedge devices, there is no guarantee that at some time the whole of the slotting will not come into play. For design purposes, therefore, the maximum amount must be considered, and it is conceivable that the tractive force could be applied when the engine and tender are fully compressed. Put in another way, the drawbar is analogous to a bar having a load equal to the tractive force dropped on it from a height equal to the amount of slack.

Work is therefore done on the bar by an amount equal to the product of tractive force and slack, plus the extension of the material; that is,

$$K = T_e (d + x) \ldots\ldots\ldots\ldots (1)$$

Where K = work in inch lb.
T_e = tractive force in lb.
d = total slotting or slack in inches
x = extension of material in inches.

This amount of work is absorbed by the material of the bar if the connections and surrounding structure are infinitely rigid. The work done by the material is:

$$\frac{1}{2} Wx$$

Where W = an equivalent static or dead load
x = extension caused by W
We now have the equation

$$T_e (d + x) = \frac{1}{2} Wx \quad \ldots\ldots (2)$$

From definition of modulus of elasticity

$$E = \frac{W}{A} \times \frac{l}{x} \quad \ldots\ldots (3)$$

Where E = modulus of elasticity of the material in lb.
A = area of section in square inches
l = length of section in inches
x, W and d as before
From equation (3)

$$W = \frac{EAx}{l} \quad \ldots\ldots (4)$$

Substituting the value of W in equation (2)

$$T (d + x) = \frac{1}{2} \frac{EAx}{l} x$$

$$T (d + x) = \frac{EAx^2}{2l} \quad \ldots\ldots (5)$$

From which for any particular values of T, l, d, A and E the extension x can easily be computed. Having found x the stress f may be found from equation (3) modified:

$$f = \frac{Ex}{l} \quad \ldots\ldots (6)$$

as also $x = \frac{fl}{E}$ substituting this in equation (5)

We obtain $T (d + x) = \frac{EAf^2l^2}{2lE^2}$ and

$$T (d + x) = \frac{f^2}{2E} \times Al \quad \ldots\ldots (7)$$

Al is obviously the volume of the bar and $\frac{f^2}{2E}$ is the resilience per unit volume if f is taken at the elastic limit.

It is now evident that a drawbar can be made stronger either by increasing the length or volume or using a material of higher resilience and reducing the amount of slotting or slack. Any or all of these methods will have a strengthening influence.

The specification for drawbar material should include a resilience requirement or work done per cubic inch in stretching the bar up to the elastic limit and also work per cubic inch required to fracture a specimen. These two values give a better idea of the suitability of material subjected to shock than ultimate tenacity.

Then equation (7) becomes

$$T (d + x) = R \times V \quad \ldots\ldots (8)$$

where R = resilience in inch lb. per cubic inch
V = volume of the bar in cubic inches

As x will be small compared to d, it may be omitted.

Up to this point the assumption has been that the connections of the bar and surrounding structure are infinitely rigid. This, of course, is not true in practice, as all the surrounding material is elastic and absorbs some of the energy of impact. We may, therefore, quite safely select a higher resilience value than that at the elastic limit for the material without actually reaching dangerous high stresses, for it will most probably be found that f, the stress calculated from equation (7), will be abnormally high for any selected average drawbar. It, therefore, becomes a question as to the economical practical value to be assigned to R.

From the experiments of Wohler, Spangenberg and others on fatigue of metals under repeated stresses, it was found that the stress could be much above the elastic limit, if load was applied momentarily and that the limit of stress depended more upon the ultimate static breaking stress, than the elastic limit. Upon these results the "dynamic theory" is based which assumes that a piece of material will not break under repeated loadings if the momentary stress due to sudden application of load does not exceed the statical breaking strength of the material.

Supposing a material of 55,000 lb. per sq. in. tenacity is used. Taking, say 0.94 of this gives 52,000 lb. sq. in. as momentary stress. Equation (7) then becomes

$$52{,}000 = \sqrt{\frac{2E\,Td}{V}}$$

If E = 27,000,000, then $V = \frac{27\,Td}{26 \times 52}$ or $= \frac{Td}{50} \ldots\ldots (9)$

The volume of the drawbar V should be taken from center to center of eyes.

A bar designed to this formula would never be stresssd to the breaking point even if the connections were infinitely rigid; the elasticity of the latter provides what is equivalent to a factor of safety. Moreover, a set of bars suitable for different conditions would be all equally strong, under their respective conditions, and it is considered that this method overcomes the objection sometimes raised that the stress of 4,500 lb. sq. in. taken in A. R. A. formula is too low for high tractive forces.

The comparative table of actual existing drawbars and the proposed cross-section as found by equation (9) is of interest in showing the wide difference of bars even when considered on an area-stress-tractive force basis. For example, compare B and C with J. The tractive force is for J 1.7 times B, yet the existing bars have some cross-sectional area. On a volumetric basis they show a little better. The column to the extreme right shows the volume as calculated to formula (9). This table is graphically represented by Fig. 2, in which curve A shows the volumes of bars calculated to the proposed formula, and curve B shows existing bars, all reduced to a standard of one inch slack. From the considerations given above the importance of limiting the amount of wear in eyes is apparent, and bars that have reached the limit of wear that was allowed for in the new bar should be taken out of service.

The eyes should be machined accurately to dimensions, and the body of the bar should be as smooth and of as even section throughout as possible in order to avoid localization of stress.

COMPARATIVE TABLE OF DRAWBARS

Drawbar	Tractive effort, in lbs.	Existing Drawbars					Proposed		
		Slack, in.	Section	Area, sq. in.	Length, in.	Volume, cu. in.	Section	Area, sq. in.	Volume, cu. in.
A	24,573	1⅝	5 in. by 3 in.	15	50.5	757	5 in. by 3¼ in.	15.8	797
B	33,150	1¾	6 in. by 3 in.	18	60.5	1,080	6 in. by 3¼ in.	18.7	1,120
C	32,046	1⅝	6 in. by 3 in.	18	54.5	982	6 in. by 3¼ in.	19.8	1,080
D	33,150	1⅜	6 in. by 3 in.	18	58.0	1,020	5 in. by 3¼ in.	15.7	912
E	40,758	1½	6 in. by 3 in.	18	53.25	958	6 in. by 3⅞ in.	22.9	1,220
F	40,758	1½	6 in. by 3 in.	18	53.5	963	6 in. by 3⅞ in.	22.9	1,220
G	67,173	1½	7 in. by 3 in.	21	56.25	1,180	8 in. by 4½ in.	36.0	2,020
H	73,800	1½	5½ in. by 3 in.	16.5	65.25	1,078	8 in. by 4¼ in.	33.9	2,210
J	51,041	1 5/16	6 in. by 3 in.	18	65.25	1,175	6 in. by 3½ in.	20.6	1,345
K	30,222	1⅝	5 in. by 3 in.	15	36.0	540	6½ in. by 4¼ in.	27.4	985
L	33,699	1⅝	5 in. by 3 in.	15	36.0	540	6 in. by 5 in.	30.4	1,095

Draw Pins

If the pin is short between the pockets, it may be considered as under double shear stress. As the material is 0.8 as strong in shear as in tension (assuming the same material is used for pin and drawbar) then twice the area of the pin must equal 1¼ times the sectional area of the drawbar, or

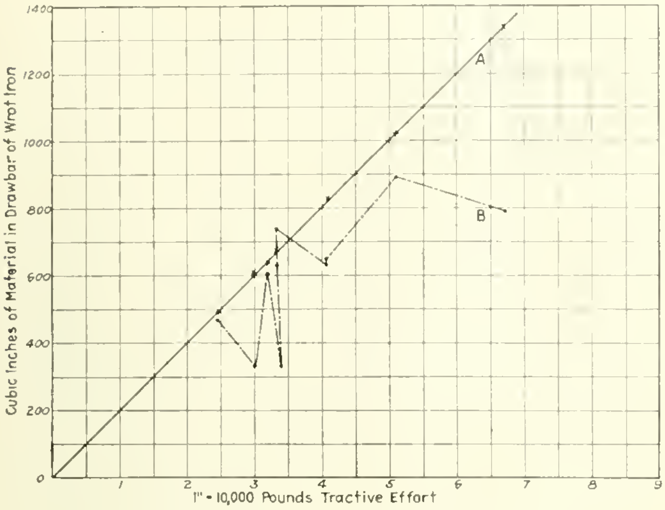

Fig. 2—Comparison of Actual Drawbars with Sizes from Proposed Formula

$$A_p = 0.625\ A$$

$$= 0.625\ \frac{Td}{50l} = \frac{Td}{80l} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

If the pin is long, it must be treated as a beam loaded at the center with the "momentary load" and using a stress of (.8 × .94) = .75 of the ultimate stress of the material.

The "momentary load" may be found from equation (7) by multiplying the value of f by the area of the drawbar.

Taking f at 52,000 lb. per sq. in. as in equation (9), the "momentary load" becomes 52,000 A

$$\text{Bending moment of pin} = \frac{Wl_1}{4} = \frac{52{,}000\ Al_1}{4} \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where l_1 = length of pin between pocket.
Bending moment = stress × modulus of section.
Hence $13{,}000\ Al_1 = f_1\ Z$ ....(12)

$$13{,}000\ Al_1 = .75 \times 55{,}000 \times \frac{\pi D^3}{32}$$

$$D^3 = \frac{32 \times 13{,}000\ Al_1}{41{,}250 \times \pi}$$

$$D = \sqrt[3]{3.22\ Al_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

substituting value of A from equation (9)

$$\sqrt[3]{3.22\,\frac{Td}{50\,l} \times 1.}$$

$$D = \sqrt[3]{3.22 \times l_1\,\frac{Td}{50\,l}}$$

$$= \sqrt[3]{\frac{Td\,l_1}{15.5\,l}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

The formulas may be summarized as follows:

T = Tractive effort in lb.
A = Area of body of bar in square inches
l = Length of bar in inches
d = Total amount of slack in eyes including a maximum allowance for wear in inches
V = Volume of drawbar in cubic inches
l_1 = Length of draw pin in inches
D = Diameter of draw pin in inches
For wrought iron of 55,000 lb. tenacity.

$$\text{Drawbar}\ V = \frac{T.d}{50}\ \text{or}\ A = \frac{Td}{50\,l}$$

$$\text{Long pin}\ D = \sqrt[3]{\frac{Td\,l_1}{15.5\,l}}$$

$$\text{Short pin}\ D = \sqrt{\frac{Td}{62.8\,l}}$$

For mild steel of 80,000 lb. tenacity

$$\text{Drawbar}\ V = \frac{T.d.}{94.25}\ \text{or}\ A = \frac{T.d}{94.25}$$

$$\text{Long pin}\ D = \sqrt[3]{\frac{Td\,l_1}{29.45\,l}}$$

$$\text{Short pin}\ D = \sqrt{\frac{Td}{118.4\,l}}$$

These formulas are offered as a more logical basis of design than that of the A. R. A., yet because of the unknown influence of the surroundings and connections to the drawbar some other numerical factors than those given may be more suitable. Those given, however, should provide bars that are safe under nearly all conditions. In this connection mention may be made of one railroad that gave dimensions and tractive effort, but no formula for a series of bars. Upon checking these in the manner here set forth, they were in practically all cases found to conform to the equation $V = \frac{Td}{55}$ for wrought iron bars.

Is Mechanical Firing Reducing the Cost of Train Operation*

The outstanding features of stoker firing are the possible increase in tonnage or decrease in time between terminals, or both, together with the possibility of handling a fuel of a lower B. t. u. value and a corresponding lower cost.

As an offset against these considerations, which directly affect the cost of train operation, there has always been charged the increase in coal consumption per 1,000 gross ton miles, which has always been considered as going hand in hand with stoker operation. In the early development of the stoker the only successful machine was one having a relatively high point of delivery, and, consequently, when the locomotive was being forced to its maximum the lighter particles of coal were carried over the arch, where arches were used, thereby resulting in an excessive stack or spark loss. In recently conducted road tests it has been found that this condition no longer prevails. It was shown that where the same attention was given the stoker as in hand firing, the fuel consumption per 1,000 gross ton miles per hour was generally lower on the stoker-fired locomotive. This difference in fuel consumption was no doubt due to the higher average temperature obtainable in stoker firing, due to the elimination of the periodical inrush of cold air, and the more perfect combustion possible through carrying a lighter fire as well as the more regular and uniform fuel feed.

The data in the table was obtained as the result of a careful test conducted on a trunk line road to determine the difference between assigned and pool service.

FUEL PERFORMANCE OF U. S. R. A. LIGHT MIKADO TYPE LOCOMOTIVES EQUIPPED WITH STOKERS

February, 1922	Assigned service	Pool service
Engine No.	652	656
Engine miles	3,150	3,703
Gross ton miles	4,514,835	4,496,685
Pounds coal between terminals	476,710	605,530
Pounds per 1,000 G. T. M	105.59	134.66
March, 1922		
Engine No.	652	656
Engine miles	3,750	6,144
Gross ton miles	5,129,449	7,723,177
Pounds coal between terminals	580.862	913,279
Pounds per 1,000 G. T. M	113.24	118.25

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*Abstract of report at Traveling Engineers' Association convention, Chicago, November, 1922.

The test extended over a period of 60 days. The two locomotives were identical in every respect, and operated in the same class of service, viz., fast freight. Locomotive No. 652 was operated by the same crew throughout the entire test, while locomotive No. 656 was handled by four crews alternating. Note that during the first 30 days the assigned locomotive made 18,150 more ton miles and 553 less engine miles than the pooled engine, and consumed 128,820 pounds less coal or a difference of 27.5 per cent calculated on a 1,000 gross ton mile basis.

At the end of the first month it was possible to make an immediate comparison which showed up the above difference in coal consumption. Steps were therefore taken to bring the performance of the pool crews to that of the assigned crew by teaching and getting the men interested, and the result of this action is reflected in the results for March.

While these results show an increase of 7.3 per cent in fuel for the assigned engine, this increase was due almost entirely to weather conditions. The table shows, however, that the active supervision over the pool crews, together with their co-operation, resulted in a decrease of 13.8 per cent. As the weather conditions affected both alike, it is reasonable to assume that had the pool crews been allowed to go on during the month of March as in February, the coal consumption for Engine No. 656 would have been affected the same as in the case of Engine No. 652, i. e., increased 7.3 per cent, which would have made it approximately 144.49 lb. per 1,000 gross ton miles instead of 118.25 lb.

This test proves, first, that the excess in fuel consumption of the pooled over the assigned engine was not due to the stoker or the locomotive, but altogether to the manner in which it was handled by the four crews; and, second, that intelligent supervision will bring the same results in case of stoker as in hand firing.

Economical train operation means the movement of the greatest possible tonnage over a division in the shortest possible time. Where the coal consumption per hour approaches the physical limitations of the fireman, it is only through the application of the stoker that a uniform maximum steam pressure is possible at all times, and it is only through the maintenance of the maximum steam pressure that the desired speed can be sustained.

Opinions vary as to the size of the locomotive to which the application of stokers seems justified. A certain railroad in the Southwest, where temperature ranges are high, operated consolidation type locomotives of 45,000 lb. tractive effort, 49.5 sq. ft. grate area, over two divisions, one being 117 miles long of practically one per cent continuous grade, the other 124 miles long with one per cent broken grades, the longest continuous grade being 40 miles. The rating of the locomotives when worked to their capacity was 1,500 gross tons. Owing to the physical limitations of the firemen it was found necessary to reduce the tonnage over the first district to 1,150 gross tons and over the second to 1,250 tons in order to get the trains over the road within the sixteen-hour period. Stokers were afterward applied to these locomotives and the tonnage raised to the locomotive capacity; i.e., 1,500 gross, or an increase in the first instance of 30 per cent and in the second of 20 per cent. As the wages remained the same, this change resulted in a corresponding direct decrease in operating cost. In this instance it was not a question of the size of the locomotive so much as a question of climatic conditions and physical characteristics of the railroad.

We now cite a case where the locomotives were so large that when worked to their capacity the firemen were unable to supply the coal as fast as the engine could burn it. These were of the 2-10-2 type, 67,000 lb. tractive effort, 80 sq. ft. grate area, operated over a choppy division 100 miles long having short grades of 1½ per cent. The tonnage behind these engines when hand fired was 2,350 gross tons. Stokers were applied and the tonnage increased to 2,650 gross or 12.76 per cent. The wages and other costs remained the same.

In some very exhaustive tests conducted in the Dominion of Canada during the months of May and June, 1921, with Mikado type locomotives, 53,000 lb. tractive effort and 56.5 sq. ft. of grate area, it was found that the maximum drawbar horsepower that could be developed hand firing on the maximum grade was 996, while the same type of locomotive stoker fired gave a drawbar horsepower output of 1,227, an increase of 22 per cent. An increase of 300 gross tons over the normal hand-fired rating was handled by the locomotive stoker-fired, maintaining the same average speed as was maintained by the hand-fired engines with the lighter tonnage.

On the road represented by the chairman, there is a seasonal fruit rush which calls into service every available man and locomotive to such an extent as to make it necessary to double the road (150-mile division) wherever the condition of the locomotive, the crew, and the hours of service make it possible. When this rush is on, we find no difficulty in getting the men to double back on stoker-fired locomotives even though they have a stoker-fired engine in but one direction. Therefore it is clear that if we did not have stoker-fired engines it would mean either more men, which would often result in the payment of the arbitrary held from home terminal, or in holding the engines for the crew's rest, or in an increase in the number of engines assigned to this service which would mean an increased number of idle engines during the slack period. An idle engine costs money even if standing dead behind the roundhouse, as it represents an investment on which the interest will run from $10 to $15 per day.

The above simply represents the definite decrease in cost of train operation as developed on different railroads through the application of stokers to locomotives of different dimensions.

There is, however, another decrease in cost of train operation which can be directly attributed to the application of the stoker, but which varies with the seasons and climatic conditions of the states traversed by the railroads. We refer now to the necessity of sending out relief firemen to take the place of others who on account of the extreme heat or through other causes have become physically exhausted. The committee has records of one railroad located in the Mississippi Valley having one division 156 miles long, operated by locomotives developing 39,000 lb. tractive effort where during the summer months it is necessary to have relief firemen stationed at intermediate points 50 miles apart, and as a rule one or more firemen are relieved daily. As under the schedule, 100 miles or less constitutes a day's work, it follows that in a case of this kind the labor cost insofar as firemen are concerned, is doubled. This in itself would not amount to so much, provided there is no attendant train delay, but where it is necessary to tie up a train at some intermediate station until a fireman has been deadheaded from a terminal, it results not only in an increased labor cost, but it upsets the dispatcher's entire schedule, delaying not only the train in question, but often other opposing trains.

Going back to the Canadian test previously referred to, it was found that the maximum speed on the grades possible with the hand-fired locomotives was 12.42 miles per hour, while with the stoker-fired engine handling the same tonnage a speed of 15.61 miles per hour was maintained, or an increase in speed which is equivalent to an increase in ton-miles per hour of 25 per cent.

It is on account of the speed factor not being considered that in many instances the mechanical stoker has been charged with an increase in fuel consumption over hand firing. Ton miles or train miles or locomotive miles are poor yardsticks by which to measure train or locomotive operation. The time element should always be taken into consideration and where this factor is considered and coal consumption as well as other operating costs are based on the ton miles per hour, it will be found that the stoker can show economies over the best hand firing.

In the beginning of this paper we referred to one possible reduction in operating costs through the possibility of burning a cheaper grade of fuel. During the last months in 1921 slack coal, or what is termed screenings, became a drug on the market and could be purchased at $1.20 per ton less than the mine-run coal produced at the same mines. A saving of $1.20 per ton held out a very attractive proposition to the railroads, but it was found that in hand-firing practice it could only be handled successfully in switch engines, as in road service the firemen experienced considerable difficulty in maintaining full steam pressure at all times in either passenger or freight service. Tests were conducted to determine whether or not the coal could be successfully used in connection with mechanical stokers, and it was found that with some types of stokers practically the same locomotive horsepower output could be obtained per pound of screenings as per pound of mine-run, and therefore on such roads as were equipped to handle both mine-run and screenings at their coaling stations, screenings were used in the stoker-fired locomotives, resulting in a net saving in fuel cost of 7.6 cents per locomotive mile—more than enough to offset the wages of the fireman.

The report is signed by James Fahey (N. C. & St. L.), chairman; A. L. Bartz (E. P. & S. W.), Joseph Keller (L. V.), William Lowney (G. N.), and F. P. Roesch (Standard Stoker Company).

Discussion

The trend of the discussion bore out the conclusions in the report that fuel consumption with stokers firing, when measured on a ton mile basis, is more economical than hand firing. Of course, the only direct comparisons which can be made are with locomotives of less than about 50,000 lb. tractive effort, since engines of greater capacity are beyond the limit of practicability for hand firing.

Considerable attention was given to the question of spark losses in the discussion and it is evident that while these losses were large with some of the early stokers, they are now no longer serious, even when slack coal is being burned. On the Baltimore & Ohio the steam from the stoker exhaust is being diverted into the stoker barrel, where it serves to moisten the coal slightly and to hold it in the firebox long enough for complete combustion to take place. It was suggested that eventually it will be impossible for the railroads to procure screened coal at the mine because of the difficulty of disposing of the screenings and that it will become necessary to purchase mine run coal. It was brought out that this is already the case in some districts. The railroads should, therefore be prepared to burn coal economically with any percentage of slack that may be produced at the mine.

The design of the grate is also receiving attention in connection with stoker firing. The Santa Fe is replacing finger grates with table grates having circular instead of slotted air openings in territory where Gallup coal is being burned. This has effected a reduction both in the spark losses and the loss of unburned fuel through the grate. The Pere Marquette is also applying the table grates on stoker fired locomotives. On the Wabash it was brought out that the standard finger grates are being replaced with Hulson grates. Stress was also laid on the need for high standards of stoker maintenance, particularly of the distributors, to insure that the fuel be uniformly distributed over the grate.

Very little was said about stoker failures. Although the members taking part in the discussion generally admitted that there are stoker failures, it is evident that they are of no more frequent occurrence than the failure of other parts of the locomotive and that they have not had any detrimental influence on the miles per engine failure.

Material and Equipment Prices

THE downward trend in the prices of practically all materials, which began in the fall of 1920 and continued through 1921, was in most cases checked in the first part of 1922. The latter half of the year was characterized by an increase in the prices of most commodities, as a result of which railroads must now pay from 7 to 70 per cent more for their supplies than a year ago. A better knowledge of the changes which have taken place and an approximation of the current prices can be obtained by considering various classes of materials by themselves.

Lumber. The lowest mill prices for Douglas fir were reached in November, 1921; since then there have been several advances. As illustrations of the changes in prices from the low figures to those prevailing at the end of 1922, car sills advanced from $18 to $30 per thousand feet board measure, car framing from $15 to $26, car decking from $19 to $27, car lining from $20 to $27, and car siding No. 2 from $45 to $58. Mill prices of Southern pine began to advance in April, 1922, and by the end of the year car sills had increased in price from $32 to $46, decking from $26 to $34, siding from $52 to $62, and lining from $25 to $35.

Iron and Steel. The prices of many steel products began to advance slightly early in the year. There were marked advances in the fall, largely due to the shortage in fuel, which was followed by some decline in November and December. Car axles increased from $2 to $2.50 per 100 lb., and chilled iron car wheels from $1.75 to $2.10 per 100 lb. Prices for scrap, pig iron and castings showed proportionate advances.

Coal. The recent coal strike has been extremely costly to the railroads, the average cost of the coal used in August and September being about 30 cents a ton greater than the peak prices in 1920. The roads suffering the most were those in the Great Lakes and Northwestern regions, where from a low cost of $3.86 in March the cost had risen to $6.01 in September. The regions least seriously affected were the Pocahontas and the Southern. In the Pocahontas region the range was from $2.44 to $3.22 per ton, and for the Southern region from $3.01 to $3.12.

Cars and Locomotives. The prices of cars and locomotives followed the trend of the basic commodities entering into their construction. From the level of the period between 1910 and 1914 there was a rapid rise to the peak of 1920. Using 100 as the index number for the 1910 to 1914 period, the peak prices were 251 for locomotives, 300 for all-steel freight cars, 313 for composite wood and steel freight cars, and 218 for passenger coaches. Orders placed during the latter part of 1921 were from 30 to 50 per cent below the peak prices. Present prices are approximately half way between the peak prices and the low figures of 1921. From information made public by the Interstate Commerce Commission in connection with equipment trust certificates it appears that prices in 1922 were approximately as follows: Passenger coaches from $20,000 to $24,000 express and baggage cars from $17,000 to $20,000, dining cars from $35,000 to $45,000, passenger train refrigerator cars about $7,000, box cars from $1,500 to $1,850, gondola and hopper cars from $1,500 to $1,800, flat cars from $1,200 to $1,400, stock cars from $1,200 to $1,700, and refrigerator cars from $2,400 to $2,800. Locomotive prices varied with the type, the weight, character of equipment, etc. Mikado (2-8-2 type) locomotives ranged in price from $36,500 to $55,000, while some of heavy weight and equipped with boosters and other appliances cost $72,000; Pacific (4-6-4 type) locomotives ranged in price from $40,000 to $63,000, the latter being equipped with boosters. Eight-wheel switch engines cost from $32,000 to $36,000, and six-wheel switch engines from $28,000 to $32,000.

Advantages of Diesel Electric Locomotives*

Co-operative Research Bureau Advocated to Develop This Type of Equipment for the Railroads

By L. G. Coleman

Assistant General Manager, Boston & Maine

FOR the past twenty-five years American railroads have been under severe criticism from many quarters and have suffered much regulation. The criticism in the past has been largely unintelligent, the result of more or less well-founded resentment of railroad practices, but producing legislation of not very constructive nature. One does not have to be a prophet to say the probabilities are that during the next two or three years criticism and regulation will be more severe than in the past, with, however, this difference,—it will be more intelligent and probably more unfair. It would appear necessary for the railroads to clean house, to make every effort to take advantage of modern ideas and methods, made possible by the rapid industrial development occasioned by the war. We have been disposed to be very conservative, to hesitate to adopt new methods. Criticism of this failure, while frequently not taking into account financial impossibilities, nevertheless has stuck, and it is one that we must combat, preferably, where possible by deeds rather than by argument. It is time to do—not to talk.

The Need for Co-operative Research

Two or three years ago the mechanical officers of the American Railway Association were asked to make a recommendation as to the advisability or desirability of establishing a research bureau. A committee was appointed to consider the matter, and after much discussion an inconclusive report was handed down, not because a majority did not think such a bureau was desirable, but, I am informed, because they doubted the possibility of obtaining necessary funds. So far as I know, the matter has never again been considered.

The railroad business is the largest single homogeneous industry in the United States. All of our major problems are common ones. Yet, any investigation along new lines, where any money expenditure is involved, whether it concerns mechanical, maintenance of way, or operating methods, must be made by individual railroads, or companies that supply their physical wants. Any real development usually requires a combination of products of companies manufacturing widely different articles. It is not reasonable to expect them to spend a great deal of money in experiments which may or may not lead to any direct gain to them. They would naturally wish to guide any development along lines requiring the least possible departure from the use of existing products, when the best result might require a complete new design.

Problems Requiring Joint Investigation

There are many applications of modern mechanical methods used in other industries which if assembled will develop a machine or process producing a saving in operating costs to the railroads. To apply these, however, much money must be spent in redesigning and experimenting, money running into millions of dollars. The only reasonable source of such funds is the railroads themselves. A central research bureau with sufficient income to obtain as needed the services of the foremost men in the country, and to finance the necessary experiments, would be of invaluable aid. The expense pro-rated would be small to each individual. The railroads are not competing with each other in money-saving devices, and as a body could experiment more efficiently and cheaply than independently. For instance, the application of gas and electricity to various railroad services, the co-ordination of motor trucks and automobiles to railroad business, the development of a manufactured tie, automatic train control, are all questions which such a bureau could efficiently and economically handle. A real service will be rendered if the mechanical and maintenance of way officers will push this matter to a conclusion.

Shortcomings of the Steam Locomotive

There is another question which in my opinion is the largest of any that such a bureau alone can practically solve. I think there will be no dissent to the statement that the steam locomotive today is probably the most uneconomical and unsatisfactory machine in industry. We have made enormous improvements, that, granting its inherent original weakness, have very much increased its efficiency as far as a power producer is concerned, but these same improvements have so increased the cost and difficulty of maintenance that the time lost in terminals practically wipes out the savings due to fuel economy obtained by modern devices, and increased unit power.

The inherent weakness of the steam locomotive is its boiler. The most efficient possible construction and maintenance of a steam boiler cannot overcome the absolutely necessary delays such as caused by washouts, hydrostatic tests, renewals of arches, cleaning of flues, examination of and repairs to grates, front ends, etc. The limiting factor of long engine divisions is usually the boiler, not the machinery. Therefore, regardless of the most efficient possible maintenance there will, due to this weakness, always be lost time in terminals by a machine that is otherwise ready for service, which can be conservatively put down at 50 days each year.

Cost of Electrification Is Prohibitive

For some years the railroads have been striving to overcome this difficulty. The remedy that has been generally grasped is electrification. Its principal weakness is the large first cost and the necessity for more or less constant load to get a high efficiency factor. Except in very few instances an approximately uniform volume of freight is unknown to railroads, nor can it be expected in the future. When a division is fully electrified, unless the entire system is brought to the same condition, flexibiliy is decreased. The electric locomotives cannot be used off the electric division. If the full efficiency of electrical operation has been obtained by doing away with coaling plants, ashpits, and other necessary adjuncts to steam operation, conversely steam power cannot be used on an electric division. This means, to take care of emergencies, an excess of electric power on the electric division and an excess of steam power on the steam divisions, where as a smaller surplus of power that can be used interchangeably will take care of two or more divisions. To obtain full benefit from electrical operation requires complete electrification, and the first cost is frequently prohibitive.

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*Abstract of a paper presented before the New England Railway Club, Boston, January 9, 1923.

There is little doubt that we will be unable to get much further economies as long as we continue to carry a portable steam boiler on each of our power plants, many of the economies in power production being lost by the increased terminal delay due to maintenance. To summarize briefly, the delays incidental to use of the steam boiler that can be avoided *in toto* by its abolition—washouts, hydrostatic tests, repairs due to leakage, firebox and front end maintenance, delay on ashpits and at coaling stations, and the extra expense of maintaining ashpits, coaling plants, water stations, and the delay incidental to taking water en route. Do away with the steam boiler and we do away with these delays and the ensuing costs.

Excessive Time for Repairs Increases Operating Cost

Owing to complications to modern train service schedules, many railroads are put to considerable expense if train and engine crews are delayed away from home terminal. Excessive repairs to locomotives not only mean loss of revenue upon the investment as well as increased facilities to take care of them while lying idle excessive time, but also the overtime expense due to crews held away from home, which often is a large item. It is fast approaching a state where we not only cannot double crew engines, but require more engines than crews in order to keep crews moving. This is inefficient operation. The modern locomotive has become a very expensive machine and it should be in revenue-producing service at least seventy-five per cent of the time instead of the very small percentage it now is.

There are many things that we can do and many improvements we can make that will whittle this down, but as long as we use the steam boiler the main delay will remain, and the more complicated we make the locomotive, the greater this delay is going to be and the greater the resulting expense. Most of the devices for improvement to the steam locomotive have aimed at increased boiler efficiency—superheater, feed water heater, stoker, flue blower, etc. Isn't it time to forget the steam boiler and start out with a clean slate to see if there is not some other modern method to meet our problem?

Possibilities of Diesel Electric Locomotives

There has been great development of the Diesel engine in the past five years, but only the surface has been scratched. Such engines have been projected for stationary service that will weigh in the vicinity of ninety pounds per horsepower, in which design the question of weight has not been a primary factor. Competent Diesel engine designers say that there is no reason why such engines may not be built at least as light as sixty pounds per horsepower.

A modern Sante Fe type locomotive with fully loaded tender weighs approximately 283 tons. An electric locomotive of similar tractive effort can be built at about 130 tons, and will require available at its maximum point of consumption 1,800 kilowatts. Under accepted practice this power is generated in a central stationary power plant and distributed by means of a trolley or third rail. If we can produce the current required for each electric locomotive in a movable power plant which may be attached to that locomotive, we can obtain the advantages of the electric locomotive and dispense with the disadvantages of the steam boiler.

To produce 1,800 kilowatts requires a brake horsepower of about 2,600. At 60 pounds per horsepower, this would require one or more Diesel engines of an aggregate weight of 78 tons, one or more generators not over 12 tons, a chassis to carry this load, say 40 tons, leaving 20 tons for radiation and auxiliaries. To recapitulate, for 280 tons, the same approximate weight as a Santa Fe, we may assemble a flexible, movable, fully self-contained power plant and locomotive, driven by Diesel engines using low-grade fuel, that will be at least as economical as coal, with none of the disadvantages of the steam boiler.

Design Provides Great Flexibility

The possibilities in design are so varied as to offer many opportunities for economies. Great flexibility is possible. The locomotive can be in one unit; the power plant another. The power plant itself can be subdivided. For example, the unit I have proposed would probably be made up of three or four Diesel engine generator sets mounted on a single chassis. This assembly could be so arranged that in case of failure of one of the power sets it could be replaced quickly by a spare unit and the whole restored to service in a few hours. By building the motor and power units separately they could be interchanged in case of heavy repairs being required by either.

In case of failure of one generator set the remaining ones would still be able to handle a considerable train instead of causing the complete failure that would follow a similar occurrence with one large power unit.

The electrical combinations as to voltage and amperage are increased by the possibility of hooking the units up in series or parallel. The machinery of the power plant can be under constant observation as in any stationary plant, and when one unit is cut out by reason of reduced power demand, it can receive minor adjustments without delay to the train. When such a locomotive is designed, it will be possible to run it much longer mileage between repair points than the most efficient steam engine.

I have in this brief discussion used the Diesel engine as the foundation of the scheme, because up to date it has been the most economical power producer available for the use I propose.

Other Types of Engines May Be Suitable

I am not at all sure, however, after full investigation and study, that the gas engine as used in automobiles and airplanes may not work out more successfully than the Diesel engine. The main obstacle to its use at the present time is the cost of fuel for such an assembly. It does not necessarily follow even at the present wholesale price of such fuels that the decreased weight, and first cost, and the greater flexibility gained, will not very nearly counterbalance the fuel saving of the heavier Diesel type.

There is another to me very interesting possibility which such a development would bring forth, namely, the use of fuel alcohol. If an engine should be developed using alcohol and there was any prospect of its being used in quantities, the next step, namely, a cheap supply, is a comparatively simple matter and need not be a stumbling block.

There is a third possibility, namely, the use of the Diesel engine direct, without any other than mechanical means of transmission of power. It, as you all know, has received some attention in Europe. This does not appear to me to hold forth the same promise as the use of electric transmission with its very much greater flexibility.

Research Needed to Reduce Cost of Operation and Maintenance

I have for obvious reasons only outlined this scheme in its broadest aspects. I have used only approximate weights and general description, but they are all within limits of known practice. To bring it to a successful issue will require the most painstaking work of experts in Diesel engine and electric design and many experiments.

The cost of locomotive operation and maintenance is so great today, and so much greater than in the past, that it is the most serious problem facing all railroad officers and needs heroic treatment.

To make such an investigation is out of the question for any road. It will be a light burden, if borne by all.

I believe the steam locomotive is out of date.

I believe that it is perfectly feasible to develop an equally powerful and more economical gas-driven locomotive.

I believe the railways of the country should establish a research bureau to investigate this and other matters of supreme mutual advantage.

I believe that such a bureau should be controlled by a very small committee to take complete responsibility for investigations entrusted to them, at least one and not more than three members giving their exclusive time to this work, having sufficient funds to employ temporarily, when needed, the best known experts in the world, and to finance the necessary experiments.

Whether you believe in this proposal or not, the need of a research bureau must be apparent. Use your influence to produce a resolution demanding the funds. I say "demand" because I believe the word is warranted. The maintenance officers are held responsible and should have the courage to insist upon their needs.

Discussion

Practically all who took part in the discussion endorsed Mr. Coleman's proposal to establish a co-operative research bureau. Most of the speakers took exception to the statements that the steam locomotive is inefficient and out-of-date.

G. M. Basford expressed the opinion that the locomotive should not be blamed for the fact that it is in advance of the methods of using, loading and maintaining it. Modern locomotives require increased attention, but they do so much more work that the additional expense is a paying investment.

W. E. Woodard, of the Lima Locomotive Works, stated that a research bureau rightly conducted could help greatly in the development of the locomotive, though in the past the need had been partly met by the research conducted by the Pennsylvania Railroad and the University of Illinois. He did not believe that the steam locomotive could be considered out-of-date until satisfactory equipment was available to take its place. The extremely high first cost appeared to be one of the important disadvantages of the equipment proposed by Mr. Coleman.

F. J. Carty (Boston & Albany) challenged the statement that the low efficiency of the steam locomotive is due to the boiler and pointed out that only 19 per cent of the defects reported by the federal locomotive inspectors were chargeable to the boiler and its appurtenances. There seemed to be some question as to the reliability of the Diesel engine and this defect would make it unsuitable for railroad service.

L. C. Winship (Boston & Maine) pointed out that the cost of the equipment proposed by Mr. Coleman would be so great that in some cases it would be cheaper to provide electric locomotives with central power stations and overhead conductors to distribute the current.

H. Montgomery (Rutland Railroad) questioned whether the railroads were getting full economy from modern locomotives and advocated more thorough training of employees to remedy the situation.

G. E. Ryder (Superheater Company) called attention to the high efficiency of modern locomotives and compared the size and the performance with a stationary power plant of the same horsepower, which required a building 114 by 120 ft.

H. Bartlett (Baldwin Locomotive Works) stated that the locomotive builders were on the alert for improvements, not only in the steam locomotive, but also in anything that might supplant it, but he found that respect for the steam locomotive was increased by comparison with possible substitutes.

C. B. Smith (Boston & Maine) also stated that finding any equipment to take the place of the steam locomotive was a difficult problem.

In closing the discussion Mr. Coleman pointed out that those who defended the steam locomotive dwelt on its efficiency while in service, whereas he considered the crucial question to be the excessive time which the equipment spent out of service. He stated that high-speed Diesel engines are now being developed which make the internal combustion engine more adaptable to railroad work.

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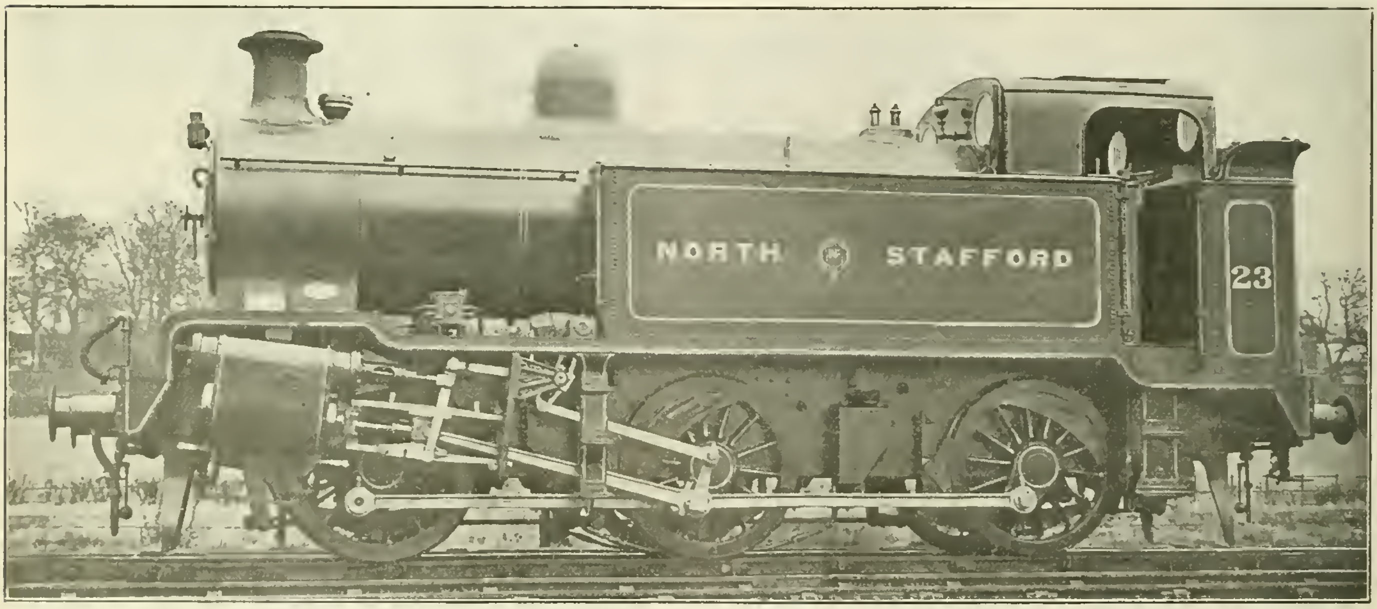

Four-Cylinder Tank Locomotive for North Staffordshire Railway of England

An interesting suburban locomotive of new design has been built recently in the railroad shops at Stoke-on-Trent. The four cylinders, 14-in. by 24-in., are all connected to the middle axle. A special feature is the arrangement of cranks; those outside and those inside the frames are set at 90 degrees apart respectively, each outside crank being at 135 degrees respectively to the corresponding inside crank on the same side. The four 8-in. piston valves are actuated by four gears of the Walschaert type. The wheels are 54-in. in diameter and the wheel base 16-ft. 6-in. The boiler carries 175 lb. pressure and has 488.6 sq. ft. of heating surface in the tubes, 261.3 sq. ft. in the flues and 106.8 sq. ft. in the fire box while the superheating surface is 195 sq. ft. The grate area is 17.5 sq. ft. The coal capacity is 2½-tons and the water capacity 1080 U. S. gallons. The weight in working order is 126,900 lb. The rated tractive force is 14,800 lb. and the cylinder horsepower 1,235.

Essential Elements of the Human Problem[*]

"Scientific Management" Must Be Broadened—Employers as Well as Employees Need Education

By E. M. Herr

President of the Westinghouse Electric & Manufacturing Company

THE human problem in industry is not a new thing. During a thousand years of ancient times, for the most part before the Christian era, self-supporting and self-regulating organizations of workmen existed, which were remarkably similar to the trade unions of today. They were publicly acknowledged and legislative enactments made to control them. But they were weakened under the reigns of successive tyrants and finally lost with the Christian massacres of Diocletian in the early part of the fourth century and the subsequent feudalism of the dark and middle ages. The immediate cause of the destruction of these far-reaching labor organizations seems to have been the coveting of their wealth and power by the rulers of the day. * * * Constantine in A. D. 337 recognized 35 crafts—architects, brass and copper smiths, blacksmiths, carpenters, decorators, doctors, founders, fullers (cloth), furriers, glaziers, goldbeaters and gilders, goldsmiths, ivory workers, joiners, looking-glass workers, lapidaries, masons, marble cutters, plasterers of various kinds, pearl and filigree workers, potters, painters, plumbers, pavers, sculptors, silversmiths, stonecutters, statuaries, veterinaries, wagon makers, workers in mosaic. There were many strikes, usually called historically, when they attained sufficient proportions, "servile wars." The greatest and last of these was the uprising led by the gladiator Spartacus. Practically all ended disastrously.

And so the tide of the human element in industry has ebbed and flowed through the centuries. The so-called English (industrial) revolution in 1760 marked the beginning of the factory system and a departure from isolated craftsmanship under oppressive landlordism. * * * As late as 1820 less than five per cent of the American people lived in cities with a population of 8,000 and over. Today we are the greatest manufacturing nation in the world and over half of our population are city dwellers. In Massachusetts from 1800 to 1815 laborers received from 35 to 75 cents a day; carpenters and blacksmiths about $1.00, and women employed as domestic servants their board and 50 cents a week. About 1825 occurred the first strike for a ten-hour day. "Sweatshop" methods had then begun. Local trade unions sprang up more or less intermittently early in the century, principally in the shoemakers' and printers' trades, both for mutual benefit and insurance, and for the reduction of working hours and the increase of wages, but it was not until the fifties that national organizations began to take effective form. These were pretty well shattered by the depression preceding the civil war and did not really come into being until the seventies and eighties.

[The speaker here reviewed the development of manufactures in this country, showing, from the census of 1920, that 40 per cent of the inhabitants support the whole, directly or indirectly.]

Principles Underlying the Human Problem

Let us now turn our attention more directly to this problem in an endeavor to ascertain at least some of the directions toward which its solution trends. The principal new thing about the problem is that industry is now conducted on a scale larger than ever known before. The problem has been intensified by the greatly increased size of manufacturing establishments, by the concentration of population in cities having a large foreign element of often radical tendencies, and by the insecurity of employment, in which business cycles play a large part.

The underlying labor unrest and distrust are born of fear and misunderstanding—fear of coercion, unemployment and sickness—and a lack of mutual confidence as between employer and employed. There is more liberty and consideration for the workers than has ever been known before, and with it has come to the workers the greater vision of what they believe should belong to them in welfare and happiness. The social responsibility of management is being emphasized as never before. The awakened worker of today, more sensitive than his predecessors, intelligent, critical and perhaps irritable, must be convinced of the ability of management as well as its good faith, and in extreme cases even of the necessity of its being. It is said that democracy without management reverts to despotism on the mere ground of its inefficiency, and that the fundamental error in the recent Russian failure was confiscation of the factories and the expulsion of the managers, with the resultant breakdown of discipline and credit, on a false theory that labor alone creates wealth, whereas management, with credit and good faith, is of the first importance in the process of production. * * * It is the duty of the management of today to prove its "reason for being" and that the collective result of the combined efforts for managers and workers is a fine and great thing. If they can feel that this is the case, most men will toil cheerfully as subordinates. The management must convince employees by their experience that their treatment is fair and honest and without "bluff." It takes time to establish such confidence, and men will discover very quickly if the "boss" is not square. It must be established that labor and management are not foes.

The personnel department is now becoming common, but its intelligent extension still has far to go and it is regrettable that some companies have seen fit to curtail this activity in times of depression when they and their men need it most. These relations should not be handled and directed by the personnel department alone. The active heads and real managers are the ones on whom this responsibility must rest and who must handle it with their employees, not occasionally nor spasmodically but regularly and continuously, for work of this kind requires a great deal of time and patience. This effort on their part will gain the confidence of the employees and instil a spirit of co-operation throughout the organization, and it must be exerted on those directly in charge of the daily work of production. Anything less than this is futile and doomed to failure. Boards of directors must keep in mind this relation and work with the officers in determining policies which the managers can carry out without destroying valuable relations established only after long and patient work and almost impossible to renew.

Shop Representation Plans

One very large organization cites good results of five years' experience. * * * They find that if the men are free to make suggestions to the management they will not ask an outsider to do it for them. They find that workmen are anxious to learn if given a chance, and they encourage the study in factory schools of the work of other departments. This broadens the employees' perspective and increases their interest in their own work.

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[*] Abstract of an address delivered in New York City on Wednesday, December 6, before a joint session of the American Society of Mechanical Engineers and the American Economic Association.

It is credibly stated that at present there are in the United States more than 300,000 employees working under shop-representation plans created to give them a voice in the conduct of the shops in which they work, and that in by far the larger number of cases considerable progress has been made in establishing the most cordial relations between management and employees.

The crux of the industrial problem includes the question —How the just share of each party to industry is to be determined and how is each to be guaranteed its right to share progressively in increasing productivity, and be held also to the corresponding obligation to see losses proportionately shared? This obligation is often overlooked. Nominal wages have increased enormously, and it is safe to assert that real wages have also augmented despite the high cost of living and the fact that in the early days of industry few workers depended entirely upon their wage but were "found" many things which must now be purchased. * * * Manufacturers naturally wish to see their employees receive a wage, with reasonable working hours, which will support them in comfort. This, of course, is only possible when economic conditions will permit, as wages are not and cannot be based on the cost of living. If this condition is to obtain, the employee must live in accordance with his income and responsibilities and exercise frugality and care in his expenditures. Unless this is done, the real interest of the employer and employee will not be conserved because wages would be lifted to the point of throttling the industry.

Scientific Management

Scientific management—which is in fact little more than getting rid of confusion and perfecting adjustments, or in other words, good management—has entered largely in recent years into the human problem in industry. As helping to avoid undue strain on the part of the worker, and waste of time and materials, it should be of benefit to all concerned. It should remove the cause of any hostility to the broadest application of scientific knowledge of the conditions of maximum labor efficiency, to the gain of all parties to production. The scientific management which dealt in the earlier stage with individual output in an engineering way must now deal with men collectively and develop that scientific breadth of imagination and application which is becoming a vital necessity for the welfare of a modern civilized community. The psychology of labor, both in good and hard times, says Professor Commons, is fundamentally the psychology of a class of people whose life is insecure. The accident-compensation law has accomplished the first little step toward giving security to the job. It has shown that the only way to establish safety and security is by making it financially profitable to do so. And so shall we make it financially profitable to business to eliminate to a large extent the wage loss due to unemployment on account of sickness, on account of changes in seasons, and on account of fluctuations in business. Labor can never accomplish this result. The only possible accomplishment of it will come when the employer arranges to cover unemployment from sickness by some adequate form of insurance, to the expense of which the employee will contribute, indemnifying the employee against loss of employment from this cause (accident is now covered by our compensation law), and to lessen unemployment on account of the fluctuation in production because of changes in seasonal demand by the proper use of stocks of finished product so as to smooth out these fluctuations and also those due to abnormal variations in business.

Increased security and continuity of employment greatly lessen the human problem, but on account of lessened labor turnover and uniformity of production they also reduce the cost of the product. Many progressive industrial organizations have gone far beyond the requirements of the accident compensation laws and the safety of the worker, incurring large expense in providing liberally for free life insurance, advantageous savings and loan opportunities, housing, service pensions, and education.

Education, Economic and Moral

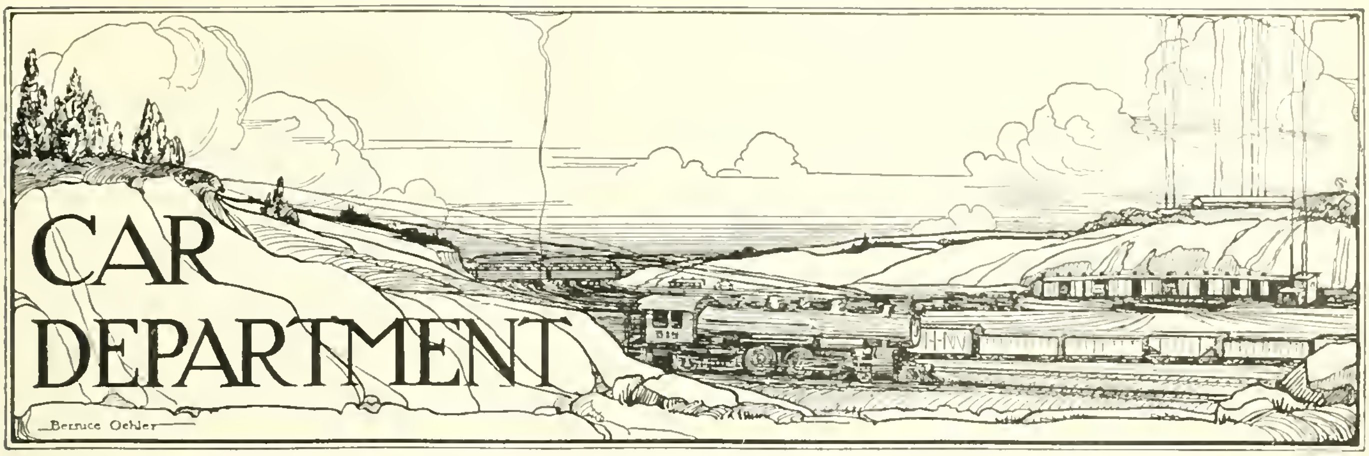
Additional phases of helpful education might well be tried; for example, how to make repetitive work, in itself monotonous, interesting. A knowledge of the "why" of their product and the use of it and of related products of other departments has been found to materially broaden the operator's perspective. Then, too, workers can be encouraged to exercise their ingenuity in devising means to lighten and quicken their work and thereby incidentally increase their earnings. With shorter working hours there arises the question of what to do with idle time. Any one who investigates the use to which the average employee devotes his leisure undoubtedly will be convinced that such employee would be much better physically, mentally, and morally if he had less idle time, for it is generally used in loafing or in amusements which consume a material part of his earnings without corresponding benefits.

Work well done and with a knowledge of progress is a source of enjoyment with many, taking the place of the recreation others find necessary to their happiness, but education of both sexes in ways in which to use leisure time profitably yet pleasantly is needed. The young should be taught thrift, for a thrifty person will not uselessly waste his leisure time. The human problem in industry cannot but be largely affected by example. H. G. Wells speaks of the disturbing influence of "the obvious devotion of a large and growing proportion of the time and energy of the owning classes to pleasure and excitement. This spectacle of amusement and adventure affects the imagination of the working man. In making labor a part of every one's life and the whole of nobody's life lies the ultimate solution of our industrial difficulties."

The human problem in industry is very complex and can never be entirely solved. To measurably improve the feeling of confidence of the employee in the employer we must always and fundamentally be absolutely honest in our dealings; not only honest in our actions but also in our thoughts and intentions. Unpleasant facts and information necessary to be told to the employees should be given them as honestly as the others, and very promptly, so as to give them as much time as possible to adjust themselves to difficult or distressing conditions.

Finally, is it not clear that at least one direction of the solution of the problem is along educational lines? First, education of ourselves, the employers, to a more general understanding of the spiritual, personal, economic, and physical relations involved; and second, education to encourage and aid in every proper way the general and vocational training of the employees in thrift, especially the younger boys and girls, but also the mature but still impressionable group of young men and women who are keen to learn how their position in the workaday world can be improved. Example in this effort to educate and train the employee is especially effective. Such educational effort should establish confidence and encourage co-operation. It should also be directed so as to develop individuality in each workman and woman.

Let us therefore substitute the rule of reason and intelligence for force and so endeavor to restore in America the freedom of the individual, be he employer or employee— "that freedom which enables the young man to look into the future with confidence, knowing that the only limitations to his achievements are the boundaries of his intellect and the measure of his energy."



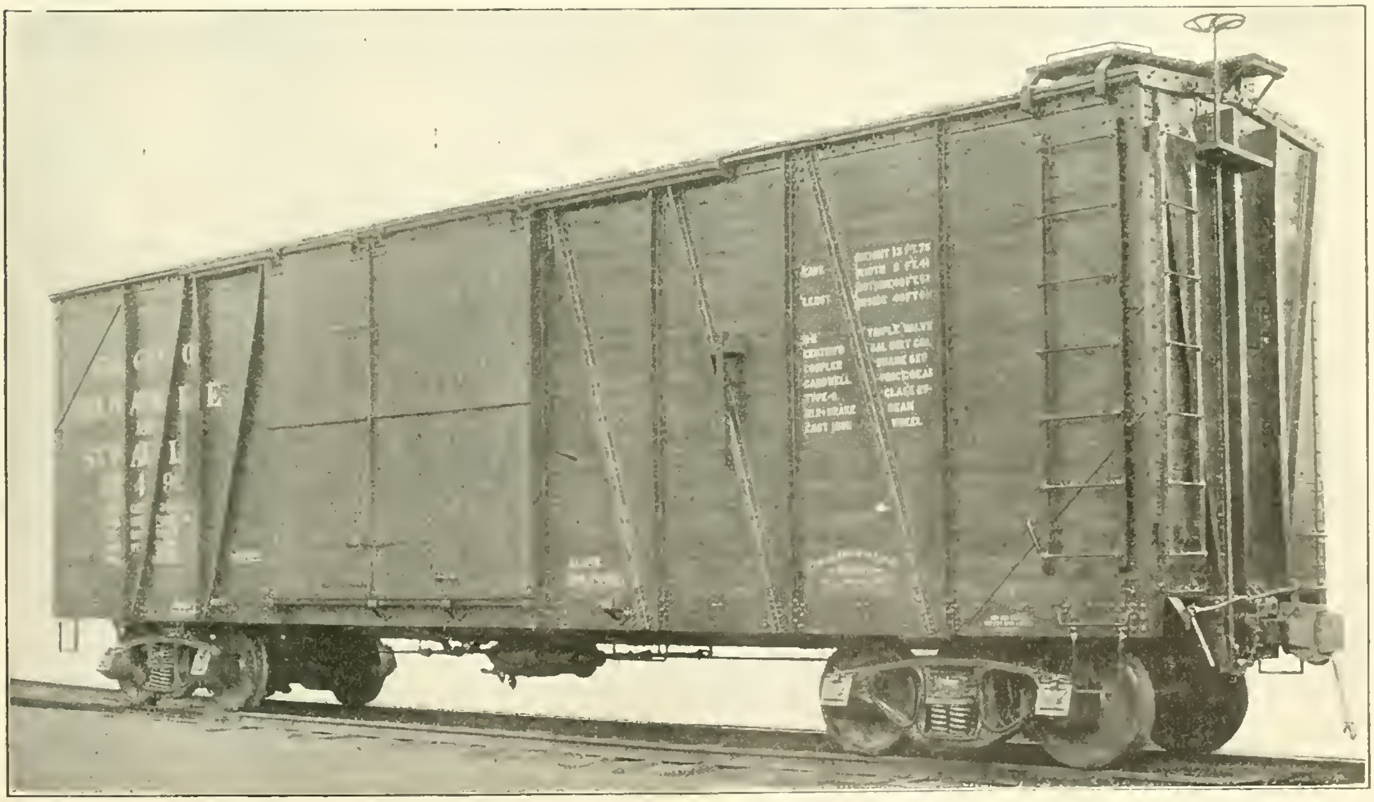
CAR DEPARTMENT

Chicago, Milwaukee & St. Paul Automobile Cars

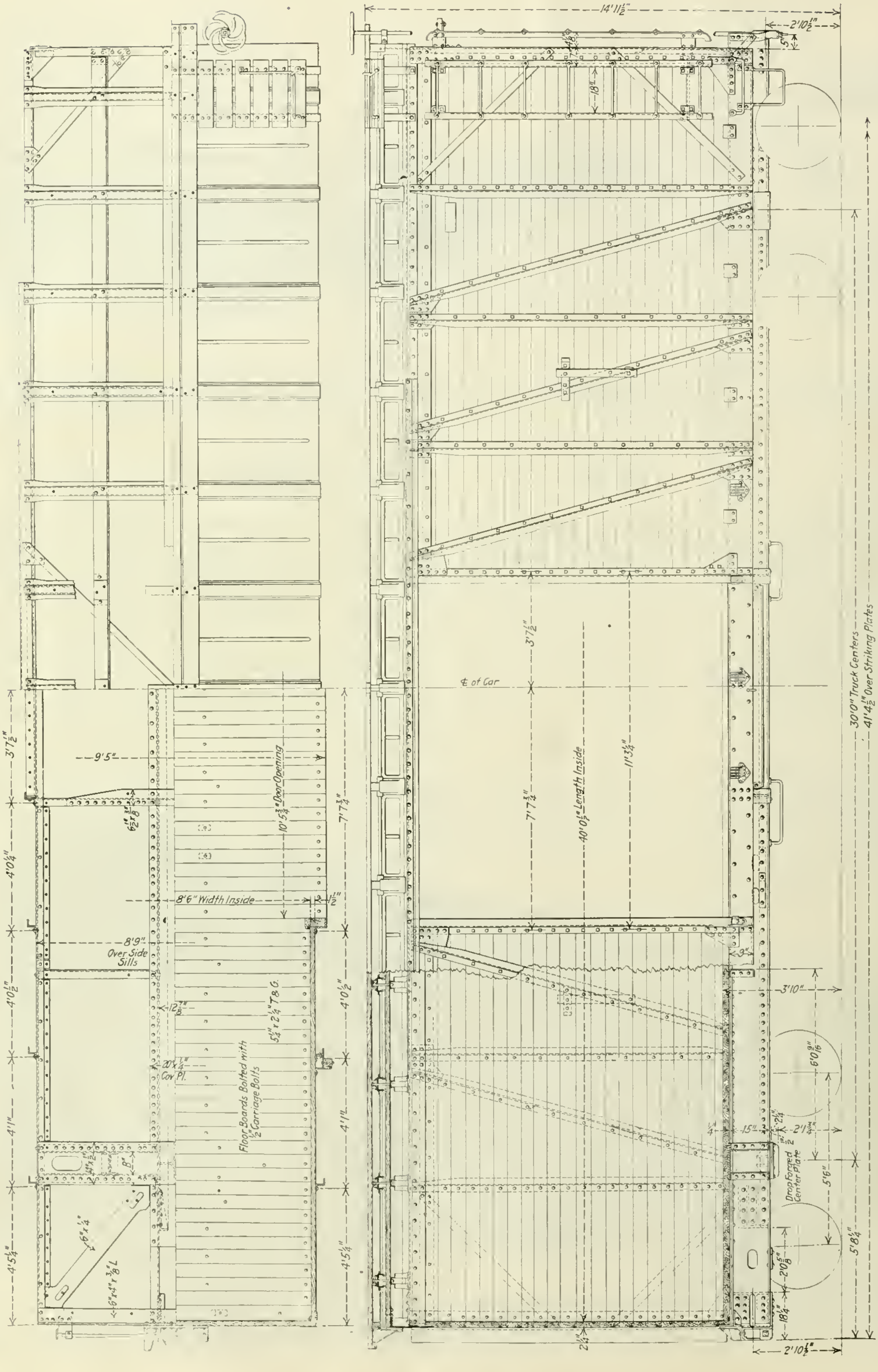
Calculations from the Specifications of Stresses in Truck Members, Body Frame and Underframe

During 1922 two orders aggregating 1,000 steel frame automobile cars were placed by the Chicago, Milwaukee & St. Paul with the General American Car Company. The first 500 cars are 40 ft. ½ in. and the others are 40 ft. 6 in. long inside. All are 8 ft. 6 in. wide and have a clear height of 10 ft. The door openings are 10 ft. wide by 9 ft. 8 in. high and are located unsymmetrically with respect to the transverse center line. The side frame trusses, which are interchangeable, are designed to carry the weight of the car body and lading and the center sills, which are of uniform section throughout, are designed to take the buffing stresses only.

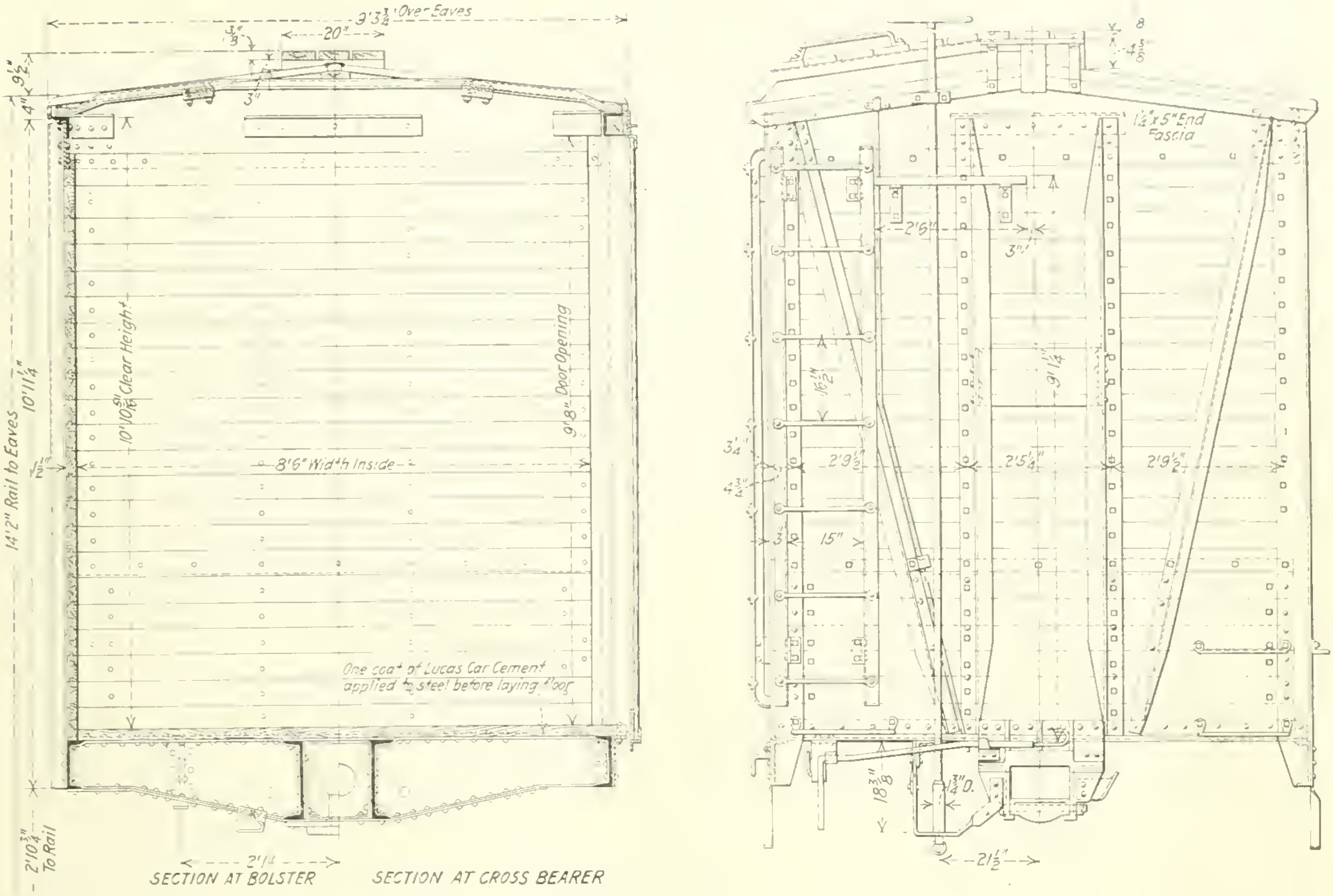
According to the practice adopted by the Chicago, Milwaukee & St. Paul, an engineering specification containing all basic data for the design and the stress calculations for all members subjected to definable loads, by which the sizes of these members are determined or checked, forms a part of the complete specifications for the equipment. In this specification the maximum unit stress for structural steel is 16,000 lb. per sq. in. For tension members this applies to the net section while for compression members it applies to the gross section. In the case of compression members and the compression flanges of members subjected to bending, the above unit stress is reduced by 70 times the ratio of the length of the member to the distance from the center of gravity of the section to the most stressed fibre. This ratio



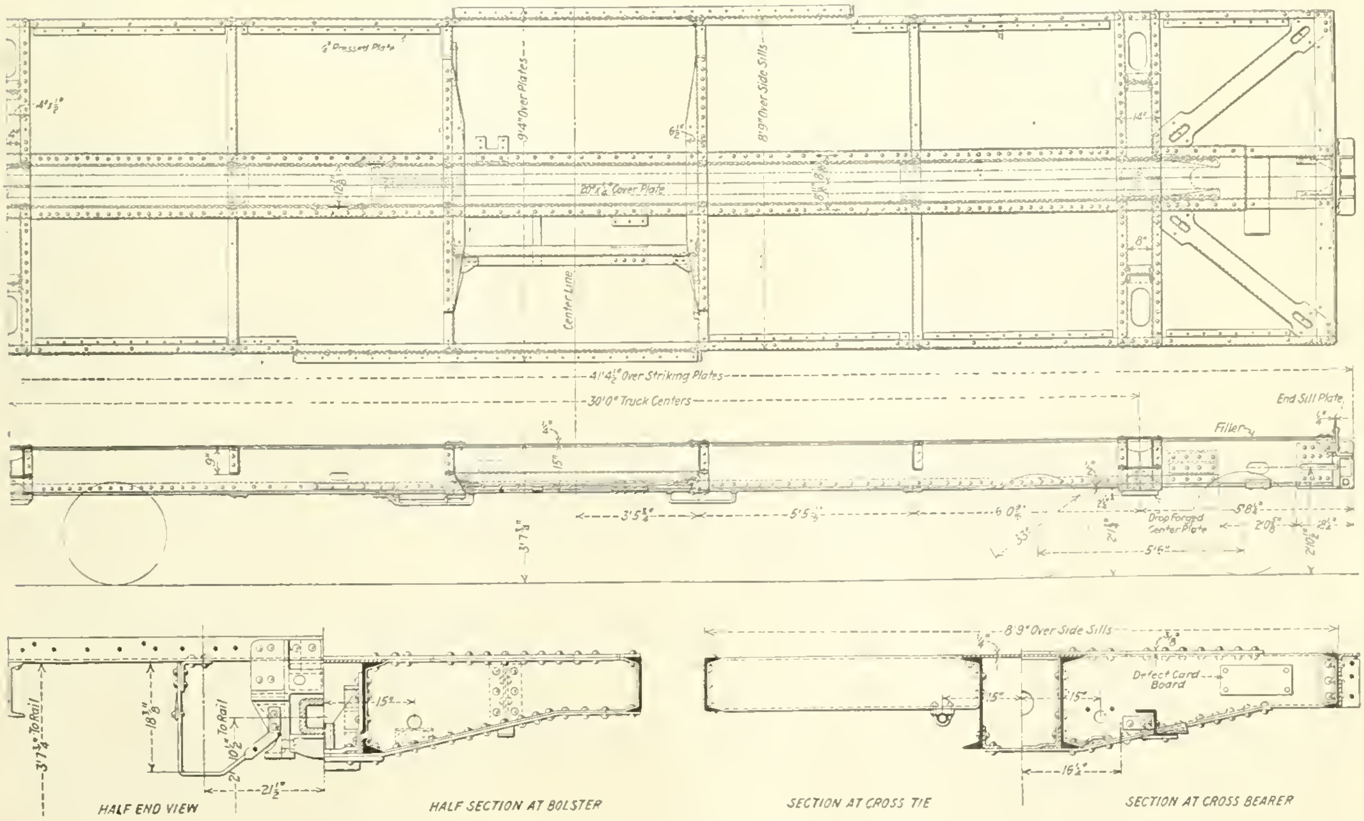
Steel Frame, Single Sheathed Automobile Box Car, Built for the C. M. & St. P. by the General American Car Company



Plan and Elevation of C. M. & St. P. Automobile Car



End Elevation and Cross Sections of Body of C. M. & St. P. Automobile Car



Plan, Side Elevation and Cross Sections of Underframe is not to exceed a maximum value of 120. Rivets are allowed a maximum bearing value of 20,000 lb. per sq. in. and both rivets and webs of rolled sections are designed not to exceed 10,000 lb. per sq. in. shearing stress. Working stresses of 8,000 lb. per sq. in. in tension and 12,000 lb. per sq. in. in compression are permitted in the cast steel members; combined stresses of 10,000 lb. per sq. in. are allowed in tension and 15,000 lb. per sq. in. for compression.

Underframe

The underframe is built up of 15-in. 33-lb. channel center sills the top flanges of which are reinforced with continuous top cover plates 20 in. wide by ¼ in. thick and the bottom flanges with 3½-in. by 3-in. by 5/16-in. chord angles, riveted to the inside faces of the channels. The latest recommendations of the American Railway Association for center sill construction are a minimum area of 28 sq. in. and a ratio of unit stress to end strain not to exceed .05 for box cars. In the following calculations and Fig. 1 it will be seen that the area of the combined section is 28.66 sq. in. and the ratio of unit stress to end strain is .05, bringing it within the requirements. In these calculations let:

A = Area.
x = Distance base to center gravity each section.
d = Distance center of gravity of each section to neutral axis of the combined section.
S_t = Section modulus of top.
S_b = Section modulus of bottom.
$\frac{U.S.}{E.S.}$ = Ratio of unit stress to end strain.

	A		x		Ax	d	Ad²	Iz
Top plate	5 00	×	15.125	=	75.63	7.145	255.00	.03
Channels	19.8	×	7.5	=	148.50	48	4.58	625.20
Angles	3.86	×	1.06	=	4.10	6.92	184.00	4.66
	28.66				228.23		443.58	629.89
								443.58
								1,073.47

$$\frac{228.23}{28.66} = 7.98$$

$$S_t = \frac{1,073.47}{7.27} = 147.7$$

$$S_b = \frac{1,073.47}{7.98} = 134.5$$

$$\text{Ratio } \frac{U.S.}{E.S.} = \frac{1}{A} + \frac{E_c}{S_b} = \frac{1}{28.66} + \frac{1.98}{134.5} = .035 + .015 = .05$$

The bolster is designed to transmit the load from the side frame to the center plate and to resist the stresses set up by shocks at the side bearings. It is of double diaphragm construction, with a cast steel filler between the sills and continuous top and bottom cover plates. The diaphragms are of ¼-in. steel plate with 3-in. continuous flanges and are spaced 8 in. back to back. The cover plates are of ½-in. steel, 14 in. wide. The side bearings are supported by double flanged fillers between the bolster diaphragms, riveted back to back.

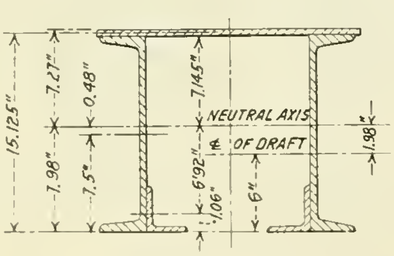


Fig. 1—Center Sill Section

The cross bearers have single diaphragms of the same section and countour as the bolster diaphragms, with pressed steel fillers between the center sills. They are completed with top and bottom cover plates ⅜ in. in thickness. These cover plates have a maximum width of 6½ in., tapering toward the end to the width of the diaphragm flanges. The cross ties are single diaphragms of ¼-in. pressed steel, uniform in section, 9 in. deep, with neither cover plates nor fillers between the center sill channels.

The end sills are 6-in. by 4-in. by ⅜-in. angles. The corners of the underframe are stiffened by diagonal braces of ¼-in. by 10-in. plates, which extend back to the junction of the center sills and bolsters, to the top flanges of both of which members they are riveted.

Body Construction

The side frames are unsymmetrical but interchangeable trusses, with 4-ft. panel spacing on both sides of the doorway. The side plates are built up of a ¼-in. plate, 8¾ in. deep, with 4-in. by 3-in. by 5/16-in. angle flanges at the top. The truss posts and diagonals are Z bar sections. The 9-in. channel side sill forms the bottom chord of the truss. The door panel top chord consists of the side plate angle, reinforced with a supplementary angle of the same section riveted to the top flange of the side plate angle to form an inverted channel. The bottom chord of the door panel is formed by reinforcing the side sill with a 9-in. by 3½-in. angle pressed from ½-in. plate. With the exception of the door posts, which are 4-in., 8.2-lb. Z bars, the posts and diagonals are all 3-in. sections, but varying in weight from 11.5 lb. per ft. for the diagonal member extending from the bolster post to the adjoining intermediate post, to 8.5 lb. for the third diagonals and the bolster and intermediate posts. The second diagonals from the bolsters have a weight of 9.8 lb. per ft. The corner posts are 6-in. by 6-in. by ⅜-in. angle sections.

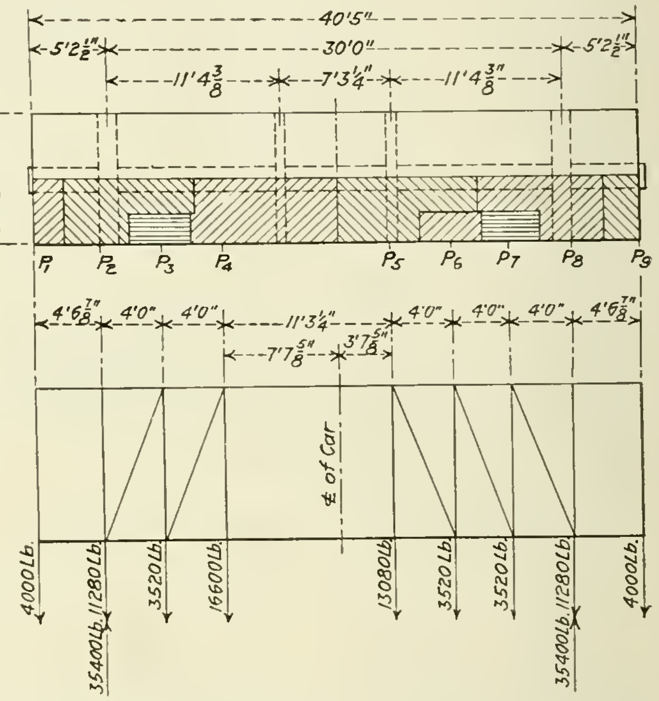


Fig. 2—Truss Loading Diagram for Uniformly Distributed Load

The ends of the car body are of composite construction. The frame members are 6-in., 15.7-lb. Z-bar end posts, and 3-in., 6.7-lb. Z-bar diagonal braces. These members and the angle corner posts are attached at the top to a ¼-in. pressed steel end plate, reinforced at the top with 4-in. by 3-in. by 5/16-in. angles. At the bottom the posts and diagonals are secured directly to the end sills through a ¼-in. web plate, which extends across the end of the car to a height of 32¾ in. The top corners of the body frame are braced diagonally by a 2½-in. by ⅜-in. steel bar secured to the end and side plates with gussets.

The roof frame consists of pressed steel carlines of flanged channel sections, the contour of which provides for the location of the ridge pole above the carline and the purlines below the carline. The roof is of flexible steel construction. In addition to the bracing at the corners of the car, diagonal braces of 2½-in. by ¼-in. steel plates are applied across the car, intersecting at the center. These braces are secured to the side plates by gussets and at the point of intersection are secured to the tension member of the carline. This carline is trussed with a 3-in. by ¼-in. pressed channel tension member, with a U-shaped strut of 2½-in. by ⅝-in. material at the center, the flanges of which are riveted to the carline. The diagonals are riveted to the tension member of the strut.

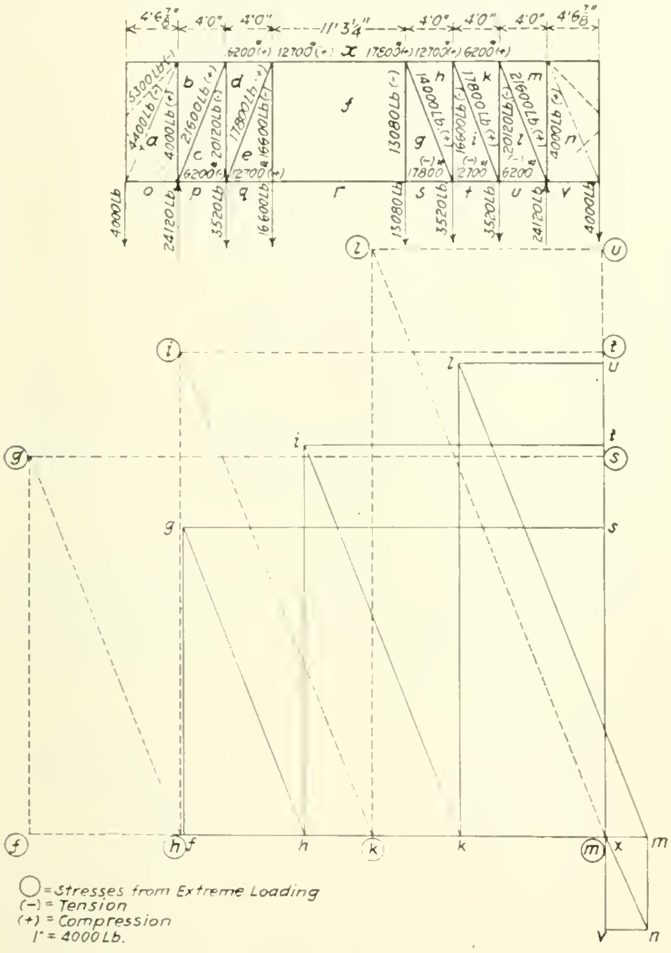


Fig. 3—Graphic Determination of Total Stresses in Truss Members

The floor and sheathing are of tongued and grooved fir. The floor and end sheathing are of 2¼-in. material and the side sheathing of 1½-in. material.

In calculating the stresses of the body frame, 44,000 lb. are allowed for the weight of the car, from which is deducted an estimated weight of 14,000 lb. for the trucks. Adding 88,000, the nominal capacity plus 10 per cent overload, the gross weight of the loaded car amounts to 132,000 lb., which is the maximum for four 5-in. by 9-in. axles. After deducting the weight of the truck and adding 20 per cent of the remaining gross weight as an allowance for the effect of oscillation, the total load for which the body frame is designed is 141,600 lb. By referring to the dimensions on Fig. 2, it will be seen that the floor area of the car is 354 sq. ft., giving a uniformly distributed load of 400 lb. per sq. ft. On each side of the car this load is carried one-half directly by the side frame and the other half by the center sill. The latter load is in part carried across to the side frame by the cross bearers and in part delivered directly to the center plates at the bolsters. The total loads on one side of the car are as follows:

Panel (1) 2 ft. 3 1/16 in × 4 ft. 4½ in. = 10 00, × 400 = 4,000 lb.
Panel (2) 8 ft 7¼ in. × 2 ft. 2¼ in. +
4 ft. 3 7/16 in. × 2 ft. 2¼ in. = 28.20, × 400 = 11,280 lb.
Panel (3) 4 ft. 0 in. × 2 ft. 2¼ in. = 8.80, × 400 = 3,520 lb.
Panel (4) 9 ft. 7⅝ in. × 2 ft. 2¼ in. +
9 ft 3 13/16 in × 2 ft. 2¼ in. = 41.5, × 400 = 16,600 lb.
Panel (5) 5 ft. 7⅝ in. × 2 ft. 2¼ in. +
9 ft. 3 13/16 in. × 2 ft. 2¼ in. = 32.7, × 400 = 13,080 lb.
Panel (6) 4 ft. 0 in. × 2 ft. 2¼ in. = 8.80, × 400 = 3,520 lb.
Panel (7) 4 ft. 0 in. × 2 ft. 2¼ in. = 8.80, × 400 = 3,520 lb.
Panel (8) 8 ft 7¼ in. × 2 ft. 2¼ in. +
4 ft. 3 7/16 in. × 2 ft. 2¼ in. = 28.20, × 400 = 11,280 lb.
Panel (9) 2 ft. 3 7/16 in. × 4 ft. 4½ in. = 10.00, × 400 = 4,000 lb.

Total on one side 70,800 lb.

Using these loads, the stresses in the truss members are determined graphically as shown in Fig. 3. In this diagram the vertical loads are laid out on a vertical line starting at "x" and ending at "x," proceeding according to the direction in which the force acts. These stresses may be determined either by the graphical method or by calculation. Referring to Fig. 3 and Fig. 4, the calculations may be made systematically in the following manner:

STRESSES IN TOP AND BOTTOM CHORDS

Moment at "fg"

24.120 × 3 × 4 ft. 0 in. = ... 289,440 ft. lb.
3,520 × 4 ft. 0 in. = ... 14,080 ft. lb.
3.520 × 2 × 4 ft. 0 in. = ... 28,160 ft lb.
4,000 × (3 × 4 ft. 0 in. + 4 ft. 6⅞ in.) = 66,280 ft. lb 108,520 ft. lb.
180,920 ft. lb.

$$\frac{180,920}{10.28} = 17,600 \text{ lb.}$$

Moment at "ef" or "hi"

24,120 × 2 × 4 ft 0 in. = ... 192,960 ft. lb.
3,520 × 4 ft. 0 in. = ... 14,080 ft. lb.
4,000 × (2 × 4 ft. 0 in. + 4 ft. 6⅞ in.) = 50,280 ft. lb. 64,360 ft. lb.
128,600 ft. lb.

$$\frac{128,600}{10.28} = 12,500 \text{ lb.}$$

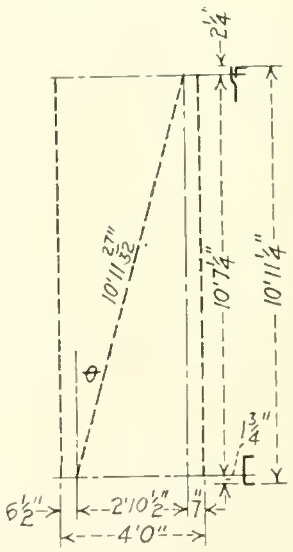


Fig. 4—Angle of the Truss Diagonals

Moment at "cd" or "kl"

24,120 × 4 ft. 0 in. = ... 96,480 ft. lb.
4,000 × 8 ft. 6⅞ in.= .... 34,280 ft. lb.
62,200 ft. lb.

$$\frac{62,200}{10.28} = 6,050 \text{ lb.}$$

Moment at "ob" or "mn"

$$\frac{4,000 \times 4 \text{ ft. } 6\tfrac{7}{8} \text{ in}}{10.28}$$ .... 1,780 lb.

LOADS ON POSTS

"ab" and "mn" = ... 2,000 lb.
(One-half of end panel load carried to center plate by center sills)
"cd" and "kl" = ... 20,120 lb
"ef" and "hi" = ... 16,600 lb.
"fg" = ... 13,080 lb.

[illegible]

[illegible]

20,120 [illegible] = [illegible]

10,600 [illegible] = 17,200 lb.

[illegible]

The preceding calculations are based on a uniformly distributed load. With some kinds of grain it is conceivable that under certain conditions there might be a concentration of load toward the center with a corresponding diminution toward the ends. A rough analysis of such a possible condition led to the assumption that if the loadings at panel points P_2, P_3 and P_4, as shown in Fig. 5, are increased by 25 per cent, the stresses produced will be as severe as may be expected from any lading in a car of this type. The panel loads and resulting stresses in the truss members obtained in this manner, are shown in Fig. 5.

In checking the strength of side frame members another condition must also be taken into account. A load of wheat will create a lateral bending moment in the side of the car and the side posts and braces must withstand this in addition to the stresses of tension or compression imposed on them by the vertical load. The amount of this bending moment is approximated by the application of Rankine's formula for retaining walls and assuming that the maximum bending moment coincides with the point at which the resultant of the side pressure is applied, at one-third of the height of the load above the car floor. In the latest revision of the specifications on the basis of these assumptions, the bending moment per foot of car length is determined as follows (see Fig. 6):

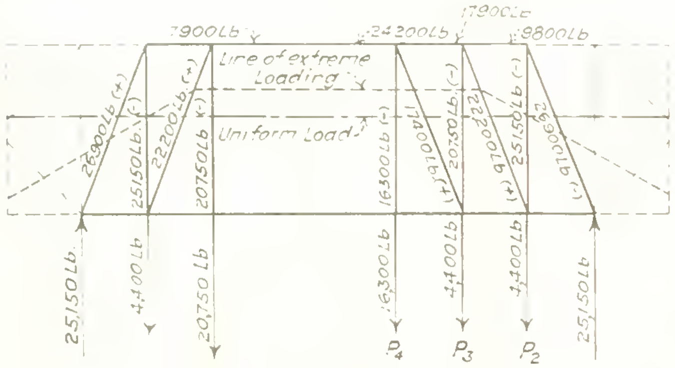


Fig. 5—Truss Loading and Total Stresses Caused by Assumed Extreme Loading Distribution

[illegible]

Maximum [illegible]

Weight of [illegible] per cu. [illegible]

Inside [illegible] ft. [illegible] sq. ft.

[illegible]

P [illegible]

Φ = angle of [illegible]

W [illegible]

W [illegible]

H [illegible]

P_1 [illegible] 16 [illegible] ft. 6 in. [illegible]

R_2 = 24[illegible] × 2 ft. 4½ in. / [illegible] ft. [illegible] in. = 57[illegible]

P = [illegible] × 3 ft. [illegible] in. [illegible]

BM = [illegible] ft. [illegible] in. [illegible] ft. lb.
[illegible] ft. [illegible] in. [illegible] 1[illegible]1 ft. lb.

[illegible] ft. lb.
[illegible] 12 = 3,8[illegible] in. lb.

[illegible] 4579 [illegible] 4,[illegible] in. lb.

For extreme loading conditions
add 25 per cent [illegible]

[illegible] lb. per ft. of car length

With the direct load and the bending moments caused by the bulging action of the lading established, the proposed

Fig. 6

sections of the truss members are checked for strength to withstand the combined stresses. These calculations, which follow, are made both on the basis of normal loading conditions and the extreme loading conditions assumed to be caused by heaping the lading toward the center of the car.

[illegible]

[illegible]

Direct load = [illegible] lb. (—)

[illegible] 13,500 in. lb.

[illegible] Z.

[illegible] SM = [illegible]; $\frac{L}{r} = \frac{108}{1.21} = 84.7$ [illegible]

[illegible]

Direct stress [illegible] per sq. in.

Bulging stress = [illegible] lb. per sq. in. . . . . 6,56[illegible] lb. per sq. in.

Extreme loading [illegible] cent to normal loading) = 9,84[illegible] lb. per sq. in.

Diagonal "[illegible]"

Direct load = [illegible] 21,600 lb. (+)

Bulging moment = 4,[illegible] × 2 = [illegible] 9,200 in. lb.

Proposed section: [illegible]-in. 11.5-lb. Z.

[illegible] SM [illegible] L = 10[illegible], $\frac{L}{r} = \frac{[illegible]}{1.17} = [illegible]$

[illegible] allowing 20 per cent for combined stresses, =

11,540 lb. per sq. in.

[illegible] per sq. in.

Bulging stress = [illegible] = 3,060 lb. per sq. in. . . . . [illegible]480 lb. per sq. in.

Extreme loading

Direct stress = [illegible] = [illegible] 8,000 lb. per sq. in.

Bulging stress = [illegible],750 × 2 / 3.6 = 3,800 lb. per sq. in. . . . . 11,800 lb. per sq. in.

Vertical "[illegible]" and "kl"

Direct load . . . . 20,120 lb. (—)

Bulging moment 6,500 × 2 = ... 13,000 in. lb.

Proposed section = 3 in. [illegible] 5-lb. Z.

Gross area = [illegible] SM = 2[illegible]

Deduct .25 for one $\frac{13}{16}$-in. by $\frac{5}{16}$-in. hole, net area = 2.23

Direct stress = $\frac{20,120}{2.23}$ = 9,000 lb. per sq. in.

Bulging stress = $\frac{9,200}{2.4}$ = 3,830 lb. per sq. in. .... 12,830 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{25,150}{2.23}$ = 11,260 lb. per sq. in

Bulging stress = $\frac{5,750 \times 2}{2.4}$ = 4,790 lb. per sq. in.. . 16,050 lb. per sq. in.

Diagonal "de" and "ik"
Direct load = ... 17,800 lb. (+)
Bulging moment = 4,600 × 2 = ... 9,200 in. lb.
Proposed section = 3-in. 9.8-in. Z.

A = 2.86; r = 1.16; SM = 2.6; L = 107; $\frac{L}{r} = \frac{107}{1.16}$ = 92.2

16,000 — 70 $\frac{L}{r}$ = 9,550 lb.; adding 20 per cent for combined stresses = 11,460 lb. per sq. in.

Direct stress = $\frac{17,800}{2.86}$ = ...6,230 lb. per sq. in.

Bulging stress = $\frac{9,200}{2.6}$ = 3,540 lb. per sq. in. ..... 9,770 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{22,260}{2.86}$ = ... 7,790 lb. per sq. in.

Bulging stress = $\frac{5,750 \times 2}{2.6}$ = 4,420 lb. per sq. in..... 12,210 lb. per sq. in.

Vertical "ef" Door Post
Direct load = ... 16,600 lb. (—)
Bulging moment = 4,600 × 3 ft. 7½ in. = ... 16,680 in. lb.
Proposed section = 4-in., 8.2-in. Z.
Gross area = 2.41; SM = 3.1
Deduct .21 for one $\frac{13}{16}$-in. by ¼-in. hole; net area = 2.20

Direct stress = $\frac{16,600}{2.20}$ = 7,550 lb. per sq. in.

Bulging stress = $\frac{16,680}{3.1}$ = 5,380 lb. per sq. in.......... 12,930 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{20,750}{2.20}$ = ... 9,430 lb. per sq. in.

Bulging stress = $\frac{5,750 \times 3.625}{3.1}$ = 6,730 lb. per sq. in.. .16,160 lb. per sq. in.

Camel Company's sliding door post
Bulging moment = 5,750 × 5-ft. 7½. = ... 32,350 in. lb.

Minimum section modulus for steel = $\frac{32,350}{16,000}$ = 2.02.

Vertical "fg"-Door Post
Direct load = ... 13,080 lb. (—)
Bulging moment = 4,600 × 4-ft. 6-in. = ... 20,700 in. lb.
Proposed section = 4-in. 8.2-lb. Z.
Gross area = 2.41; SM, = 3.1
Deduct .21 for one $\frac{13}{16}$-in. by ¼-in. hole, net area = 2.20

Direct stress = $\frac{13,080}{2.20}$ = 5,950 lb. per sq. in.

Bulging stress = $\frac{20,700}{3.1}$ = 6,680 lb. per sq. in........... 12,630 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{16,300}{2.20}$ = ... 7,420 lb. per sq. in.

Bulging stress = $\frac{5,750 \times 4.5}{3.1}$ = 8,350 lb. per sq. in...... 15,750 lb. per sq. in.

Diagonal "gh"
Direct load = ... 13,600 lb. (+)
Bulging moment = 4,600 × 2 = ... 9,200 in. lb.
Proposed section = 3-in. 8.5-lb. Z.

A = 2.48; r = 1.21; SM = 2.4; L = 107; $\frac{L}{r} = \frac{107}{1.21}$ = 88.4

16,000—70 $\frac{L}{r}$=9,800 lb.:adding 20 per cent for combined stresses = 11,760 lb.

Direct stress = $\frac{13,600}{2.48}$ = 5,480 lb. per sq. in.

Bulging stress = $\frac{9,200}{2.4}$ = 3,830 lb per sq. in........... 9,310 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{17,400}{2.48}$ = 7,020 lb. per sq. in.

Bulging stress = $\frac{5,750 \times 2}{2.4}$ = 4,780 lb. per sq. in .... 11,800 lb. per sq. in.

Vertical "hi"
Direct load = ... 16,600 lb. (—)
Bulging moment = 4,600 × 2 = ... 9,200 in. lb.
Proposed section = 3-in. 8.5-lb. Z.
Gross area = 2.48; SM = 2.4
Deduct .25 for one $\frac{13}{16}$-in. by $\frac{5}{16}$-in. hole. net area = 2.23

Direct stress = $\frac{16,600}{2.23}$ = 7,450 lb. per sq. in.

Bulging stress = $\frac{9,200}{2.4}$ = 3,830 lb. per sq. in. .... 11,280 lb. per sq. in.

Extreme loading:

Direct stress = $\frac{20,750}{2.23}$ = ... 9,300 lb. per sq. in.

Bulging stress = $\frac{5,750 \times 2}{2.4}$ = 4,790 lb. per sq. in .... 14,090 lb. per sq. in.

Top Chord
Maximum stress = ... 17,800 lb. (+)
Effective area at door = 4 in. by 3 in. by $\frac{5}{16}$ in. side plate angle =..... 2.09
4 in. by 2½ in. by $\frac{5}{16}$ in. door angle =..... 2.00
4.09

Stress = $\frac{17,800}{4.09}$ .... 4,360 lb. per sq. in.

Extreme loading stress = $\frac{24,200}{4.09}$ .... 5,920 lb. per sq. in.

Bottom Chord
Maximum chord load = ... 17,800 lb. (—)
Proposed section = 9-in. 13.4-lb. channel
Gross area = 3.89
Deduct 0.96 for two holes in flanges and three in web, net area = 2.93

Stress in at right cross bearer = $\frac{17,800}{2.93}$ = ... 6,070 lb. per sq. in.

Loading across the doorway:
Chord load = ... 17,800 lb. (—)
Uniformly distributed load = W = 11 ft. 3½ in. × 2 ft. 2¼ in. × 400 = 9,890 lb.
Load concentrated at left crossbearer = W_2 = 9 ft. 3$\frac{13}{16}$ in. × 2 ft. 2¼ in. × 400 = 8,170 lb.

Maximum moment = $\left(W_2 + \frac{W}{2} \right) \frac{CC_1}{l}$

C = distance from left door post to left cross bearer = ... 3.64 ft.
C_1 = distance from right door post to left cross bearer = ... 7.63 ft.
l = door panel length = ... 11.27 ft.

Maximum moment = $12 \left(8,170 + \frac{9,890}{2} \right) \frac{3.64 \times 7.63}{11.27}$ = ... 387,120 in. lb.

Proposed section:		
9-in. 13.4-lb. channel;	SM = 10.5; net area = ...	2.93
9-in. 25.2-lb. ship channel:	SM = 19.4; net area = 6.63—1.33 =	5.30
	29.9	8.23

Chord stress = $\frac{17,800}{8.23}$ = 2,160 lb. per sq. in.

Bending stress = $\frac{387,120}{29.9}$ = 12,930 lb. per sq. in ..... 15,090 lb. per sq. in.

Trucks

The cars are equipped with Bettendorf trucks with U-section cast steel side frames and integral journal boxes. Completely equipped, each truck weighs 7,128 lb., of which the side frames account for 1,125 lb. and the bolster 818 lb. The details of the weight distribution are shown in a table.

Fig. 7 is a sketch of the side frame showing the loads to which it is subjected and the properties of the sections of the side frame members. The vertical load on the side frame is based on the assumption that it must withstand an increase of 50 per cent in the truck load distribution over the normal axle capacity. The maximum transverse load is assumed to be 40 per cent of the normal vertical load. The method of external moments is used in determining the stresses caused by the vertical loading. In these calculations a moment arm equal to the distance from the journal center to the adjacent spring seat has been used throughout. This is longer than that used by some engineers, who assume that the effective moment arm is equal to the horizontal distance from the journal center to the axis of the truck column. The stresses determined by the longer arm are about 18 per cent greater than those determined by the other method. In these specifications, however, combined stresses are permitted to exceed the usual maximum working stress by 20 per cent, so that there is little difference in the final result so far as the size of the members is concerned. The stresses on the various sections are determined as follows:

Actual Weights of 40-Ton Truck Parts

	Weight Lbs.
4 5-in. by 9-in. wedges	59.5
4 5-in. by 9-in. brasses	80
2 Nests of truck springs	206
4 Brake shoe keys	4
4 Brake shoes	76.5
2 Brake beams	189.5
2 Side bearings	29.5
2 Side bearing filler blocks	19
1 Tie bar	125
2 Brake beam safety bars	31
2 Spring caps	20
2 Oak spring fillers	9
2 Truck levers	47.5
1 Dead lever fulcrum bracket	5.5
1 Bottom rod	32
4 Dust guards	3
4 Brake beam hangers	30
4 Brake beam hanger pins	15.5
6 M. C. B. brake pins	5.5
4 Wheels	2,774
2 Axles	1,338
Waste	8
Oil	24
4 Asco lids and pins	23
Rivets and cotters	4
1 Truck bolster	818
2 Side frames	1,125
2 Side bearing fillers	26
	7,128
	2
One set of trucks	14,256

Unit Stresses in 40-Ton Truck Side Frame

Section A-A

Area = 6.6; Transverse SM = 10.54

Transverse force at $R_2 = \dfrac{6{,}200 \times 14.70}{21.2} = \ldots\ldots$ 4,300 lb.

Transverse force at $R_1 = 6{,}200 - 4{,}300 = \ldots\ldots$ 1,900 lb.

Transverse stress $= \dfrac{4.300 \times 25.58}{10.54} = \ldots\ldots$ 10,400 lb. per sq. in.

Vertical stress $= \dfrac{23.250 \times 30.2}{21.2 \times 6.6} = \ldots\ldots$ 5,000 lb. per sq. in.

Total combined stress .... 15,400 lb. per sq. in.

Section B-B

Area = 12.37; Transverse SM = 36.79
Vertical SM = 10.85

Transverse stress $= \dfrac{1{,}900 \times 25.58}{36.79} = \ldots\ldots$ 1,320 lb. per sq. in.

Vertical stress $= \dfrac{23{,}250 \times 30.2}{21.2 \times 12.37} = \ldots\ldots$ 2,680 lb. per sq. in.

Local stress $= \dfrac{23{,}250 \times 5.2}{2 \times 10.85} = \ldots\ldots$ 5,570 lb. per sq. in.

Total combined stress .... 9,570 lb. per sq. in.

Section C-C

Area = 12.26; Transverse SM = 15.44
Vertical SM = 12.75

Transverse stress $= \dfrac{1{,}900 \times 25.58}{15.44} = \ldots\ldots$ 3,150 lb. per sq. in.

Vertical stress $= \dfrac{23{,}250 \times 30.2}{21.2 \times 12.26} = \ldots\ldots$ 2,980 lb. per sq. in.

Local stress $= \dfrac{23{,}250 \times 4.45}{2 \times 12.75} = \ldots\ldots$ 4,050 lb. per sq. in.

Total combined stress .... 10,180 lb. per sq. in.

Section D-D

Area = 6.45; Transverse SM = 7.72; Tan. 6 deg. 45 minutes = 0.118

Transverse stress $= \dfrac{4{,}300 \times 6.5}{7.72} = \ldots\ldots$ 3,620 lb. per sq. in.

Vertical stress $= \dfrac{23{,}250 \times 30.2 \times 0.118}{21.2 \times 6.45} = \ldots\ldots$ 600 lb. per sq. in.

Total combined stress .... 4,220 lb. per sq. in.

Section E-E

Area 5.64; Transverse SM = 8.06; Sec. 6 deg. 45 min. = 1.007

Transverse stress $= \dfrac{4{,}300 \times 19}{8.06} = \ldots\ldots$ 10,130 lb. per sq. in.

Vertical stress $= \dfrac{23{,}250 \times 30.2 \times 1.007}{21.2 \times 5.64} = \ldots\ldots$ 5,900 lb. per sq. in.

Total combined stress .... 16,030 lb. per sq. in

Section F-F

Area 5.25 in.; Transverse SM = 6.31; Sec. 33 deg. 40 min. = 1.2015

Transverse stress $= \dfrac{1{,}900 \times 16}{6.31} = \ldots\ldots$ 4,820 lb. per sq. in.

Vertical stress $= \dfrac{23{,}250 \times 30.2 \times 1.2015}{21.2 \times .525} = \ldots\ldots$ 7,600 lb. per sq. in.

Total combined stress .... 12,420 lb. per sq. in.

In sections A-A and F-F the combined stresses are in excess of the allowable unit stress for cast steel. These sections are considered satisfactory, however, because the unit stresses caused by the vertical loading are low in section A-A and the components are both low in section F-F. In the case of section D-D of the truck column, the combined stress is much below the allowable maximum. Here, however, the fact that the web member is subjected to wear, is the controlling factor in fixing a minimum thickness of ⅞ in.

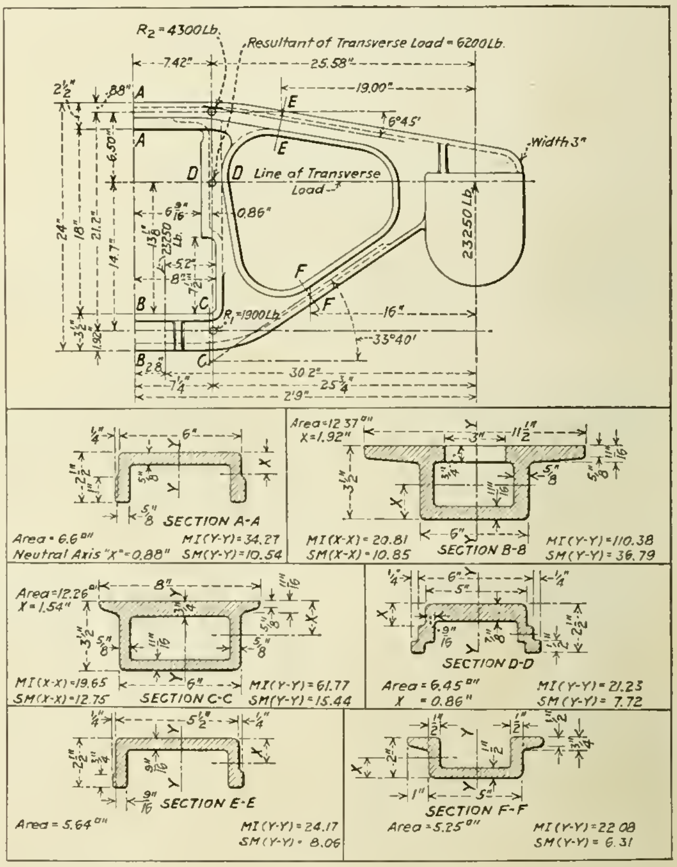


Fig. 7

Bolster

The bolster is of box section, a general outline of which is shown in Fig. 8. The stresses are checked at sections through the center, through the side bearing, at intermediate points 11½ in. and 20½ in. from the center and at a point 7 in. outside the side bearing. The loading conditions assumed and the stress calculations are shown herewith:

Loading

Total weight (A. R. A. maximum) at rail	132,000 lb.
Less two trucks	14,000 lb.
	118,000 lb.
Weight of two truck bolsters	1,640 lb.
	119,640 lb.

Load per each bolster 119,640 × ½ = ... 59,820
Add for oscillation 20 per cent 11,964

71,784 say 72,000 lb.

Extreme loading = entire load on one side bearing
Horizontal load 0.4 × 72,000 = ... 28,800 lb.
Center of gravity of load and car body for automobile cars, from top of rail .... 6 ft.-10 in.
Distance from rail to resultant of horizontal force .... 21⅛ in.
Distance from center line of horizontal force to center of gravity for car body and load = 6 ft. 10 in. — 1 ft. 9⅛ in. = ... 5 ft. 0⅞ in.

Minimum distance from center to side bearing $= \frac{28,800}{72,000} \times$ 5 ft. 0⅞ in. = 2 ft. ⅜ in

Section at Center
Section Modulus, Tension = 119.00
Section Modulus, Compression = 161.00

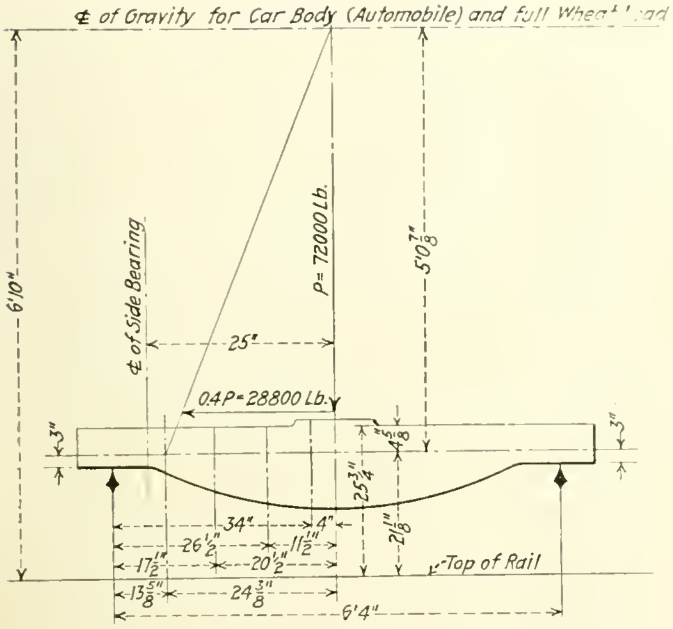


Fig. 8

Tensile stress $= \frac{72,000 \times 38}{2 \times 119} =$ .... 11,500 lb. per sq. in.

Compression stress $= \frac{72,000 \times 38}{2 \times 161} =$ .... 8,500 lb. per sq. in.

Section 11½ in. from Center of Bolster
SM Tension = 104.7
SM Compression = 92.1
Extreme loading:

$R_1 = \frac{72,000 \times 63}{76} =$ 59,700 lb.

$R_2 =$ 72,000 — 59,700 = 12,300 lb.
B M = 49.5 × 12,300 = 610,000 in. lb.
Load concentrated at center:
BM = 36,000 × 26.5 = 954,000 in. lb.

Load on Side Bearing.

Tensile stress $= \frac{610,000}{104.7} =$ .... 5,830 lb. per sq. in.

Compression stress $= \frac{610,000}{92.1} =$ .... 6,620 lb. per sq. in.

Load on Center Plate.

Tensile stress $= \frac{954,000}{104.7} =$ .... 9,100 lb. per sq. in.

Compression stress $= \frac{954,000}{92.1} =$ .... 10,350 lb. per sq. in.

Section 20½ in. from Center to Bolster
SM Tension = 79.9
SM Compression = 72.4
Load on Side Bearing:

Tensile stress $= \frac{12,300 \times 58.5}{79.9} =$ .... 9,020 lb. per sq. in.

Compression stress $= \frac{12,300 \times 58.5}{72.4} =$ .... 9,940 lb. per sq. in.

Load on Center Plate:

Tensile stress $= \frac{36,000 \times 17.5}{79.9} =$ .... 7,890 lb. per sq. in.

Compression stress $= \frac{36,000 \times 17.5}{72.4} =$ .... 8,710 lb. per sq. in.

Section at Side Bearing
SM Tension = 65.1
SM Compression = 78.9
Load on side bearing:

Tensile stress $= \frac{59,700 \times 13}{65.1} =$ .... 11,800 lb. per sq. in.

Compression stress $= \frac{59,700 \times 13}{78.9} =$ .... 9,850 lb. per sq. in.

Load on Center Bearing:

Tensile stress $= \frac{36,000 \times 13}{65.1} =$ .... 7,190 lb. per sq. in.

Compression stress $= \frac{36,000 \times 13}{78.9} =$ .... 5,930 lb. per sq. in.

Section 32 in. from Center of Bolster
SM Tension = 50.9
SM Compression = 50.9
Load on Side Bearing:

Tensile stress $= \frac{59,700 \times 6}{50.9} =$ .... 7,040 lb. per sq. in.

Compression stress $= \frac{59,700 \times 6}{50.9} =$ .... 7,040 lb. per sq. in.

Load on Center Plate:

Tensile stress $= \frac{36,000 \times 6}{50.9} =$ .... 4,240 lb. per sq. in.

Compression stress $= \frac{36,000 \times 6}{50.9} =$ .... 4,240 lb. per sq. in.

As the extreme conditions, with the entire load on one side bearing, probably will never occur unless the car is turned over, these sections are considered satisfactory.

* * * *

The Past and Present in Coal Cars on the Reading

Successful Lubrication of Journal Boxes[*]

Close Attention to Minor Defects Makes Delays; Does It in Fact Reduce or Increase Hot Boxes?

By W. J. O'Connor

THE preparation of boxes, journals and bearings should be handled as follows: All boxes should be thoroughly cleaned. Where new boxes are applied, great care should be exercised in seeing that all scale and sand are removed; this is easily accomplished by using compressed air. Close fitting dust guards should be applied in all cases when renewing wheels.

The preparation of journals for service is of the utmost importance. Where journals are finished on a lathe, the finishing cut should not exceed 1/16 in. in width. Where it is wider than this the cutting edge is so heavy that the roller will not produce a smooth finish. Furthermore, anything more than the ordinary friction heat on such journals automatically brings out these edges, and the result is a cut journal. With the finest cut possible, and the roller properly adjusted on the holder, this condition is practically eliminated. The roller should be oval-shaped so that the edges do not come in contact with the journal. It should also be placed on the holder in such a position that it burnishes slightly below the center of the journal. The trueing of journals by grinding is best done with a medium grade of wheel; the polishing is also best done with a medium grade of emery cloth.

The finishing of collars and fillets, no matter how the journal has been trued up, always produces more or less cutting edges on each end. The finishing of these parts is best accomplished by using a 1½-in. by 16-in. flat mill file, after which they are polished with a medium grade of emery cloth.

Experience tells us that, as a general rule, journal bearings do not fit properly on the journals when received from the manufacturer. In other words, the bearings have high spots, apparently caused by shrinkage in the lining metal. The unevenness of the lining in the bearing averages about 1/32 in. It is our practice to use a power-boring machine to fit these bearings to the journals, and so far the results we have received are more than gratifying.

When applying a brass to the journals, the surface of the bearing should be given a coating of oil. Never wipe the face of the brass or journal with oily waste. When trucks are assembled or removed for repairs, suitable lubrication must be applied to center plate and friction side bearings.

The journal bearing wedges, in my opinion, is the most important feature of the contained parts of journal boxes. A check was recently made of some 100 or more new journal bearings applied within a given period: 60 were renewed on account of cracked linings caused by the journal bearing wedge; 28 bearings were renewed because the wedge either of the hollow-back or solid-back type was worn flat.

We have had failures on fast trains where it was found that there was practically no crown on top of the wedge. The wedges had been continued in service until they were worn flat. It is, therefore, safe to assume that had these bearings had proper wedges, the failures might have been avoided.

My purpose in illustrating these cases is to call attention to the desirability of giving as much attention to the condition of the wedge as we do to the condition of the journal bearing when a change of brass is necessary. It has been our experience that the drop forged steel solid back wedge is the most serviceable.

Some of the causes of journal failures are as follows:

1.—Flat top wedges will take a permanent set on journal bearing, stopping the proper motion of the brass. Result: A cut journal in 25 miles.

2.—Lumps of babbitt metal on the back or sides of the brass prevent the wedge from having a correct fit on the journal bearing. Result: A hot box in 50 miles.

3.—Lining of journal bearing nicked and edges torn. Will pick up a waste grab. Result: A hot box in 10 miles.

4.—On heavy passenger cars equipped with a single brake, the extension on the side of the brass becomes worn and crushed after six months' service. This distorts the lining, causing it to be drawn out over the sides of the brass.

5.—Back end rolls too long. Result: The end of the roll catches under the bearing and starts a hot box.

6.—Boxes overpacked; the waste becomes glazed and will not lubricate.

7.—Journal box covers missing.

All large repair points and shops should have a special truck gang for the purpose of changing journal bearings, wheels, journal boxes and truck sides. Such men should be trained to see the importance of having the separate parts thoroughly cleaned and properly fitted when assembling. It has been found to be a rather difficult matter to train all repairmen to handle this kind of work as it should be done when they have other parts of the car to repair.

We should try, in all ways possible, to specialize on this class of work and endeavor to attract the oldest, most experienced and careful mechanics to follow it out. It is found at the present time, at the majority of shops and repair tracks that the changing of wheels is not the most desirable job.

The discontinuance of compensation for periodical repacking of journal boxes on foreign cars must have been for good reason, but I feel it should have remained one of the requirements of the rules, as much so as the periodical cleaning of air brakes.

While standard instructions for inspection of journal boxes in interchange on all railroads more or less bring out the method of handling a box when there is evidence of previous heating, still it is to be regretted that so many railroads find it necessary to disturb the packing, anticipating that there may be trouble. Over-zealousness is more detrimental to the service than beneficial. No box should be disturbed when the packing is in good condition, where there is no sign of recent heating either on the wheel plate or the face of the collar of the journal. This practice has been adopted as good railroading for a number of years, and we feel it is still good enough to be continued.

We maintain equipment largely at the expense of the owner on all necessary repairs at the present time, and there is no valid reason why the upkeep of the journal box packing and contained parts should not be in the same category. This is a most vital item for expediting the movement of freight. We all feel that our present means of lubrication will continue with us for some years to come. Such being the case, let us all work together to bring it to the very highest standard.

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[*] This paper was read and discussed at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held at the Hotel Sherman, Chicago, November 9 and 10, 1922.

Discussion

G. Lynch (Cleveland, Ohio): The writer of the paper speaks a great deal about the worn condition of the wedge in the box. Now, if the wedge is worn, the roof of the box should be also. What does Mr. O'Connor do with the box?

Mr. O'Connor: I find where this worn condition exists invariably you find the hollow back type of wedge. That is why I lay such stress on the drop forge wedge. Where a box is worn badly, it is removed, but this is not frequently. The drop forged solid back type will take care of a poor journal box sufficiently.

T. S. Cheadle (Richmond, Va.): There is one thing the paper did not bring out, and that is the question of the loose linings. A lining sometimes is loose because it does not stick as it should. One of the manufacturers with whose brasses we had a good deal of trouble told us if we would test the brass by ringing, it would show whether the lining was loose. We have followed that practice, not only on new brasses, but on the relined brasses. We do not have as many hot boxes where new brasses are applied as we had formerly.

Mr. O'Connor: It must be understood that the tinning will melt at a lesser degree than the lining. Where the tinning is not properly applied or the mixture is not correct, you will have loose linings.

C. J. Wymer (C. & E. I.): One cause of hot boxes is lack of the use of the packing iron. We have men out in the yard to go over the boxes, but in practice they merely lift the lid and snap it down. The proper use of the packing iron in the train yards, getting the packing properly adjusted in the journal will eliminate a lot of hot boxes.

During the recent trouble, we were bothered with hot boxes on passenger trains, and we took some men, who had no experience in the packing of boxes, and showed them how to take care of them. The result was that we scarcely had a hot box on passenger trains while these men were looking after them.

G. P. Zachritz (M. St. P. & S. S. M.): We are told that our journals must be right, our brasses must be right, our boxes must be right, and all conditions must be right. On a road in the northwest all these things were right and yet there was at one time a lot of hot boxes. Men were sent out to ride passenger trains and it seemed impossible to locate the trouble. But when it was finally located, they found they were using a waste that threw off fine particles of lint. One of these men who was chasing hot boxes, opened a box and he found the sides of the box entirely lined with lint that was thrown off from the waste, and when the box was jacked up and the brass removed, it was found that this lint had worked between the journal and the journal bearing and had embedded itself in the babbitt. If any of you are bothered with an epidemic of hot boxes, in addition to the things mentioned in the paper there is one thing I would advise you to look after, and that is the waste.

Mr. O'Connor: We have found the best character of waste to use is a mixture of 40 per cent wool and 60 per cent cotton, to get away from that lint. It is produced by the collar of the journal and more so by packing the boxes by the M. C. B. method.

There is a difference of opinion as to the value of the plug in the front of the box. Packing is best done by feeding the waste in, so that it will be in one piece, applied underneath the journal, which prevents the rising of the packing. We had the same condition that Mr. Zachritz mentioned in 1916.

Mr. Zachritz: The packing in this case was wool in long strands.

T. J. O'Donnell (Buffalo, N. Y.): There is one point I would like to ask the chief interchange inspectors if they agree on. If a train of meat comes into a yard, after it has run 540 miles, is it good railroading to lift every lid and test the metal to see if you should condemn the car to the repair track, to avoid the possibility of a "call down" from our operating officers if some of those journals give trouble on the next division?

The superintendents, of course, are very zealous to keep their hot boxes down to the lowest point, but we have had a lot of trouble with cars being set out and I contend it is not the best method to look for trouble unless it has approached you.

Now, you know what it means to tell your inspectors to try those journals and overcome complaints of heating. Instead of leaving the box alone, they will hook every box, and possibly you will have five or six cars of high class freight set out where the repair foreman will lift the brass, test it and let it go. But you have laid the foundation for a claim when you delay a car of meat from one fast train to another, usually from 8 to 24 hours.

I am supposed to approve of the expense for cut journals; and the incidental wheel work has gone up almost 150 per cent in the last two years. The reason is this: When you charge the delivering line for a cut journal and you have a lot of work, invariably you have no second hand wheels. The car owner gets the benefit of a new pair of wheels at the expense of the delivering line. The result is, instead of a $5 or $10 charge, you have probably a $21 charge. You are doing a lot of harm, directly, in good weather when the train and the boxes are running well and your trucks are square, in trying to discover defects that really would take care of themselves if you keep the hook away from the journal.

J. J. Gainey (Southern): I agree with Mr. O'Donnell that there is no use of looking for trouble. During the strike I think we had in the neighborhood of nine hot boxes in 83 days. Some of those journals had cuts in them, and they were on our fast passenger trains. Brasses were applied to them and they were properly packed, and those wheels have been running 60 days and not giving any trouble.

I believe if in all terminals, on starting out trains, they are properly taken care of with the paddle, as instructed by the Galena Signal Oil Company you can prevent 90 per cent of your hot boxes.

Mr. Cheadle: We handle on our line a great deal of fruit. It comes to us on a schedule of 30 miles an hour and we deliver it on a schedule that averages 40 miles an hour. I decided to stop using the packing hook. I took one side of the train, and I told the man on that side to stir up the packing in every box, according to the Galena recommendations. On the other side, I did not lift a lid. Ninety-nine per cent of the hot boxes were on the side where we stirred the packing up.

Mr. Gainey: You did not have an experienced man to handle it as it should have been handled.

E. H. Mattingley (B. & O. C. T.): I was very much pleased with the items which Mr. O'Connor enumerated as to the causes of hot boxes and the special treatment that should be given the various parts of the box and its contained parts in the application of wheels. We do not give the wedge the attention it deserves, we look at the journal bearing and if it is at all defective we will renew it; but we will put the wedge back in a defective condition on a new bearing and expect it to function properly.

While there is a great deal of contradiction regarding the subject, I believe that the tight journal box used today is absolutely wrong. Oil has a flash point, and when your heat reaches that flash point you have a blaze.

Now, if you start a car out of the terminal, properly packed, new journal bearing, new journal, new journal box, new pedestal, possibly a passenger car, you are going to have a certain amount of friction until the bearing becomes properly fitted to the journal. With that friction, you naturally have heat. Where you have excessive heat above the normal running temperature, you are bound to consume oil, which will go off in a blue gas that will not lubricate. Now, unless you have something to compel that temperature, to stay below the flash point, you are going to have a hot box. The air cooling process is the best known today. I feel we are closing our boxes up too tightly to properly take care of the gas in them, which will ignite at the flash point.

Has anyone had any trouble with hot boxes, with the journal box lids missing?

W. G. Wallace (American Steel Foundries): An engineer running a very fast train on the New York Central Lines, recently came up to me with a proposition of an air-cooled box, just exactly what Mr. Mattingley has spoken of. He stated that where he had trailers that were beginning to get hot, if he raised the cover and put a chip between the cover and the box and let in the air the box gave him no further trouble. He also stated that there was a certain amount of soapy material formed in the box.

Mr. O'Connor: In 1917, we made an exhaustive test with a baggage car, having 5½-in. by 10-in. journals and a light weight of 57 tons. We loaded 22 tons of axles directly over the body bolster. We had that car in a train that was scheduled to make a mile a minute between stations. We had a pyrometer to give us the temperature of each journal bearing under the car. We found that the normal temperature of a journal bearing is from 130 deg. F. to 160 deg. F. They will run successfully at 190 deg. F. We found that with the box lids closed we would run 40 deg. less temperature than with the box lid open. Now, because this high temperature is exposed to a low atmospheric temperature in the winter, the moment the train stops you do not find gas, where on the other hand, in a box where the lid is closed, this vapor puffs out. But that is a normal running condition. The great trouble is that many car inspectors do not know what the normal running temperature is. There isn't anything in the matter of the absence of journal box lids. You do not see the temperature, but it is there.

Mr. Mattingley: In your experience, how many journal boxes have you noticed blazing where the lid was missing?

Mr. O'Connor: I never saw very many.

Mr. Overton (Southern): Mr. Chairman, about 1900 or 1901, I was general car foreman at a point where one division was in a sand country and the other in a clay country, and this hot box question was disturbing us a great deal. I found the trucks were out of line, and we lined up the pedestals of all these cars. The next thing, we tested the running of the dope, to see how long the specifications as outlined by the Galena Oil Company would run in a clay country and how long in a sand country. Now, the cars in the sand country would operate about 800 miles less on one packing of the box before we had to disturb the packing.

Oil will last just so long in the waste, and when the foreign matter begins to accumulate in that waste and oil, then you are going to have a hot box, and when you remove the mechanical defects and lubricate the box regularly at certain periods, that will stop hot boxes.

Secretary Elliott: One railroad in East St. Louis was at one time making a practice of hooking journals, and some of the roads were kicking about it, because they were being carded for it. We found they were taking out journals that were not giving any temperature. Finally, they were told that if they wanted to take them out they would have to pay for them. That was one of the large railroads. I thought it was a very poor practice, and I agree with Mr. O'Connor that it is poor practice.

Mr. Barnaby: We have trouble on account of stock cars being loaded with sand. On a dry day, that sand drifts out and gets in the boxes; four or five cars behind the stock cars we have hot boxes. That is a practice that ought to be discontinued.

Secretary Elliott: They used to have a practice, at the East St. Louis National Stockyards, of bedding with sand, but they now use cinders.

James Reed (N. Y. C.): I have been very closely associated with Mr. O'Connor for a number of years, and I know that he has made a very careful study of this lubrication of hot boxes proposition, and he knows what he is talking about.

The idea of ventilating oil boxes is old; a number of years ago, it was tried out by a number of prominent railroads. I can remember on a certain railroad when the locomotive engineers would lift up the tender journal box lid and place a piece of wood or a stick or something to hold it up, with the result that they gathered all kinds of foreign matter—snow and ice or dust and sand. A number of hot boxes were the result of that experiment. The box lid should be tight.

In taking care of boxes in interchange, as Mr. O'Donnell has stated, in the yards on fast freight where we receive cars in interchange that are apparently all right, we should leave well enough alone. If we go to extremes and issue instructions to our inspectors to look for these defects, we will find 90 per cent of the defects in freight equipment that is running all right. With too much attention, too careful inspection, you are creating trouble.

Mr. O'Connor and I, not very long ago, went over a very important terminal in Chicago. We looked into the method of handling fast freight cars in interchange, and with a few instructions given by Mr. O'Connor, we got wonderful results. But we did not jack up every car or remove every brass to see if the lining was all right; we simply let those that were running all right alone, and those we thought were in trouble, we gave them attention, mostly by the packing iron, not by a whole lot of unnecessary oil. After the attention that we gave those boxes, we marked them to see whether they were going to their destination. We found that these cars, that the average inspector would mark for a defect, went to New York or Boston and returned with the same marks. So I believe we can overdo the inspection by following our instructions too closely.

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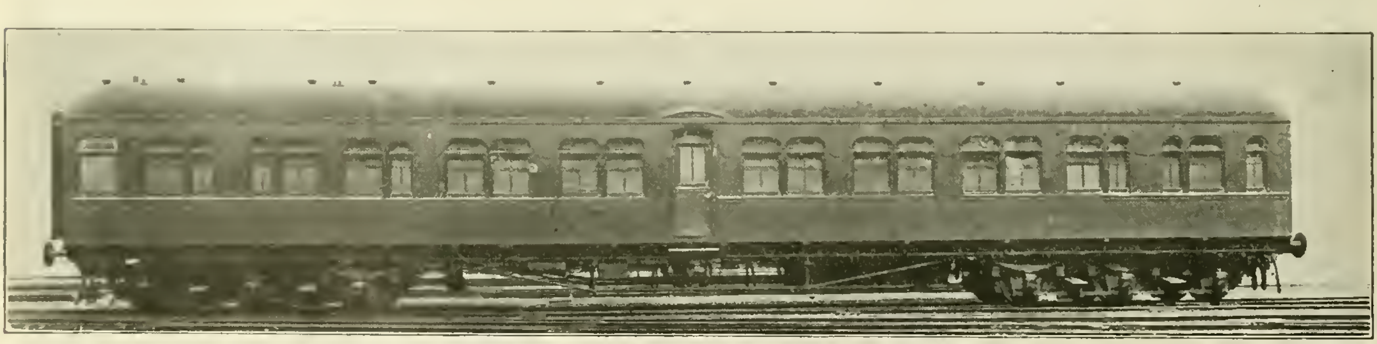


A Sleeping Car on the New South Wales Government Railways

A Discussion of the Methods Used in Designing the C. M. & St. P. Gondola

By Wendel J. Meyer

THE method used in designing the C.M. & St.P. gondola cars as described in the November issue of the *Railway Mechanical Engineer*, is surely a step in the right direction away from "rule of thumb" methods of car design. Believing that the value of this interesting treatise may be enhanced by discussion, the writer submits the following comments on the analyses used by the author.

Center Sills

The center sill was assumed as a beam supported at the bolsters, carrying a load of 59,000 lb. uniformly distributed over its entire length and resisting an end load of 250,000 lb. applied at each end along the center line of the draft gear. Too much importance should not be attached to such assumptions and their resulting stresses.

The draft gear tests conducted by the United States Railroad Administration showed "that the force developed between cars is due to the inertia of the cars and when the slack is not bunched, is the same whether the struck car be standing alone or whether it be at the head of a draft of cars" (see page 130, "Draft Gear Tests of the U. S. Railroad Administration"). Therefore, the assumption that the center sills are loaded at each end simultaneously, is incorrect: the force probably is dissipated as it is transmitted through the sills, each cross member taking part in transferring the impact load to the superstructure and lading. The buffing stresses are maximum at the point of impact of the struck end and may be any value down to zero at the opposite end.

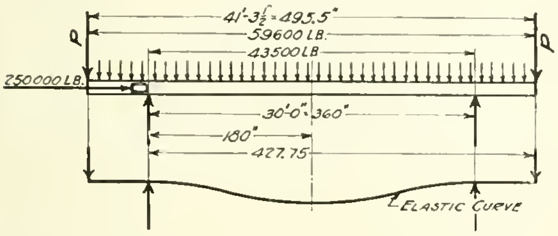


Fig. 1

The following method of approaching the actual stresses in a center sill of the type under discussion might be better, although the amount of load carried by the sills and the intensity of the buffing load are elements open for further discussion.

Fig. 1 shows the center sills supported at the bolsters, loaded with 59,600 lb. uniformly distributed. The end load of 250,000 lb. is assumed to be applied along the center line of the draft gear to the sills at the bolster of the struck end and is dissipated by the cross members, to zero at the opposite end. These are the same loads which were used by the author. Due to the rigidity of the end and side constructions, an indeterminate force (P), may be assumed to act downward at each end, making the sills a beam, virtually fixed at the bolsters and having an elastic curve as shown. The load between the bolsters is then:

$$W = (59{,}600 \times 360) \div 495.5 = 43{,}500 \text{ lb.}$$

The bending moment on the sills at the bolster is:

$$M_{bol.} = \frac{W\,L}{12} = \frac{43{,}500 \times 360}{12} = 1{,}305{,}000 \text{ in.-lb.}$$

and at the center of the car:

$$M_{cen.} = \frac{W\,L}{24} = \frac{43{,}500 \times 360}{24} = 652{,}000 \text{ in. lb.}$$

The properties of the sills are as follows:

Area	29.4
Section Modulus (Top)	151.0
Section Modulus (Bot.)	144.0
Eccentricity	2.05
Stress Ratio (Top)	0.0204
Stress Ratio (Bot.)	0.0482

The unit stresses in the sills at the bolster of the struck end are:

Tension at top due to bending. $f = 1{,}305{,}000 \div 151 = 8{,}640$ lb. per sq. in.
Compression at top (buffing)... $f = 250{,}000 \times 0.0204 = 5{,}100$ lb. per sq. in.

Combined (tension) .... $f = 3{,}540$ lb. per sq. in.

Compr. at bot. due to bending. $f = 1{,}305{,}000 \div 144 = 9{,}060$ lb. per sq. in.
Compr. at bot. (buffing)...... $f = 250{,}000 \times 0.0482 = 12{,}050$ lb. per sq. in.

Combined (compression) ..... $f = 21{,}110$ lb. per sq. in.

At the center line of the car the buffing is assumed to have been dissipated in direct ratio to the length of sill traversed,

$$B_{cen.} = (250{,}000 \times 180) \div 427.75 = 105{,}200 \text{ lb.}$$

The unit stresses in the sill at the center of car are:

Compr. at top due to bending.... $f = 652{,}000 \div 151 = 4{,}320$ lb. per sq. in.
Compression at top (buffing)...... $f = 105{,}200 \times 0.0204 = 2{,}150$ lb. per sq. in.

Combined (compression) .... $f = 6{,}470$ lb. per sq. in.

Tension at bot. to bending....... $f = 652{,}000 \div 144 = 4{,}530$ lb. per sq. in.
Compr. at bot. (buffing) .... $f = 105{,}200 \times 0.0482 = 5{,}070$ lb. per sq. in.

Combined (compression) .... $f = 540$ lb. per sq. in.

The maximum unit stress obtained by this method is 21,110 lb. at the bolster and 6,470 lb. at the center, while the stress obtained by the author is 12,060 lb. at the bolster and 15,270 lb. at the center. In any repair yard, evidence can be found that the center sills are rarely damaged at the center but almost invariably at the bolsters. This logically indicates that the method given here is more nearly in accord with actual conditions even though it may not be absolutely correct.

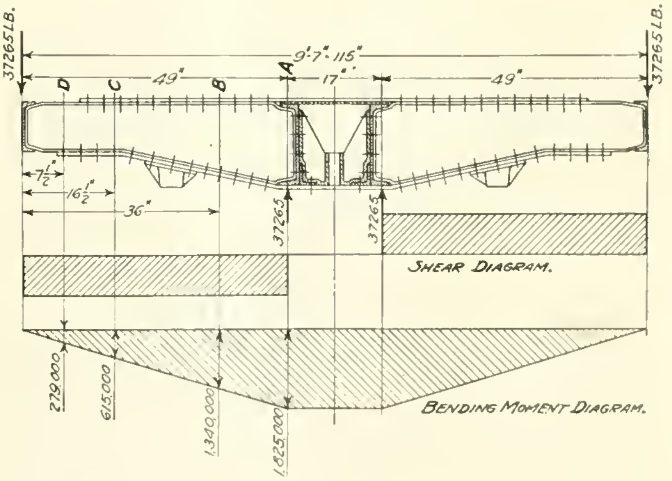
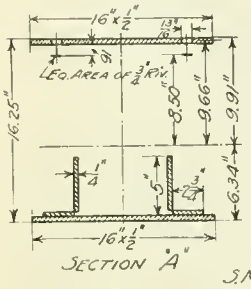


Fig. 2

Although, to conform to present practice, the buffing load is assumed to act along the center line of the draft gear, the writer wishes to question the correctness of such an assumption. In his opinion, based on observation of the evidence that the coupler horn comes in contact with the striking plate, the buffing load should be considered as acting through the coupler horn instead of through the center line of draft gear.

Body Bolster

The author's method for analyzing the body bolster seems open to criticism. The reaction at the center is incorrectly taken as a single concentrated force and then after finding the bending moment at the center, it is incorrectly applied to a section through the center sill flange rivets. Since this bending moment results in a high stress in the cover plates, the center sill cover plate is incorrectly assumed to be brought into action by means of the rivets connecting it with the bolster plate. In order that such an assumption be true it would be necessary to have (14.375 × 0.25 × 12,350) ÷ 4,690 = 9.45, say 10 rivets on each side of the center line connecting the two plates. In analyzing the section taken at 12 in. from the center line of the car, the full section of the cover and web plates are taken without investigating whether this material is sufficiently connected to permit such an assumption.



SIZE	AREA	ARM	MOM	ARM	AD²	I_o
14 3/8" × 1/2"	7.19	16.00	104.90	16.00	1839.0	—
2 Riv @ .297	.59	14.84	8.76	14.84	130.0	—
2 × 4 3/4" × 1/4"	2.38	3.125	7.42	3.125	23.2	4.5
2 × 2 3/4" × 1/4"	1.38	.625	.86	.625	.5	—
16" × 1/2"	8.00	.25	2.00	.25	.5	—
TOTALS	19.54	6.34	123.94		1993.2	4.5
STATICAL MOMENT						1993.5
14 3/8" × 1/2"	7.19	9.66	69.50			1998.0
2 Riv. @ .297	.59	8.50	5.01	$19.54 \times \overline{6.34}^2 =$		785.0
TOTALS			$M_s = 74.51$	$I =$		1213.0

$S.M._{(TOP)} = \frac{1213.0}{9.91} = 122.5\ \text{IN.}^3$; $S.M._{(BOT.)} = \frac{1213.0}{6.34} = 191.6\ \text{IN}^3$

$M = 1,825,000$ INCH LB

TENSION AT TOP $= \frac{1,825,000}{122.5} = 14,900$ LB. PER SQ. IN.

COMPR. AT BOTT. $= \frac{1,825,000}{191.6} = 9,540$

UNIT LONGITUDINAL SHEAR $= f_s = \frac{VM_s}{tI} = \frac{37265 \times 74.51}{.50 \times 1213.} = 4,580$ LB. PER SQ. IN.

Fig. 3

The writer believes that the assumptions of the following method agree more closely with actual conditions. Fig. 2 shows the bolster with its forces and reactions indicated. The end forces—37,265 lb.—are assumed to act on the outside of the side sill because the truss load is delivered at this point by the transom brace rivets. The bolster center plate and center brace transmit the center reaction to the webs of the center sills. Since the center sill flanges will also assist in transmitting this reaction we may safely resolve the latter into two forces acting through the gage line of the center sill flange rivets. The shear and bending moment diagrams—Fig. 2—are derived from these assumptions.

It will be noted that the top and bottom cover plates are shorter than those shown in the author's illustrations. Some designers believe that the bolster covers on cars with wood floors should extend to and be connected with the side sill flanges in order to transmit the buffing stresses coming through the bolster. However, the holes through the side sill flanges and webs are in the same line and the net sill section is so reduced that this practice certainly offsets a questionable gain. The stress due to buffing is beyond the scope of this article and is not taken into account.

The bending moment at section *A* is 1,825,000 in.-lb. Assuming this to be resisted by the cover plates only, the stresses are:

$$\text{Top Plate.......}f_t = \frac{1,825,000}{15.75 \times 14.375 \times 0.50} = 16,110 \text{ lb. per sq. in.}$$

$$\text{Bottom Plate....}f_c = \frac{1,825,000}{15.75 \times 16 \times 0.50} = 14,500 \text{ lb. per sq. in.}$$

The proper riveting of the plates is obtained by using a rivet area equivalent to steel in direct stress. The equivalent area of a rivet is found by multiplying its area by the ratio between its ultimate strength and that of mild steel. Taking the values of 60,000, 42,000 and 95,000 lb. per sq. in. respectively as the ultimate strength of mild steel, rivets in shear and rivets in bearing, we find the equivalent area to be:

$$\text{¾-in. Rivet in single shear} = \frac{0.4418 \times 42,000}{60,000} = 0.309 \text{ sq. in.}$$

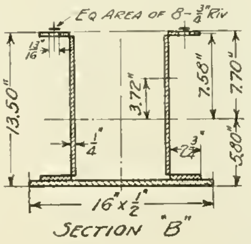
$$\text{¾-in. Rivet in bearing ....} = \frac{0.25 \times 0.75 \times 95,000}{60,000} = 0.297 \text{ sq. in.}$$

To develop the full strength of the top cover it must be connected to the bolster pans by (0.50 × 14.375) ÷ 0.297 = 24.2, say 12 rivets in each flange, beyond section *A*. The bottom plate must have (0.50 × 16) ÷ 0.297 = 26.9, say 14 rivets in each flange including the rivet at section *A*.

The number of rivets and their pitch will usually determine the required length of plates although an analysis of the webs at points not reinforced by the covers may require increasing this length.

Fig. 3 shows the detailed calculations for a closer analysis of section *A*. All material which logically may be considered, has been taken into account. This includes the net section of the top cover, the equivalent area of the rivets between center sill flange and bolster flange, the full area of the bottom cover and the compression portion of the bolster pan. The latter is arbitrarily assumed as about one-third of the depth but the error involved affects material near the neutral axis and so is of little consequence to the properties of the section. This analysis shows the stresses in the top and bottom covers to be respectively, 1,200 and 4,960 lb. per sq. in. less than those obtained by the approximate method and indicates that the size of the bottom cover could be reduced to save weight and cost.

Since the bolster is a short beam with a large concentrated load, it is always well to analyze for longitudinal shear in the webs. This is greatest at the neutral axis and is given by $f_s = \frac{V M_s}{t I}$ where f_s is the unit longitudinal shearing stress at the neutral axis, M_s is the statical moment of the area included between the neutral axis and the extreme fiber taken about the neutral axis and I is the moment of inertia of the whole section. The calculation for statical moment and also for unit longitudinal shear is given for each section.



16 Riv. @ .297	4.75	13.50	64.20	13.50	867.0	—
2 × 1 15/16" × 1/4"	.97	13.38	12.93	13.38	173.0	—
2 × 12 1/2" × 1/4"	6.25	7.00	43.75	7.00	306.3	81.4
2 × 2 3/4" × 1/4"	1.38	.625	.86	.625	.5	—
16" × 1/2"	8.00	.25	2.00	.25	.5	—
TOTALS	21.35	5.80	123.74		1347.3	81.4
STATICAL MOMENT						1347.3
16 Riv @ .297	4.75	7.70	36.55			1428.7
2 × 1 15/16" × 1/4"	.97	7.58	7.35	$21.35 \times \overline{5.80}^2 =$		718.0
2 × 7.45" × 1/4"	3.72	3.72	13.82	$I =$		710.7
TOTALS			$M_s = 57.72$			

$S.M._{(TOP)} = \frac{710.7}{7.70} = 92.3\ \text{IN.}^3$; $S.M._{(BOT)} = \frac{710.7}{5.80} = 122.5\ \text{IN.}^3$

$M = 1,340,000$ INCH LB.

TENSION AT TOP $= \frac{1,340,000}{92.3} = 14,500$ LB. PER SQ. IN.

COMPR AT BOTT. $= \frac{1,340,000}{122.5} = 10,920$

$f_s = \frac{37265 \times 57.72}{.50 \times 710.7} = 6,050$ LB. PER SQ. IN.

Fig. 4

The tendency of web buckling is remote in a double web bolster unless the web is of unusual depth. The method for calculating the buckling stress in beams is given in the "Pocket Companion" of the Carnegie Steel Company and is easily applicable to bolster design.

Fig. 4 shows the detailed calculation for section *B*. The full section of the top cover cannot be considered because it is connected to the webs by 16 rivets beyond the section at *B*, whose equivalent area is less than the plate area. The full area of the pans is taken into account for this is permissible as will be shown. The total tension in each web is transmitted to the center of the car by five rivets in bearing and one rivet in single shear. The amount of their equivalent area about the neutral axis of the section is

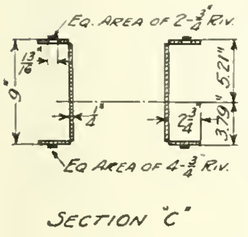
$$7.70 \times (5 \times 0.297 + 0.309) = 13.81$$

The amount of the tension portion of each pan is:

$$1.9375 \times 0.25 \times 7.58 + 7.45 \times 0.25 \times 3.72 = 10.62$$

Therefore the rivets are sufficient to develop the full strength of the pan.

It will be noted that the corners of the pans have been omitted. This is done because, due to flanging, this material is of doubtful value.



4 Riv @ .297	1.19	9.00	10.69	9.00	96.2	—
2×1 15/16"×1/4"	.97	8.875	8.60	8.875	76.4	—
2×8 1/2"×1/4"	4.25	4.50	19.11	4.50	86.1	25.6
2×2 3/4"×1/4"	1.38	.125	.17	.125	—	—
8 Riv @ .297	2.38	0	0	0	0	—
Totals	10.17	3.79	38.57		258.7	25.6
Statical Moment						258.7
4 Riv @ .297	1.19	5.21	6.20			284.3
2×1 15/16"×1/4"	.97	5.09	4.93	$10.17\times\overline{3.79}^2 =$		146.0
2×4.96"×1/4"	2.48	2.48	6.16			I = 138.3
Totals		$M_s = 17.29$				

$$S.M.(\text{top}) = \frac{138.3}{5.21} = 26.6 \text{ in.}^3;\ S.M.(\text{bot.}) = \frac{138.3}{3.79} = 36.5 \text{ in.}^3$$

$$M = 615{,}000 \text{ inch lb.}$$

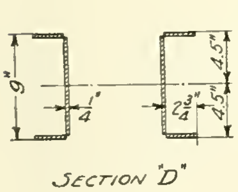
$$\text{Tension at Top} = \frac{615\,000}{26.6} = 23{,}100 \text{ lb. per sq. in.}$$

$$\text{Compr. at Bott.} = \frac{615\,000}{36.5} = 16{,}850$$

$$f_s = \frac{37265 \times 17.29}{.50 \times 138.3} = 9{,}310 \text{ lb. per sq. in.}$$

Fig. 5

In checking over the computations for section *B*, the writer finds that he had used the full area of the bottom plate instead of the equivalent area of 20 rivets. This, however, will have slight effect on the calculated stress because adding or deducting material on the heavy side of an unbalanced section does not change its section modulus very much.



$$I \text{ of Webs} = 2 \times \tfrac{1}{12} \times \tfrac{1}{4} \times \overline{8.5}^3 = 25.6$$

$$I \text{ of Flgs.} = 4 \times 2.75 \times .25 \times \overline{4.375}^2 = 52.6$$

$$I = 78.2$$

$$S.M. = \frac{78.2}{4.5} = 17.38 \text{ in.}^3$$

$$M = 279{,}000 \text{ inch lb.}$$

$$\text{Tension at Top} = \text{Compr. at Bott.}$$

$$f = \frac{279{,}000}{17.38} = 16{,}050 \text{ lb. per sq. in.}$$

$$M_s \text{ of Webs} = 2 \times 4.25 \times .25 \times 2.125 = 4.51$$

$$M_s \text{ of Flgs.} = 2 \times 2.75 \times .25 \times 4.375 = 6.01$$

$$M_s = 10.52$$

$$f_s = \frac{37265 \times 10.52}{.5 \times 78.2} = 10{,}200 \text{ lb. per sq. in.}$$

Fig. 6

The stresses given in Fig. 5 show that the cover plates should have been made longer so that more rivets would be provided to reinforce section *C*. The importance of analyzing several sections of the bolster is here indicated.

Increasing the cover plates would decrease the bending moment to be resisted by the unreinforced pans as shown in Fig. 6 for section *D*. It is important to note, however, that this would not change the value of the unit longitudinal shear. This shear is just beyond the safe limit which is usually given at 10,000 lb. per sq. in. and brings up the question as to the advisability of using 5/16-in. pans instead of 1/4-in. Besides, a 5/16-in. pan would increase the bearing value of the rivets.

Side Frame

The side frame analysis is along lines which have been in use for some time but it should be pointed out that the method is more or less an approximation of the true stresses. Riveted joints are rigid and bring in high secondary stresses. The members of the truss do not meet in points and this brings in additional eccentric stresses. Then there are weaving and bulging stresses. The bulging stresses are roughly approximated by the author, but assuming the wood lining to reinforce the top chord is open to question. The effect of buffing on the side frame has been entirely neglected.

Conclusion

The writer has gone into the bolster stresses in some detail in order to hint at the vastness of the analysis of car design. A proper study of all the stresses in the car structure in service would take time and earnest effort, but these would not be wasted. Here is indeed a field of research which has hardly been touched.

The so-called practical man is prone to smile at theoretical analyses but this tendency is disappearing. Theory and practice always agree when the theory is correct and the practice is properly interpreted. If theory and practice apparently do not agree, then either the theory is incorrect or else the observation of the effects has not taken in the true facts.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Insufficient Proof That Repairs Were Not Made

Peerless Transit Line tank car PTL-1422 was shopped at the Westwego, La., shops of the Texas & Pacific and on April 20, 1919, a repair card issued by that railroad covering the application of one new coupler knuckle. The owner took exception to the bill, claiming that the knuckle was not renewed. This claim was based on an inspection following the return of the car to the owner's siding, by which the owner claims to have identified the original knuckle by a private identification mark placed on it before the car was repaired. The owner claims that a representative of the Atchison, Topeka & Santa Fe witnessed the marking of the knuckles and was also present at the inspection following the return of the car after the repair bill was rendered. Joint evidence to this effect, however, was not presented.

The Arbitration Committee decided that the evidence submitted is not sufficient to disprove the positive statement of the Texas & Pacific that the repairs were actually made as claimed, and the bill is sustained.—*Case No. 1233, Texas & Pacific vs. Peerless Transit Line.*

Delivering Line's Responsibility for Wrong Repairs

Bessemer & Lake Erie car No. 40407 was delivered home by the New York, Chicago & St. Louis on February 3, 1921, with one Bettendorf cast steel truck and two pairs of cast wheels in place of the arch bar truck with wrought steel wheels standard to the car. When the delivery was made, a defect card was issued against the delivering line to cover the wrong truck and two pairs of wrong wheels. The New York, Chicago & St. Louis contends that the defect card should be cancelled and is willing to furnish a card to cover the wrong wheels, which, under the rules are delivering line defects. The owner of the car contends that the responsibility of the New York, Chicago & St. Louis for the wrong truck is proved by the fact that no defect card is offered from a more remote connection, claiming that the acceptance by that line of responsibility for the wrong wheels justifies the conclusion that the road also applied the wrong truck, and is therefore responsible under Rule 4.

The Arbitration Committee decided that the New York, Chicago & St. Louis is responsible under Rule 70 for the wrong wheels, but that it cannot under Rule 4, be required to issue its defect card for the wrong truck if the latter was not applied by it.—*Case No. 1234, New York, Chicago & St. Louis vs. Bessemer & Lake Erie.*

Protection of Delivering Line After Defect Card Is Issued

On April 16, 1921, the Atchison, Topeka & Santa Fe delivered SZX tank car No. 77 to the Peoples Tank Line at Coffeyville, Kans. The car owner later requested the Peoples Tank Line to forward the car to the General American Tank Car Corporation at Sand Springs, Okla., for repairs. The car moved over the Missouri, Kansas & Texas, and on its receipt the General American Tank Car Corporation requested a defect card for delivering line defects. The Missouri, Kansas & Texas furnished a defect card on May 17, covering several defects to the jacket and tank head caused by the cornering of the car. This road in turn requested protection from the Atchison, Topeka & Santa Fe, under Interchange Rule 4, on the ground that the Santa Fe had acknowledged that the defects existed when the car was delivered to the Peoples Tank Line. This request was declined. The Santa Fe stated that it had received the car under load from the Missouri, Kansas & Texas on April 8, 1921, and that the movement in question followed the discharge of the load at Augusta, Kans. The Santa Fe claimed that the car was in no accident while on its line, that it was received from the Missouri, Kansas & Texas in the damaged condition, and had been under load since the damage was done.

The Arbitration Committee decided that the Missouri, Kansas & Texas, having issued its defect card, is responsible for the defects in question.—*Case No. 1235, Missouri, Kansas & Texas vs. Atchison, Topeka & Santa Fe.*

An Application of Rule 32

Coal car No. 5289 of the Fort Smith & Western was broken in two while moving in a train on the Pittsburgh & West Virginia on November 7, 1920, the failure resulting from a burst air hose. The car was of wooden construction, equipped with metal draft arms and of 80,000 lb. capacity. The handling line claimed that the car was not derailed but that it had to be loaded on another car, over which one end of the car body had telescoped, to be taken to the shop because it could not be handled in the train on its own wheels. The Pittsburgh & West Virginia first asked disposition of the car under Rule 112, delivering line responsibility, but later changed its request to come under Rule 120, owner's responsibility, claiming that all longitudinal sills had previously been spliced and were badly deteriorated. The handling line claimed that the car was not derailed at the time it was damaged but that in moving the car out of the train to a side track it was in such condition that it would not take the curve and one pair of wheels dropped off the rails.

The committee decided that the damage to the car was due to unfair usage under Rule 32, for which the handling line is responsible, and that Case No. 1186 applied.—*Case No. 1236, Pittsburgh & West Virginia vs. Fort Smith & Western.*

Does Rule 113 Apply to Relations Between Railroads and Industries?

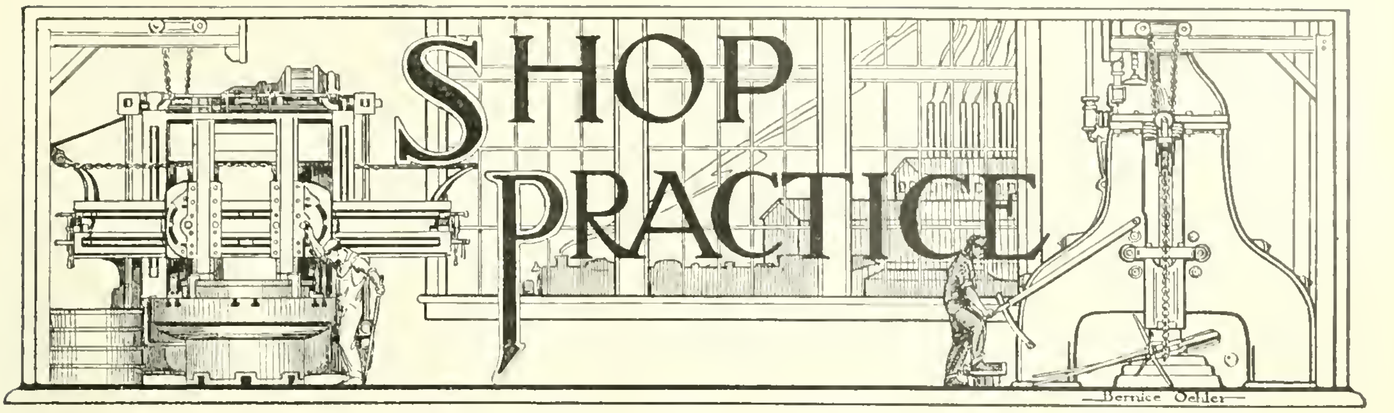
Fire, caused by lightning, which destroyed the warehouse of the Pierce Oil Corporation at Osceola, Ark., on July 6, 1921, spread to and badly damaged the oil corporation's tank car POCX No. 2230, which was unloading gasoline at the time. The spur on which the car was standing was built and is owned by the St. Louis-San Francisco, but is for the sole use of the oil company. The Pierce Oil Corporation claims that under the interchange rules the railroad company is responsible for the damage to the car, citing Rule 113 to substantiate its claim. The oil company does not own or control trackage outside of its property line and does not receive cars home for repairs except at Ft. Worth, Tex.; Texas City, Tex., and Sand Springs, Okla., and contends that the car was in the possession of the railroad company at the time of the fire, citing the fact that the railroad loaded the tank and salvage of the damaged car on two flat cars and shipped them to the oil corporation at Sand Springs, Okla., in violation of an interpretation of Rule 120 (1921 code) as evidence that the railroad recognized this as a fact. The railroad holds that Rule 113 was framed solely for convenience in effecting settlement between railways and not for establishing responsibility between a railway and the industries which it serves, and raises a question as to whether the rules of interchange apply to a case of this nature.

The Arbitration Committee rendered the following decision: "Rule 113 does not apply. It is understood that there was no side track agreement between the interested parties. According to the information furnished in agreed statement of facts, the car was evidently in the possession of the owner when the damage occurred. It is not evident that the St. Louis-San Francisco is responsible for damage to this car.—*Case No. 1238, Pierce Oil Corporation vs. St. Louis-San Francisco.*

Application of Rules 32 and 43 to Damage Caused in Switching

Cincinnati, Indianapolis & Western gondola No. 10032 was broken in two in switching over the hump in the Pennsylvania System yards at Scully, Pa., on October 11, 1920. On November 1, 1920, the Pennsylvania furnished the owner an inspection certificate showing an estimated cost of repairs of $329.40 for labor and $273.50 for material. The car, which was of wood construction, had received general repairs to the extent of $600 eight months previous to its failure, but they did not include reinforcement. The car was neither derailed, cornered nor side swiped. At the time of the accident it was the first of a five-car cut under the protection of one rider, and in addition to the damage which it received, the steel end sill on the first of the standing cars was broken. The owner contends that the damage was caused by collision or impact other than that occurring in regular switching, making the Pennsylvania responsible. The Pennsylvania contends that under the first interpretation of Rule 43, in the 1919 code, the responsibility is clearly the owner's and cites decisions Nos. 1157, 1165, 1166 and 1185 as being parallel.

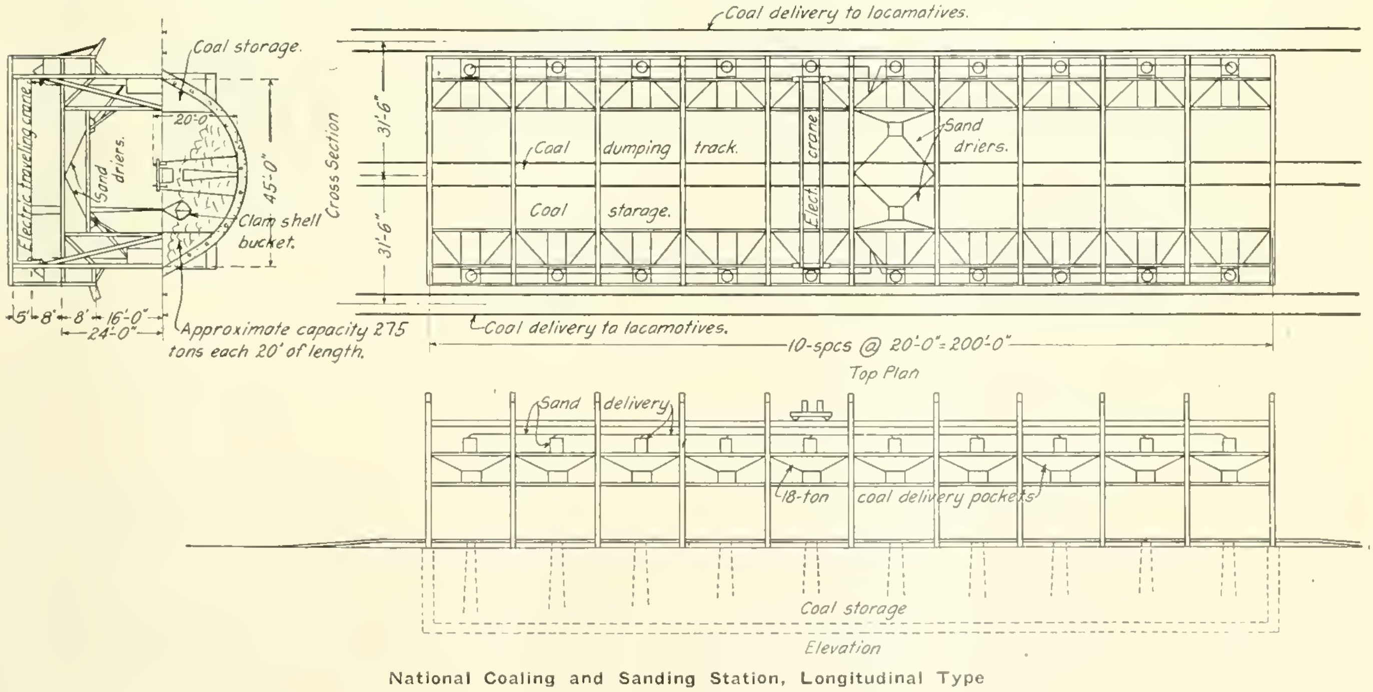
The Arbitration Committee decision is as follows: "The evidence presented does not show that damage resulted from any of the conditions enumerated in Rule No. 32. The car owner is responsible."—*Case No. 1239, Cincinnati, Indianapolis & Western vs. Pennsylvania System.*



An Innovation in Locomotive Terminal Design

Rectangular or Circular Enginehouses with Inside Cinder Pits Designed for Promptly Turning Power

As the result of extended studies of locomotive terminal operation, designs for engine terminals have been developed by the National Boiler Washing Company, Chicago, the special features of which are the inclusion of the ash-pit facilities at each stall inside the enginehouse. With these designs, which include the adaptation of the inside cinder pit to enginehouses of the customary type as well as to houses of rectangular design, the plan of operation contemplates that the locomotive will be removed directly from the train to its track in the engine house by the road crew and that on outbound movements the road crew will take the locomotive from the house directly to the train. This method of operation, it is estimated, will effect a saving of several locomotive hours consumed in intermediate engine terminal movements by each locomotive, a reduction in the amount of coal consumed by locomotives in the terminal, the elimination of hostler service and some reduction in the labor cost of cleaning fires.

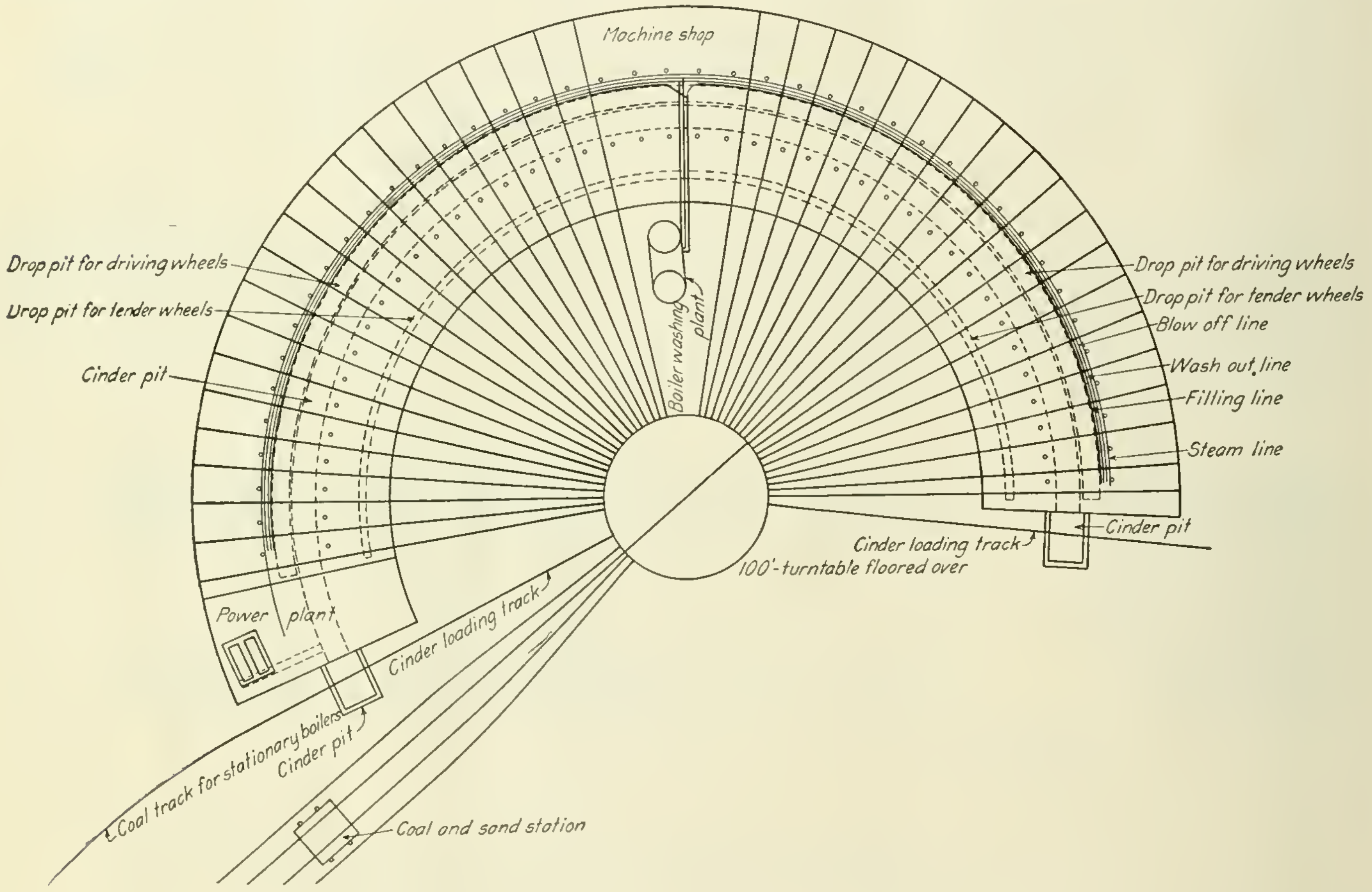


National Coaling and Sanding Station, Longitudinal Type

As a part of its studies of terminal design this company has also developed a coaling plant in which the principal fuel storage is contained in a pit below the track level, to which coal is dumped directly from the cars and from which it is elevated to the service hoppers by means of a traveling crane.

As will be seen from the drawings, the cinder pit in effect is a large trough, 14 ft. wide at the top, located below and extending transversely to the enginehouse tracks, in which a stream of water, delivered at the upper end of the trough, is kept constantly flowing down the slope of the trough toward the end of the house. Provisions are made for washing down the sides of the trough at each stall during the time that a fire is being cleaned. As ashes are dropped into the pit they are washed down to an outside storage pit adjoining the end of the enginehouse, where the cinders and water accumulate, the latter to overflow into a sump from which it is pumped back into the service pit. From the storage pit, ashes are loaded into cars by means of a clam shell bucket operated from a monorail hoist or traveling crane, arranged to suit local conditions. The top of the trough is located at the elevation of the bottom of the engine pits and when not in use is covered with a movable cast iron plate so that the continuity of the engine pit floor is unbroken.

The desirability of including cinder pit facilities inside the enginehouse was suggested by operating studies of various locomotive terminals, in which all observations were made under good weather conditions. These observations indicate that at the average terminal handling 40 or more locomotives a day, about 3 hours 10 minutes is required to house a locomotive after it leaves the train. The locomotive is first moved to the inbound terminal track by the road crew. This requires an average of about 20 minutes, after which the locomotive spends 30 minutes waiting for the hostler or because of yard congestion and similar causes, before it is moved to the coal chute. At the coal chute about 20 minutes is required to take coal, water and sand. There is then an average delay of 45 minutes between the coal chute and the cinder pit and the locomotive spends another 45 minutes on the cinder pit. It is then moved to the wood pile to receive kindling for the new fire. This movement and loading the wood requires a total of 10 minutes. Moving the locomotive to and waiting for the turntable consumes 15 minutes and 5 minutes are spent in moving over the turntable and into the house.



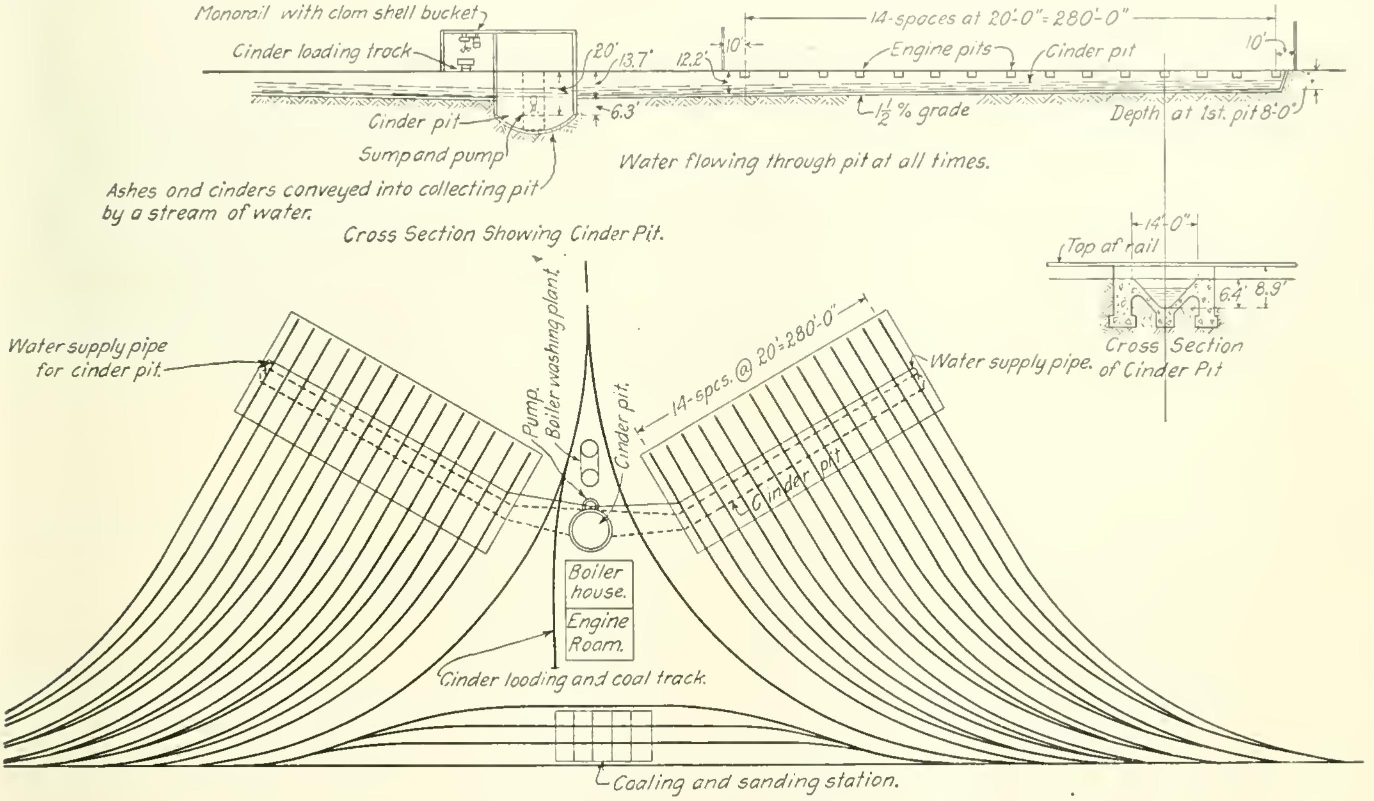
National Consolidated Locomotive Terminal Layout—Cinder Pit Inside of Round House

With the National Consolidated locomotive terminal it is anticipated that the locomotive may be moved by the road crew directly from the train to the enginehouse without intermediate delays in the same time that is now required to deliver the locomotive on the inbound assigned track in terminals of conventional layout. On the outbound movement the locomotive stops at the coal chute for coal, sand and water. In all other respects, however, it is ready for its trip before it leaves the enginehouse, in the hands of the road crews, and this movement requires no delay other than the time actually required for service at the coal chute. An allowance of 30 minutes time to the crew is made for completing the movement of the locomotive from the enginehouse to the train.

Where terminals are unequipped with a hot water washing and filling plant an average time of 6 hours is required in the roundhouse to blow down the boiler and cool it by the customary process of gradually changing the water and to refill and fire up to 100 lb. steam pressure. Of this total, 4 hours is required in blowing down and cooling down the boiler, 30 minutes in refilling and 1 hour and 30 minutes in firing up to 100 lb. steam pressure. This ordinarily determines the time required in the roundhouse, as the running repairs generally can be completed well within this period.

In the design of the National Consolidated terminal the inclusion of a boiler washing plant is contemplated, together with facilities at each pit for cleaning the exterior surfaces of the locomotive, inspecting the machinery and making running repairs. This work is all to be performed without moving the locomotive after it has been spotted on the engine pit. The facilities include jib cranes serving each two pits, and suitable drop pits arranged either continuously under all engine pits or under two or more adjoining pits, as local conditions require.

With hot water washing and filling facilities and with the ash pit facilities located inside the house, the time required for knocking the fire, blowing down the boilers, filling it with hot water and firing up to 100 lb. steam pressure is estimated at 3 hours 45 minutes, during which time the locomotive will be cleaned and inspected, and ordinary running repairs made. Comparing the two sets of conditions, the total time in the hands of the mechanical department is reduced from 9 hours 50 minutes to 4 hours 35 minutes, thus reducing the overall time from trip to trip by 5 hours 15 minutes.


Monorail with clam shell bucket
Cinder loading track
20'
13.7'
12.2'
10'
14-spaces at 20'-0" = 280'-0"
Engine pits
Cinder pit
10'
6.3'
1½ % grade
Depth at 1st. pit 8'-0"
Cinder pit
Sump and pump
Water flowing through pit at all times.
Ashes and cinders conveyed into collecting pit by a stream of water.
Cross Section Showing Cinder Pit.
14'-0"
Top of rail
6.4'
8.9'
Cross Section of Cinder Pit
Water supply pipe for cinder pit.
Pump.
Boiler washing plant.
Cinder pit.
14-spcs. @ 20' = 280'-0"
Water supply pipe.
Cinder pit
Boiler house.
Engine Room.
Cinder loading and coal track.
Coaling and sanding station.

Proposed Arrangement of Rectangular Engine House with Inside Cinder Pit

In estimating the possible savings in the cost of turning locomotives through the National Consolidated locomotive terminal the field observations of actual operations at a number of existing engine terminals have been reduced to a basis of a terminal turning 42 locomotives a day, the equipment of which is typical of many comparatively modern engine terminals. The terminal includes no boiler washing plant and neither drop pits nor jib cranes are provided in the engine house. The coal chute is of concrete construction and the terminal is served by a wet type cinder pit and a motor tractor driven turntable. The turning of 42 locomotives per day includes blowing down and filling the boilers of 14 locomotives and washing out the boilers of seven additional locomotives. The labor cost of operating this terminal, on the basis of three 8-hour shifts, is as follows:

Hostlers:		
9 men, 8 hours each, at 72.9 cents per hour		$52.49
Coal Chute and Sand House:		
1 foreman, 8 hours, at 75 cents an hour	$6.00	
3 engineers, 8 hours each, at 57.25 cents an hour	13.75	
3 laborers (sand dryer and coal chute), 8 hours each, at 43 cents an hour	10.32	
Total		30.07
Cinder Pit:		
11 fire knockers, 8 hours each, at 43 cents an hour	$39.60	
1 crane operator, 8 hours, at 63.5 cents an hour	5.08	
Total		44.68
Wood Pile:		
3 men, 8 hours each, at 43 cents an hour		10.32
Turn Table Tractor:		
3 men, 8 hours each, at 45 cents an hour		10.80
Blowing Down and Refilling Boilers:		
6 men, 8 hours each, at 52 cents an hour		24.96
Boiler Washing:		
8 men, 8 hours each, at 52 cents an hour		33.28
Fire Builders:		
6 men, 8 hours each, at 52 cents an hour		24.96
Total daily cost, turning 42 locomotives		$231.56
Cost per locomotive turned		$5.51

Under the method of operation possible with a terminal of the type in which all conditioning of the locomotives, with the exception of taking coal, sand and water, is done in the engine house, the labor costs of turning 42 locomotives a day, under the same conditions as are set forth above, are estimated as follows:

Hostler service (one-half hour allowed each engine crew).		
Freight enginemen, 21 hours, at $1 16 an hour; freight firemen, 21 hours, at 88 cents an hour		$42.84
Coal Chute and Sand House:		
1 foreman, 8 hours, at 75 cents an hour	$6.00	
3 engineers, 8 hours each, at 57.25 cents an hour	13.75	
3 laborers (sand dryer and coal chute), 8 hours each at 43 cents an hour	10.32	
Total		30.07
Cinder Pit:		
8 men, 8 hours each, at 45 cents an hour	28.80	
1 crane operator, 8 hours, at 63.5 cents an hour	5.08	
Total		33.88
Wood Handling:		
3 men, 8 hours each, at 43 cents an hour		10.32
Blowing Down and Refilling Boilers:		
4 men, 8 hours each, at 52 cents an hour		16.64
Boiler Washing:		
6 men, 8 hours each, at 52 cents an hour		24.96
Fire Builders:		
Four men, 8 hours each, at 43 cents an hour		13.76
Total daily costs, turning 42 locomotives		$172.47
Cost per locomotive turned		$4.11

The reduction in the number of fire cleaners included in the estimate of the number of fire cleaners required in the National Consolidated locomotive terminal is based on the ability to smooth out the peaks which occur at outside cinder pits because of their limited service capacity. With inside cinder pits a delay in cleaning the fire after a locomotive has been housed does not interfere with the operation of the terminal.

In addition to the reduced labor costs which is claimed for the new terminal layout, a saving in the cost of fuel and water consumed in the terminal of over 53 per cent is estimated to be possible. This includes the saving effected by the use of hot water for washing and filling boilers as well as that attributable to the elimination of delays in the movement of locomotives through the terminal. Based on the turning of 42 locomotives, washing seven and blowing down and filling 14 boilers, all of which are fired up cold, the cost of coal in the average terminals of conventional design is shown in the table which follows:

COAL

	Tons of coal per day	Cost at $3.50 per ton
42 locomotives. 500 lb. coal each account delays between train and train	10.5	$36.75
21 locomotives fired up, hot water and steam in boiler, 1,256 lb. each	13	45.50
21 locomotives fired up cold. Firing up, 2,574 lb. each. Coal for blower steam 1,754 lb. each. Total	45.4	158.90
Total cost fuel per day		$241.15

WATER

	Gal. of water per day	Cost at $0.10 per M. gal.
7 boilers washed, 2,500 gal. each	17,500	1.75
21 boilers refilled, 5,000 gal. each	105,000	10.50
Total cost of water per day		$12.25
Total cost of fuel and water per day		$253.40

With the elimination of delays in the new terminal layout the fuel required to keep up steam pressure while handling the locomotives into and out of the terminal is saved. The water blown down from the boilers is used for washing boilers and the steam blown off forms part of the hot refilling water. Under these conditions the coal and water costs are estimated as follows:

COAL

	Tons of coal per day	Cost at $3.50 per ton
21 locomotives, hot water and steam in boiler, 1,256 lb. each	13	$45.50
21 locomotives fired up, refilled. Firing up, 1,256 lb. each. Coal for blower steam, 877 lb. each. Total	22.2	77.70
Total cost of fuel per day		$123.20

WATER

	Gal. of water per day	Cost at $0.10 per M. gal.
21 boilers refilled (condensate and fresh water) 2,500 gal. fresh water each	52,500	$5.25
Total cost of fuel and water per day		$128.45

This indicated a saving of $124.95 a day in the cost of fuel and water in favor of the National Consolidated terminal, most of which should be credited to the inclusion of a hot water boiler washing plant. However, $36.75 may be credited to the inclusion of the cinder pit inside.

The drawings show the application of the inside cinder pit in an engine terminal with the customary roundhouse and turntable layout and in a proposed rectangular enginehouse served by a wye in place of the turntable. The advantages of the latter arrangement are the saving in space inside the building permitted by the parallel arrangement of tracks, the ability to standardize the building design, so that it may be constructed in multiples of four-stall units and the lower cost of maintenance of the roundhouse leads and wye track as compared with the growing cost of maintaining turntables incident to their increasing length. The greater vulnerability of the turntable to accidents of a nature likely to completely tie up the terminal is also pointed out as favorable to the use of the wye. The arrangement of the terminal with rectangular houses shown in one of the illustrations is not intended to represent a standard form but is suggestive of what may be done with this type of layout.

Coaling Plant

In connection with this terminal design, a coaling plant has also been developed in which the main storage is carried in a concrete pit below the unloading track, which is approximately at ground elevation. A typical design of this type of coaling station is shown in one of the drawings. This is of the longitudinal type serving two engine tracks, with a single unloading track between them. This plant is a steel structure built in multiples of standard units each 20 ft. in length. For each 20-ft. bay, there is pit storage for 275 tons of coal and two service hoppers, one delivering to each engine track, having a capacity of 18 tons each. The steel structure is designed to carry a crane which travels longitudinally, with sufficient clearance between the top of the service hoppers and the bottom of the crane to permit the operation of a clam shell bucket for delivering coal.

The purpose of the development of this type of coaling station is to facilitate the rapid unloading of cars without the intermediate switching movements required at coal chutes of the elevator type, to provide a ready means for increasing the capacity of a coaling station without the necessity for the construction of a complete independent plant and the simplification of the design of the structure itself. A high degree of dependability is obtained by the use of an electric traveling crane and in case of emergency it is pointed out that the plant can be operated by a locomotive crane.

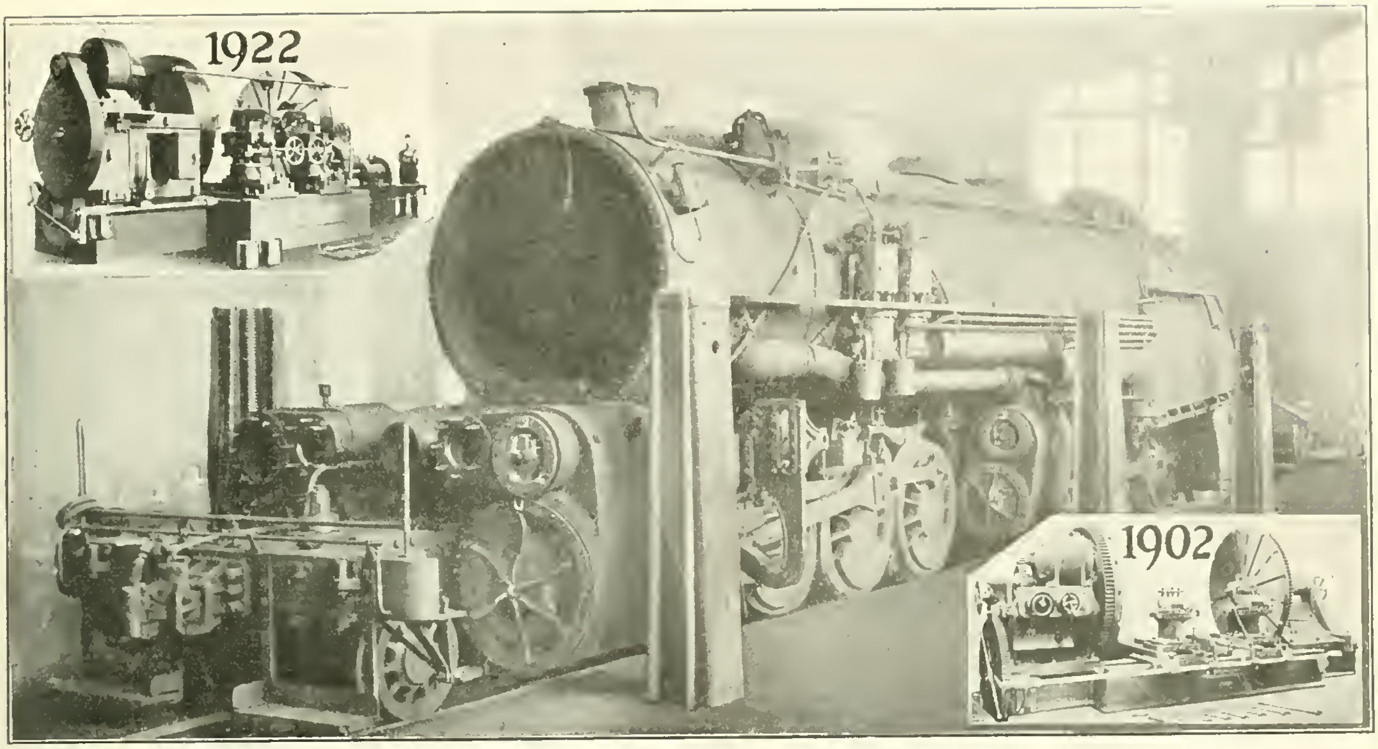
Where local conditions require a coaling station which will serve more than two tracks, a design has been worked out in which the crane, instead of traveling longitudinally over a single storage pit, travels transversely across two storage pits each 60 ft. in length and each serving two coaling tracks. Each coaling track has access to three service hoppers of 18 tons capacity each and the two pits, each 58 ft. wide and receiving coal from two unloading tracks placed 27 ft. from center to center, have a total storage capacity of 2,400 tons. Both types include sand drying facilities located at a sufficient elevation to permit the sand to fall into the dry sand storage by gravity, from which it is distributed by compressed air to the various service bins.

Patents have been obtained or applied for covering several arrangements of terminals, the application of the inside cinder pit to both rectangular and circular houses, and the coaling facilities just described.

How Do You Harden and Quench High-Speed Steel?

Do you thoroughly preheat it, or do you put it into the high heat chamber while the piece is cold? Experience has taught us that it is just as harmful to put a piece of cold high-speed steel into a high heat chamber without preheating as it is to quench it suddenly in cold water from a high heat. In the hardening of high-speed steel it has been found imperative that parts of any size be preheated to at least 1,600 deg. F. before being placed in the finishing heat of 2,250 deg. F., as the sudden shock of the intense temperature of the high-speed furnace frequently causes cracks which do not show until after the tool has been put into use. Experience again has taught us that the intricate part or parts, having large and small sections, should, to prevent breakage or cracking, be quenched in salts or molten lead heated to a temperature of 1,050 deg. F.; then cooled in oil or in the air; then drawn to the required temperature. All high-speed steel should be drawn after the hardening operation to temper and relieve strains. The proper equipment for treating high-speed steel consists of furnaces having a minimum of heat radiation and giving a constantly uniform temperature throughout. Furnaces which can be controlled accurately and held to steady temperatures are essential.—From a folder published by the Chicago Flexible Shaft Company.

The Eastern Railway of France now has more than one-quarter of its locomotives fitted with audible cab signals. The total number of locomotives in service at the present time is, for passenger trains, 1,200; for freight trains, 798; total 2,018. Of these, 428 passenger engines and 144 freight engines are fitted with the signal apparatus. Ramps have been installed at 390 distant signals and at 130 home signals. The company plans to fit up 1,278 more locomotives before the end of 1923, and to install 1,560 additional ramps.



Can Modern Locomotives Be Repaired Economically With Machinery 20 Years Old?

Lack of Modern Machinery Handicaps Railroads

Net Earnings Are Reduced by Need of Machinery to Repair Equipment with Desired Speed and Economy

By E. L. Woodward

BROADLY speaking, the machine equipment of railroad shops and enginehouses affects net earnings in two ways, and is therefore of interest to the highest executive as well as mechanical department officers. In the first place locomotive and car repair costs are bound to be excessive without sufficient heavy modern machinery, in proportion to the increased amount and size of equipment, to reduce labor costs to a minimum. Second, lack of machine facilities delays repair operations, holding equipment out of service in shops and enginehouses longer than would otherwise be necessary and cutting down revenue-earning hours. Shop machinery also represents an investment which, in the present state of railroad net earnings and credit, should be subject to the closest scrutiny by mechanical, purchasing and higher executive officers.

PRESENT machine equipment in railroad shops and enginehouses averages 20 years old. This machinery is deficient in amount, size, power and convenience of operation. It appreciably increases maintenance of equipment costs which, in 1921, were one and one-quarter billion dollars, or 23 per cent of railroad gross earnings. This article attempts to point out how serious the machine deficiency has become, what influences have brought it about, and what can be done to remedy it.

The vital importance of shop machinery is indicated by the fact that in almost every railroad shop the output is limited by that of the machine department. Usually this department is lacking in both space and modern machinery. The erecting, boiler and blacksmith shops can in most cases handle more locomotive parts a month by increasing the force, but the machine shop is equipped with a certain definite number of machines which absolutely limits the number of rods, links, driving boxes, or wheels it can repair. True, machine shop output can be increased by putting on extra shifts, but past experience has shown this practice to be generally costly and unsatisfactory. Attention has been focused on the deficiency of machines more strongly than ever before, as a result of the strike and present attempts to secure greater shop output. Higher railroad officers are coming to realize that modern machinery is essential to efficient shop operation, and money spent for it is more than an operating expense. It is an investment which often pays better than equal investments in rolling stock.

Modern machinery fulfills the same important function for the railroad as for other industries, and immense numbers of machine tools are used in 403 locomotive shops, 568 car shops and 3,271 roundhouses on Class I roads in the United States. Obviously, if any considerable proportion of these machines is inefficient, the total loss is correspondingly great. Over 600,000 men are employed in railroad shops and roundhouses, and in 1921, the latest year for which figures are available, the cost of maintaining equipment was one and one-quarter billion dollars, or 23 per cent of all the money earned by the railroads. What proportion of this money could be saved by scrapping present obsolete and worn-out shop machinery and installing modern equipment would be hard to say. If only a fraction of one per cent was saved, however, the figures would still assume striking proportions. That important savings are possible is admitted by all unbiased observers familiar with actual shop conditions.

Present Machine Facilities Seriously Inadequate

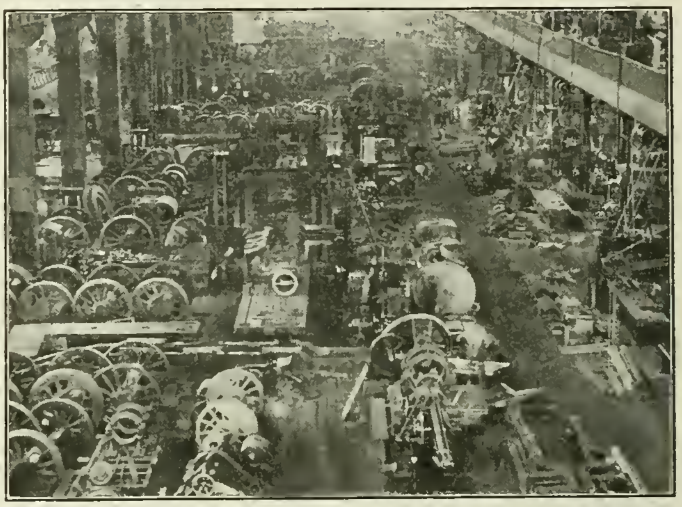
Perhaps present railroad machine tool needs can best be visualized by noting the relatively small amounts of money spent in recent years for replacing existing shop machinery and to provide for increased needs. The facts of the situation will be evident from a study of Table I, showing in column A, the total operating expenses of the railroads each year for five years; column B, the money spent in repairing and replacing present machine equipment; column C, the ratio of B to A; and column D, investments in machinery purchased to make up deficiencies and fill increased needs. A longer period is not shown in this table for the reason that additions and betterments chargeable to capital account, column D, were not compiled by the Interstate Commerce Commission previous to 1917, and the figures for 1921 and 1922 are not yet available.

Table I.—Statistics for Class I Carriers

For fiscal year ending	(A) Total operating expenses	(B) Account 302 shop machinery	(C) Per cent of total expenses =(B)÷(A)	(D) Additions and betterments to shop machinery
Dec. 31, 1917...	2,829,325,123	14,552,997	.514	6,372,825
Dec. 31, 1918...	3,948,132.200	27,520,000	.696	7,775,692
Dec. 31, 1919...	4,378,285,227	24,802,814	.569	11,384,145
Dec. 31, 1920...	5,830,620,492	29,662,306	.509	7,466,414
Dec. 31, 1921...	4,562,668,302	19,249,027	.422	....

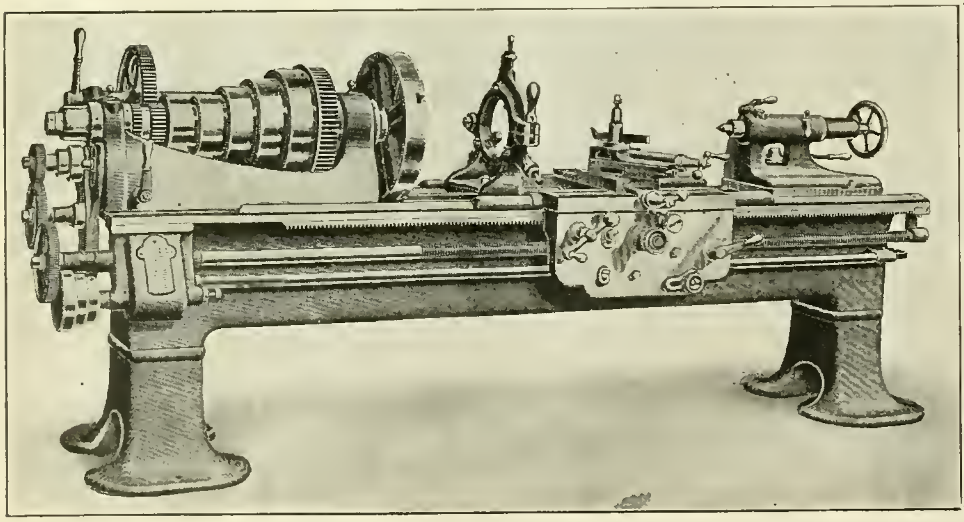
The money spent for shop machinery, column B, increased as operating expenses increased, reaching a maximum in 1920 of almost thirty million dollars. With the drastic reduction in expenses during 1921, it was natural to economize as far as possible on shop expense and Account 302 was reduced ten million dollars, or practically one-third. It was not only reduced but its proportion to the total operating expenses reached the record low point of .422, as shown in column C. This economy in shop machinery maintenance may have been, and probably was, necessary at the time, but it is merely a deferred expense which must be made up in the future. It is indicative of the general tendency to overlook machinery in favor of what may seem to be more pressing needs. Our point is that these needs have been overlooked so long on some roads that there are practically no needs more pressing.

Referring to column D, it will be noted that the money spent for additional machine facilities, chargeable to capital account, varied from over six million in 1917 to a maximum of eleven million dollars in 1919, then falling off. During 1921 and the early months of 1922, the retrenchments in operating expenses delayed betterment programs so that relatively few machines chargeable to additions and betterments were bought.



Congested Heavy Machinery Bay—The Average Railroad Machine Shop Is Lacking in Both Space and Modern Labor-Saving Machinery

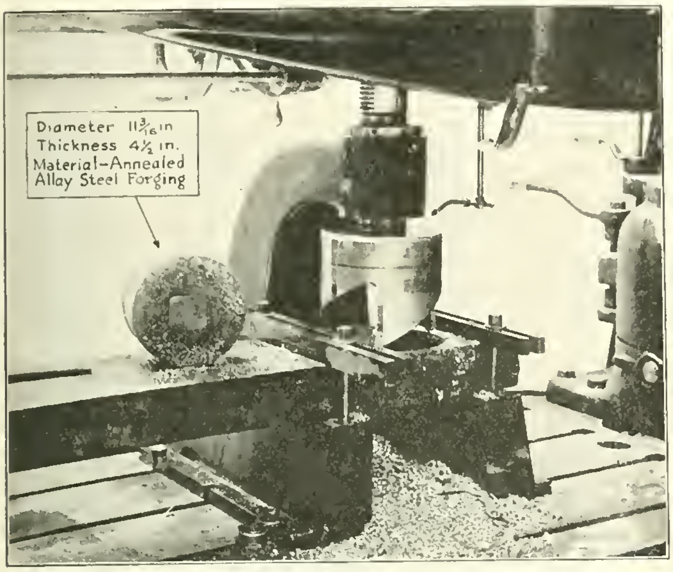
In connection with the eleven million dollars spent in 1919, it should be remembered that this unusually large amount does not properly represent a proportionate increase in machine tool facilities. Machine prices were then near their high peak and probably the number of machines actually secured did not greatly exceed those bought in 1917 for about one-half the price. It is certain that railroad investments in machinery in recent years have been insufficient to much more than maintain existing facilities, let alone make up past deficiencies, or provide normal expansion to care for the increasing number of heavier cars and locomotives.



While capable of many years more service, this machine is so inferior in productive capacity to the modern engine lathe that it can be used economically only in small shops and enginehouses having few turning operations daily. Other standard tools, like drills, planers and milling machines, 20 years old, are even more inefficient compared to modern tools.

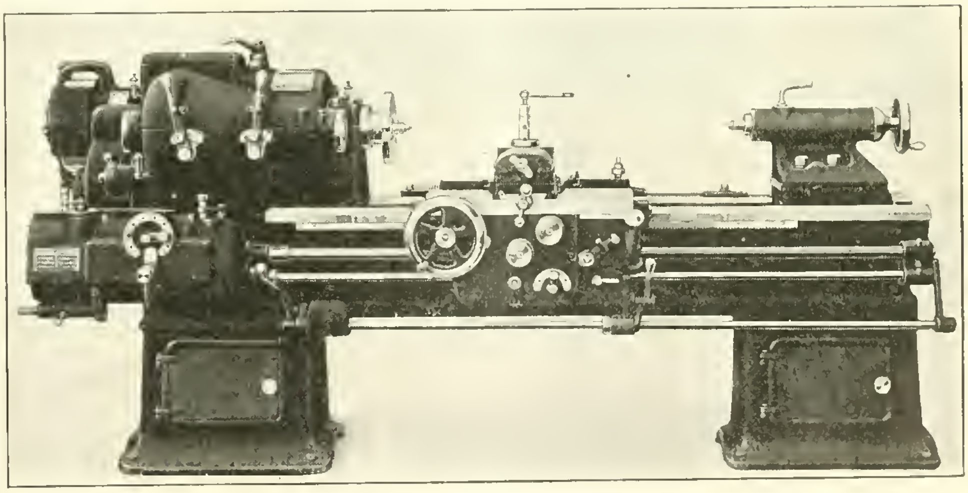
Common Type of 20-In. Cone-Driven, Back-Geared Engine Lathe. Built About 1902

The poor condition on many railroads as regards shop machinery is also indicated by the number of machine tool programs which have been entirely cancelled or carried out only partially. Attention was recently directed in the columns of the *Railway Age* (page 826, November 4 issue) to a definite case where a railroad having four moderate-sized repair shops made an exhaustive study of its machine tool needs, and outlined a program calling for an expenditure of $275,000 a year for ten years. This program was initiated over two years ago and, owing to financial limitations, three machines only have been purchased in the interim.



Side Rod Bushing Hole Roughed Out in 23 Minutes on a Modern Radial Drill. What Manufacturer 20 Years Ago Would Have Dreamed of Attempting Such a Job?

There are men who say by inference, if not in so many words, that railroad shops do not need the highest type of modern machine tools; that railroads always have got along with more or less inferior tools, and always can. There is just enough truth in these statements so that they cannot be branded as absolutely false. For the majority of machining operations, highly specialized productive tools are not needed. That does not mean, however, that so simple a tool as a lathe should not have ample power, rigidity and ease of operation. Modern lathes are sufficiently superior in these respects to many of the lathes now used in railroad shops to enable them to effect savings which will more than pay carrying charges on the additional investment.



This modern lathe will work high speed steel tools to the limit; taking heavy cuts with accuracy and speed. Selective speed and feed changes are almost instantly obtainable. The main spindle can be started, stopped or reversed by either of two easily-reached levers. Wherever sufficient work is available this machine will show important savings over older types of lathes.

1922 Model, 20-In. Motor-Driven Engine Lathe—a Compact, Powerful, High-Production Tool

Machines 20 Years Old Cannot Push High-Speed Tools to Capacity

The condition of present machinery can also be appreciated from the fact that the average age of machine tools in the largest shop of an eastern railroad is 15 years. On two southern roads the machines average over 19 years old in each case. Unquestionably, even the simplest types of standard machines, such as lathes, planers, shapers, milling machines, drills, etc., have been improved so much in design during that period that railroads cannot afford to operate the older machines, except possibly at small isolated points where they will be used only two or three times a day.

Not only is the old machinery inadequate in amount, power and convenience of operation, but also in size, being totally unsuited to handle the heavy parts entering into modern locomotive and car construction. During the past ten years alone cars have increased 11 per cent in number; locomotives have increased 40 per cent in number and 50 per cent in tractive power. Have machine facilities been increased proportionately?

In many shops the tremendous possibilities of high-speed steel in cutting the cost of machine operations cannot be realized because the machinery lacks sufficient power to work these tools. In a recent specific case, a new high-speed tool was being tried out in a shop of one of the most prosperous roads in this country. Except for the wheel lathes, no machine was found in the shop capable of pushing this tool to anywhere near its capacity. The tool was adaptable to use on lathes, planers, shapers, or slotters, and was first tried on a small planer of ancient design, machining a driving box wedge. The lack of rigidity of the planer drive was such that the speed or feed could not be increased without violent chattering. The tool head had at least 3/32 in. lost motion back and forth on the cross feed screw, and was observed to spring back that amount after the completion of each cut. Sometimes considerable material has to be removed from the faces of shoes and wedges, and, with a planer of this type and present high machinist's wages, the cost of the operation is excessive.

The tool was next tested on a lathe which apparently was far older than the shop in which it was installed. This lathe was driven from a countershaft and pulley, on which the belt slipped every time an attempt was made to increase the feed or speed. The back gear shaft on this lathe was observed to have fully ⅛ in. play in its bearings and the result on power delivered at low speed can readily be imagined. Unfortunately, such machines are not the exception but can be found in large or small numbers in almost every railroad shop in the country.

Reasons Underlying Present Machine Deficiency

As has been pointed out in these columns before, the small annual net earnings of the railroads in recent years has discouraged investors, so that capital needed to expand the railroad plant in proportion to the normal expansion of business could not be obtained. It has been difficult to get new equipment and even more difficult to secure the repair facilities needed to maintain new equipment. This explains why in many cases railroad shops and enginehouses are equipped as at present with so many machines which are antiquated, inefficient and costly to operate.

Another important reason is that mechanical department men have taken old machinery too much for granted, either entirely failing to show the managements how much money could be saved by the installation of modern equipment or else becoming discouraged after once pointing out the needs and getting no action. Many progressive mechanical department men on the other hand do realize the savings possible by new equipment, but their hands are completely tied by the financial inability of the railroads to provide the appropriations needed.

The comparative ease of getting money for new rolling stock as against new machinery has also operated to the disadvantage of the latter. In fact the difficulty in getting even small appropriations for machine tools has been so great that railroad men will patch, repair, weld in gear teeth, and frequently manufacture complete new tools in the shops, charging them to operating expense. Some shopmen take an almost unholy pride in their ability to devise ingenious makeshifts for some standard machine which could more profitably be bought. The expense of constructing these makeshifts in railroad shops is excessive and they are relatively unsatisfactory in operation.

Effect of Modern High Labor Costs

Another explanation of the generally poor condition of railroad shop machinery is that no longer than ten years ago, labor costs were fully 50 per cent less than now, and it was not relatively of as great importance to utilize labor-saving machinery. At the present time labor costs so much that many operations should now be done by machinery which formerly could profitably be performed by hand. In the days of cheap labor was born the pernicious idea that any old machine is good enough for a railroad shop, and if machines are not available, brawn and muscle will do about as well.

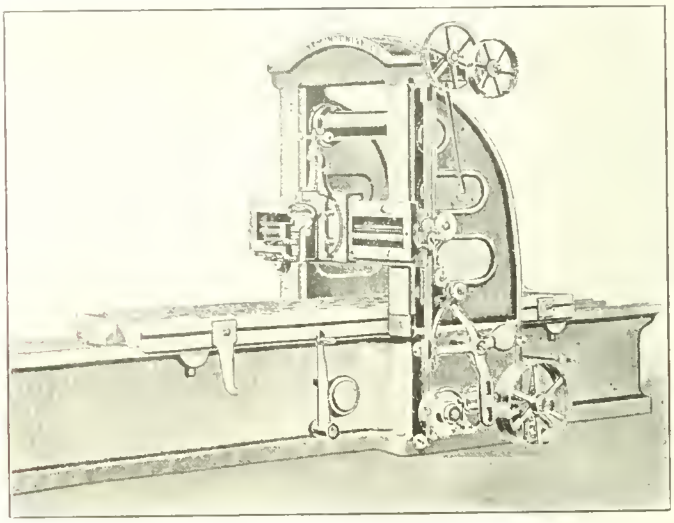
It is hardly necessary to defend the need of railroad shops for more and better machine tools, and such a defense would be absolutely unnecessary were it not that some railroad men of the old school have always got along with the old equipment and seem satisfied to continue the effort indefinitely. They forget, or at least are indifferent to, the fact that adequate modern machinery would make their own work easier as well as reduce railroad labor costs. One of these men recently said that managements are not justified in making large expenditures for facilities because in the past, peak loads have always been handled with existing equipment. True, each peak was handled after a fashion, but it is a question how successfully and how economically it was handled. In practically every case revenue was lost, perishables damaged while waiting shipment and, in the rush to get equipment through repair shops, costs were excessive.

There may be no justification for a plant and equipment able to handle with ease the peak load in any business. The plant should be available, however, to handle peak loads with a reasonable degree of efficiency and economy. That railroad equipment is not now in the latter happy condition is indicated by Secretary Hoover's recent statement that car shortage each year costs the general public (and the railroads) as much as the entire annual cost of administering the affairs of the federal government. One important reason for car shortages is lack of machinery and equipment for rapidly repairing cars, particularly steel cars.

It is not maintained that every railroad shop should be equipped with the latest types of modern productive machinery, but these machines should be installed wherever the volume of work warrants. Rugged standard types are needed elsewhere, and the best place for obsolete models, which waste valuable space and operator's time, is undoubtedly the scrap pile.

Machine Tool Budgets Should Be Prepared

If it is admitted that railroads cannot repair equipment satisfactorily with present machine tool facilities, the question is, what can be done about it? Plainly, one important thing is for the mechanical departments to prepare constructive machine tool programs, or budgets, based on accurate figures showing the cost of new machinery, the volume of work to be handled, and anticipated savings.



1902 Model Planer. Many Planers in Railroad Shops Are Older Than This Machine. They Lack the Power, Rigidity and Flexibility of Modern Planers and Are Costly to Operate on Production Work

In establishing a budget for a certain road it was estimated recently that twenty thousand dollars per thousand miles of track should be spent annually for shop machinery. It seems more logical, however, to base machinery purchases on locomotive equipment rather than mileage. This road is approximately 8,000 miles long, with 1,600 locomotives, and shop machinery having a present replacement value of $3,200,000. From a basis of normal deterioration and obsolescence, this machinery cannot be considered to have a useful life greater than 20 years and in order to maintain the plant, let alone care for increasing needs, 5 per cent should be retired and replaced annually. This means an expenditure of $160,000 per year, or $100 per locomotive per year. As a matter of fact, this road spent $400,000 in 1920 for machinery when prices were high. Had a scientific budget previously been in force, the railroad would have saved considerable money, inasmuch as it would not have been necessary to buy so much machinery at the prevailing high prices.

Improved Purchasing Methods Needed

There is opportunity for a great improvement in railroad methods of purchasing machine tools, and timely editorials on this, and general machine tool subjects, have been printed during the past year in the *Railway Mechanical Engineer* as shown in the following table:

Machine Tool Editorials in the Railway Mechanical Engineer

An Old Fallacy	March,	1922
Buying vs. Making	April,	1922
Another Comment on Price Buying	May,	1922
Drill Grinders Needed	May,	1922
Why Grind Piston Rods	June,	1922
Why Continue to Use Obsolete Machinery	July,	1922
Grinding Car Journals	July,	1922
More Drop-Forging Work Needed	Aug.,	1922
Some Comments on Internal Grinding	Aug.,	1922
Meaning of the Term "Wood Butcher"	Sept.,	1922
Machine Tool Prices Advance	Oct.,	1922
Why Not Grind Air Compressor Cylinders	Nov.	1922
A Short-sighted Policy	Nov.	1922
Second-hand Machine Tools	Dec.,	1922
Engine Terminal Machine Equipment	Jan.,	1923

Railroad methods of purchasing machine tools have been criticized in three ways and with some justification. These include lump buying, the three-machine option and placing too much emphasis on price as opposed to quality. A railroad machine tool is an investment in which first cost is entirely secondary to the amount and kind of service rendered. With the present competition in the machine tool industry, price is a fairly accurate measure of serviceability and, since machine tools are used 15 or 20 years or more, productive capacity is far more important than first cost. The present practice of placing big shop equipment orders with one large manufacturer or dealer is objectionable because no one dealer represents all the best lines in the country and, in order to quote a lump sum lower than the total aggregate bid, he must include some machines not of the first quality. Considering machine tools as an investment, each one should receive separate consideration and be purchased in accordance with the individual needs.

Regarding the common practice of requiring the mechanical department to specify at least three makes of each type of machine tool desired, the objection to this practice is that any tool with outstanding features, or superior quality, is apt to have a somewhat higher price. Although the difference in performance may pay many times over for the comparatively slight difference of first cost, the purchasing department has no means of gaging the value of such differences and so places the order for the cheapest of the three tools pronounced acceptable. Unless mechanical departments have the privilege of specifying a particular make of tool, provided the difference of price is no more than a fair differential over the next best machine in the class, the railroads will rarely get the most efficient tools but will receive only the second or third best. Furthermore, they are apt to pay more than the inferior tools are really worth.

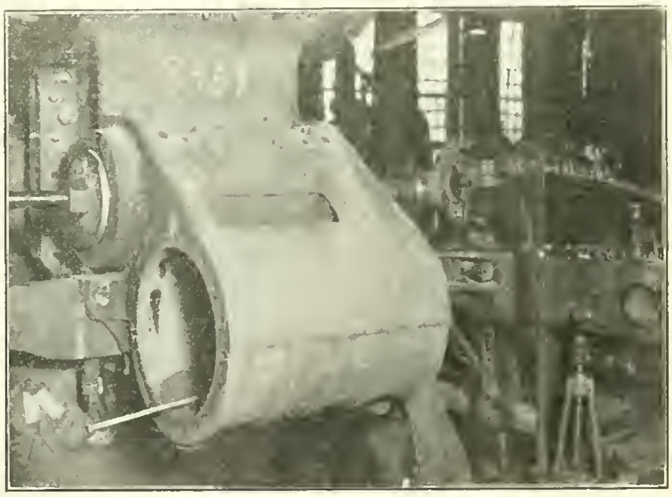
In large repair shops and enginehouses where productive capacity is of first importance, the high-duty machine is a paying investment at any price within reason. It is not maintained that in relatively small shops and terminals modern machines of the most improved type are needed. The solution of the problem is to leave the selection of machines in the hands of the mechanical department. Knowing the appropriations available and being responsible for maintenance of equipment costs, the mechanical department should not be debarred from specifying the best machine of a given type on the market if it feels that conditions warrant such action.

The arguments presented above hold also for the purchase of second-hand machines. The objections to second-hand machinery are that the first and best use has generally been obtained, and it is difficult to detect worn or defective parts. The railroads already have enough worn-out machinery in repair shops and enginehouses without installing machines which have already given their best service. Second-hand machinery should be purchased only with the greatest care, after a thorough detailed inspection.

It is vital that railroad executives and mechanical officers should appreciate more fully the present deficiency of shop machinery. Comprehensive machine tool programs, based on accurate cost figures and taking into account all overhead charges, should be prepared and presented to the managements in a concrete, readily understood form. With persistent effort along this line, the results in improved machine equipment of railroad shops will soon be evident, resulting in important reductions of maintenance-of-equipment costs.

Power Application of Valve Chamber Bushings

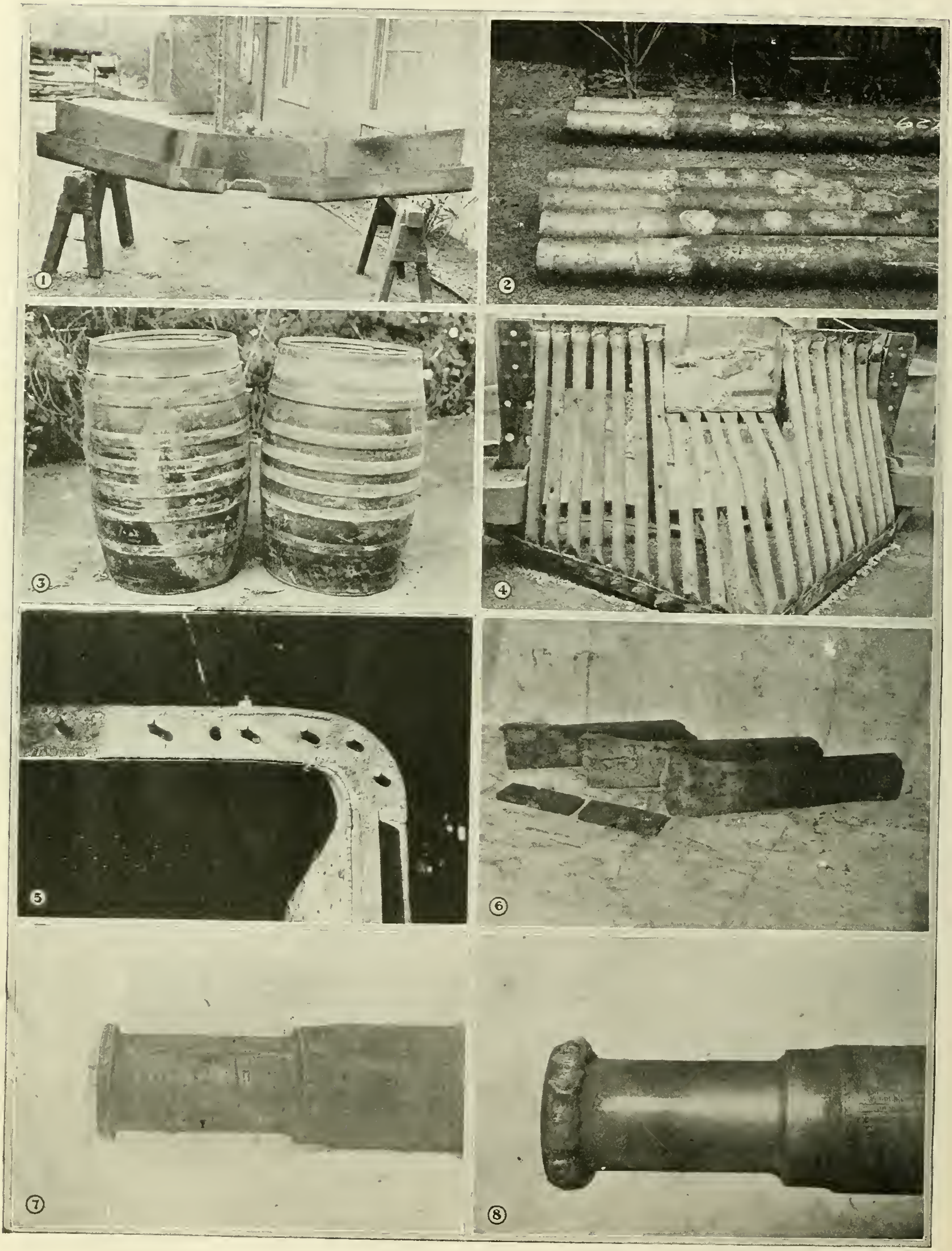
ONE of the erecting shop jobs which involves the expenditure of considerable time and physical effort is the application of new valve chamber bushings, unless some power-driven apparatus is available to perform this operation. The usual method is to employ a long screw through suitable circular plates to fit the bushings, and with nuts outside of these plates. Some form of ratchet wrench or device is then applied to the nuts and the bushings pulled into place by sheer brute strength. The operation takes considerable time and effort, especially when the bushings do not happen to be machined with the correct allowance for a force fit. It not infrequently happens that three or more men are required on the end of a long ratchet wrench to pull the bushings into place, four hours being needed to apply the bushings on both sides of a locomotive.



Valve Chamber Bushings are Rapidly Pulled into Place

The device illustrated performs this operation by means of a pneumatic motor, and in the shop where it is used, the men wonder how they managed to get along without it so many years. It takes about 15 minutes to set up the device and 10 minutes to dismount it. Bushings can be pulled into place on each side of a locomotive in from 15 to 20 min., the total time assuming the longer period, therefore being 90 min. This is a considerable saving over the four hours formerly required.

The power unit is the ordinary motor-driven flue cutter and gearing, used in cutting flues in the front ends of boilers. This gearing drives a right and left long screw of large proportions suitably connected to the bushings by means of circular plates and heavy hexagon nuts. A ball thrust bearing is provided which reduces the friction to a minimum. After this device has been set up, the most obstinate bushings are pulled rapidly into place, one advancing sometimes ahead of and sometimes behind the other, depending upon the relative friction. Both bushings eventually come solidly up against the shoulders and the job is done.



Specimens of Welding Work Done in the Southern Pacific General Shops at Sacramento

Welding Practice on the Southern Pacific[*]

How Electric Arc and Gas Welding is Used in the Sacramento General Locomotive and Car Repair Shops

Although much has been written concerning the application of electric arc and oxyacetylene welding we have yet much to look forward to, as during the last few years an unusually rapid advance has been made in both of these methods of welding and they have now become recognized as an art very essential to many industries—particularly the railway industry.

One instance is the making of car end sills for repairs to steel cars. These have deep flanges and are of irregular shape. It would be a difficult and expensive operation to flange these sills by hand. We therefore cut out a vee in the flanges with the cutting torch. The first or straight bend is made with the rolls; then the short bends are made, causing the flange to close up where it had been cut out. It is then welded either by the electric arc or oxyacetylene process, making a substantial and economical job. This is shown in Fig. 1.

Reclaiming Boiler Tubes and Flues

In the tube shop every day hundreds of various sizes and lengths of boiler tubes are repaired. Autogenous welding makes it possible to reclaim many tubes which otherwise, on account of the deep pitting, would have to be scrapped. These are reclaimed by filling in these pits by welding with either the oxyacetylene or electric arc; this operation restores them to serviceable condition, making them practically as good as new tubes. A number of superheater flues reclaimed in this way are shown in Fig. 2. Many of the larger size flues, from 4 in. to 5½ in. in diameter, that are beyond repair due to excessive pitting are split full length of tube with the oxyacetylene torch and flattened out. The plate thus obtained from the tube is used for various purposes. Practically all the larger tubes scrapped are reclaimed in this manner.

Oil drums come in for repairs and we often find them badly damaged, caused by coming in contact with heavy bodies resulting in deep dents in the drums. Some of these dents are so deep that it is impossible to straighten them with internal hydraulic pressure. It is therefore necessary to cut off one end of the drum with the oxyacetylene torch and straighten the drum by physical effort. After the drum is straightened, the end is fitted back to its original position and welded with either the oxyacetylene or electric process. This makes a strong durable job, and the cost is well within the limits of the original price of the drum. One partly, and one completely, repaired drum are shown in Fig. 3.

In making repairs to metal pilots the cutting torch is employed extensively in separating the structure, for if the rivets are cut off with sledge and chisel, on account of the light material, a decided loss would ensue through damage caused in cutting off and backing out rivets. Fig. 4 shows a pilot, on which the rivets have been cut off, ready to be dismantled and straightened. We also manufacture in this department tanks, foundry ladles, structural shapes, etc. Welding is employed wherever possible instead of riveting and other methods of joining the metal parts. One or more welding outfits are in constant use in this shop.

General Boiler Welding

Boiler work develops an extensive field for both the oxyacetylene and arc welding processes. When the inside firebox must be removed, instead of cutting it out as we were formerly forced to do with drills, hammers and chisels, the oxyacetylene process is now employed. The work is performed not only quicker and cheaper but with less hard labor and with more satisfactory results. In fabricating the new firebox to replace the old one removed, we find that numerous irregular shapes are needed. Formerly the trimming of these sheets was performed under the power punch. They are now cut with the oxyacetylene torch which reduces the cost and saves considerable time.

The question of whether the welding together of all the sheets in the firebox is better than the riveted process is now under consideration. We have partly welded fireboxes now in service and their performance so far is all that could be expected and we believe that by employing the long flange so that the weld is made between two rows of staybolts, almost perfect results can be obtained. The welding of these seams can be performed with either the oxyacetylene or electric arc process.

In removing the mudring from the boiler we very often find the bottom of the ring in poor condition due to corrosion. The sharp corner of the mudring in many instances is eaten away. We build up the corners and all flat surfaces where corrosion has taken place. Such a job is shown in Fig. 5.

After the inside firebox is removed from the boiler the staybolts still remain in the outside wrapper sheet. To remove these bolts the oxyacetylene torch is employed to turn the bolt half way through the sheet; the bolt is then hot enough in the sheet so that it can be worked out by a helper who uses a short length of pipe for this purpose. This method of removing staybolts from side sheets is fast and is an improvement over the old method of drilling them out.

Application of Flexible Staybolts

We apply a great many flexible staybolts to locomotive boilers. The sleeves were formerly screwed into the outside wrapper sheet but this is relatively an expensive operation. The new style sleeve is ball seated and welded to the wrapper sheet by the electric arc process. The oxyacetylene process could not be employed on this class of work as on account of the diffused heat, the sleeve and sheet would have a tendency to warp. A particularly advantageous feature of the electric arc weld is afforded through the concentration of the intense heat in a small area enabling it to be applied just where it is needed without heating up so much of the adjacent material.

In welding firedoor seams the practice of some roads is to prepare the door hole seam as ordinarily done for plugs or rivets and then lap weld the flange to the back head. The method followed by the Southern Pacific is to butt the flanges of the back head and door sheet, and weld with either the electric arc or oxyacetylene process. We have been following this process for several years and have never experienced any trouble with this method of welding door holes.

When the bottom of the tube sheet is badly corroded and cracked it can be repaired. If the welding process was not available we would find it necessary to remove the entire sheet, which would cause considerable delay and add greatly to the cost of making repairs to this boiler. The repairs are made by cutting out the lower section of the sheet, leaving the dry pipe and header in place and welding in a new section.

Defects that develop in the firebox sheets are repaired with

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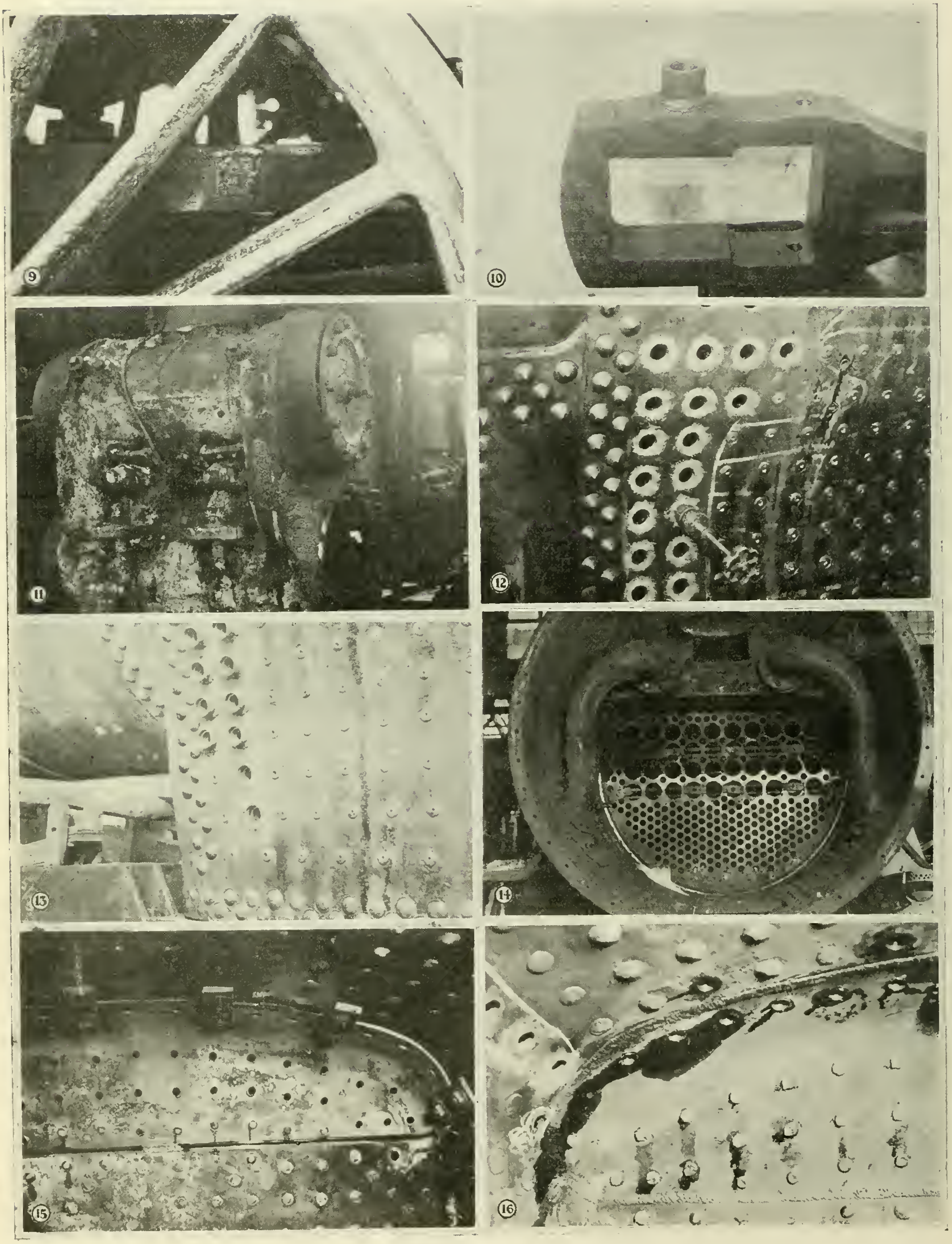
[*] Abstract of a paper presented before the San Francisco section of the American Welding Society, by H. J. McCracken and F. J. Hickey.



Specimens of Welding Work Done in the Southern Pacific Shops at Sacramento both oxyacetylene and electric arc processes where new half side or tube sheets are applied. The defective parts are cut out with the oxyacetylene torch and the electric arc is employed almost exclusively in welding in the sheets.

Another operation in which the electric arc has been employed to great advantage in railroad shops is in the maintenance of boiler tubes. Tubes are applied in the boiler in the usual manner and placed in service. After they have been in service a certain period or when they show signs of leaking the locomotive is held and the tubes are given a thorough working, then the sheets are roughened or sand blasted and the tubes welded to the sheet. We find this method has given excellent results.

There are many other articles repaired in the boiler shop by the electric arc and oxyacetylene processes. An example is a bail for a dragline bucket. This bail came in the boiler shop broken in several places. We applied a 1-in. reinforcing plate on the bottom side and welded it all around on inside and outside edges with the electric arc process, thus insuring a strong durable job which will stand up to the heavy service imposed upon it.

Machine Shop Welding

Among the many parts repaired in the machine shop are trailer truck equalizers, transmission bars, eccentric cranks, cross heads, coupler supports, truck frames, draw bar yokes, chafing iron castings, radius bars, truck spring hanger pins, eccentric blades, links, guide yokes, ends of axles, swing hangers for pony trucks, center castings, end sills for tender frames, cylinder head castings, injectors, piston rods, cylinder heads, superheater units, reverse shafts, dope cups on rods, cylinders, piston heads and axle collars.

Reclaiming Castings in the Foundry

In the steel foundry where many castings are manufactured every day, broken and defective castings can be reclaimed by welding those that are found defective from sand spots, blow holes or shrinkage cracks. These welds when properly made are as readily machined as any other part of the work. Risers and sink heads can be cut off quickly and more cheaply than by any other method.

Fig. 6 shows a method of welding high speed steel points on carbon steel lathe tools, which gives very good results and saves making the whole tool out of expensive high speed steel.

Figs. 7 and 8 shows a worn outer collar of car axle before and after reclaiming with the electric welding process. By machining the collar to the original thickness the axle is ready for use again. It would otherwise have to be scrapped.

A locomotive frame that had broken and was welded with electricity is shown in Fig. 9. This is a very good illustration of the saving that can be made by using the oxyacetylene or electric welding processes. Formerly with a break of this kind it was necessary to drop the wheels and do considerable stripping before the frame could be welded. This weld was made with the arc without doing any stripping or disturbing the driving wheels. We have had very good success with welds made in this manner. The material is cut out with an oxyacetylene cutting torch, trimmed up by hand and then electric welded; either solid weld or laminated process.

A grease cup welded on a locomotive main rod is shown in Fig. 10. The cup is finished in a turret lathe and set over the hole in the rod, welded and then smoothed up with a hollow mill. After finishing the cup has the appearance of having been made integral with the rod. An electric welding job on a cracked locomotive cylinder is shown in Fig. 11. The break is veed out and studs applied in sides of crack and then filled up solidly with the electric welder.

Patches in boilers now welded in place were formerly applied with rivets or plugs and the joints very often interfered with other parts of the machinery. The welded joint overcomes that difficulty, the seams being practically the same thickness as the sheet.

Fig. 12 shows the preparation and method of holding sleeves while welding, and Fig. 13 shows flexible staybolt sleeves welded on a locomotive boiler. After the holes are drilled and countersunk to suit sleeves the surface surrounding the holes is cleaned and roughened, which breaks away all scale and dirt on the sheet and gives the welder a chance to do a much better job than would be possible if roughing was not done.

Both superheater and small flues are electric welded around the beads, which method we have been following in all our shops for some time with very satisfactory results. There has been little basic improvement made in the method of applying and setting flues for the past 30 years or more, and flues will leak, very often causing delay to a train.

Welds across the center of front flue sheet on 2-10-2 class locomotives are shown in Fig. 14, the lower portion of the sheet being new.

A method of applying a patch to the top of a door sheet is shown in Fig. 15. The patch was necessary on account of lap cracks and because the sheet was pitted in the knuckle. This patch as shown has been tack welded in several places in order that bolts and clamps may be removed. The same door sheet after welding is shown in Fig. 16.

Welding at the Reclamation Dock

Many parts are reclaimed on the reclamation dock with oxyacetylene welding, such as switch points, frogs, couplers of all sizes and types, coupler knuckles of all types, continuous rail joints, track drills, switch stands, oil cups, water strainers, spring plates, steam hose couplings, pipe cutters, monkey wrenches, oil drums, ballast forks, body bolsters, truck bolsters, journal boxes, track jacks, brake heads, etc.

The most successful applications of welding undoubtedly have been in places where thorough supervision and training of welders have been carried on. No matter what kind of material is to be welded, or what the type of welding is, the reliability of the weld rests in a large degree with the operator.

Careful examination and inspection of the welded joint is of the utmost importance. There are certain factors which determine the physical characteristics of the weld: First—examination of the weld by visual means; second—the edges of the deposited metal should be chipped with a cold chisel or tried with a calking tool to determine the relative adhesion of deposit; third—pulling apart welded sections cut from the finished product; fourth—the bending or breaking test.

Condition of Power Hammers Important*

THE variations in steam consumption for a given size of steam power hammer depend entirely upon the condition of the hammer, relative to its state of repair and valve adjustment. In order to get the most economical operation, all valve rigging should be in the best mechanical condition. In order to obtain this, special attention must frequently be given to all bushings and bolts to keep them tight. Valves must have a good fit in the valve cases, but must not be too tight to hinder operation of the hammer.

Another very important item is the condition of the cylinder and piston rings. It takes a very short time for a cylinder to become larger in the center than at either end, particularly if lubrication is not the best. In our plant we obtain very good results by using a packing ring rather than a metallic ring. We have used steel and bronze rings, but finally came to the packing ring, which has given us entire satisfaction and we use it on every hammer in the shop, with the result that we have not had to touch a cylinder for over three years. The method of installing these rings permits at all times a very good contact throughout the circumference of the cylinder, thus eliminating to a great extent leakage of steam past the piston. You are probably all familiar with this piston ring; however, there are several on the market, and we find some which give much better service than others.

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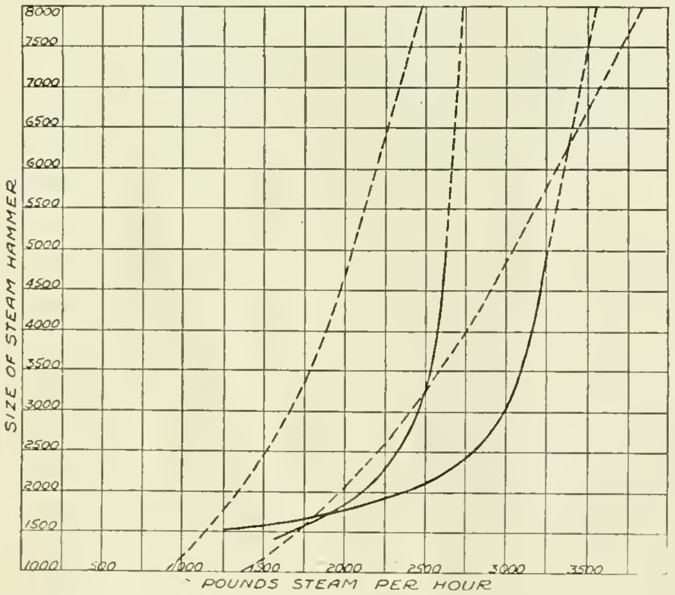
*From an article by R. E. Waldron, chief engineer, Dominion Forge & Stamping Company, Walkerville, Ontario, published in October, 1922, Forging and Heat Treating.

The correct adjustment of the main valve is a very important point for the master mechanic or repair man to keep in mind at all times, as it is quite possible to have the valve set in such a way that the hammer will operate very satisfactory, but with the operation far from economical. The valve setting question is one which is handled by every master mechanic in his own way and which is really a difficult point to keep checked up. However, you can tell a great deal about the setting and condition of steam hammer valves and rings by studying the exhaust and by watching for a good sharp cut off.

Steam Consumption Per Hour for Various Sizes of Hammers

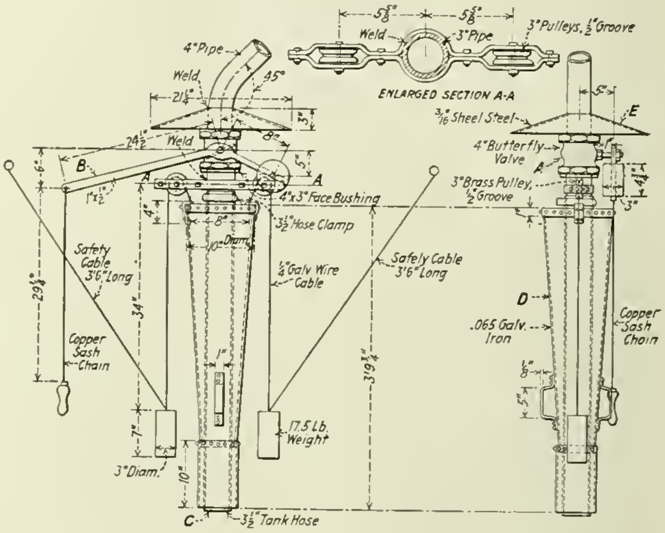
Four curves to show steam consumption per hour for various size hammers from 1,000 to 8,000 pounds are given in the illustration. You will see that there is quite a difference between the results of these various tests. The two full dotted curves were taken from Messrs. Craig and Thompson's article in the Iron Age of June 9, 1921, showing consumption of hammers in good repair and the same hammers before putting them in good condition. The great importance of keeping hammers in good repair is evident. The third curve is plotted from figures which were obtained by a series of tests run by another forge shop which has done considerable work upon this problem. The fourth curve is one which was plotted from figures obtained from actual tests in our own shop. These tests were all made by actually condensing the steam from exhaust and weighing the condensate. You will see that they vary considerably, but as I stated before, this depends entirely upon the condition of the hammer.



Steam Consumption of Steam Drop Hammers. Curves Plotted from the Results of Four Sets of Tests to Show the Steam Consumption Per Hour for Various Size Hammers

Sand Valve and Telescope Pipe for Sanding Locomotives

PRACTICALLY every coal dock and enginehouse is equipped with a sand box filling device, but some of these give trouble. The one shown in the illustration has proved unusually efficient for sanding locomotives quickly and to date has required no expenditure for maintenance. The telescope arrangement permits large and small locomotives to be sanded without spilling sand over the jacket, allowing this sand to find its way into the machinery, where it causes endless trouble. This device has been in service over 18 months and has given no trouble whatever during that period.



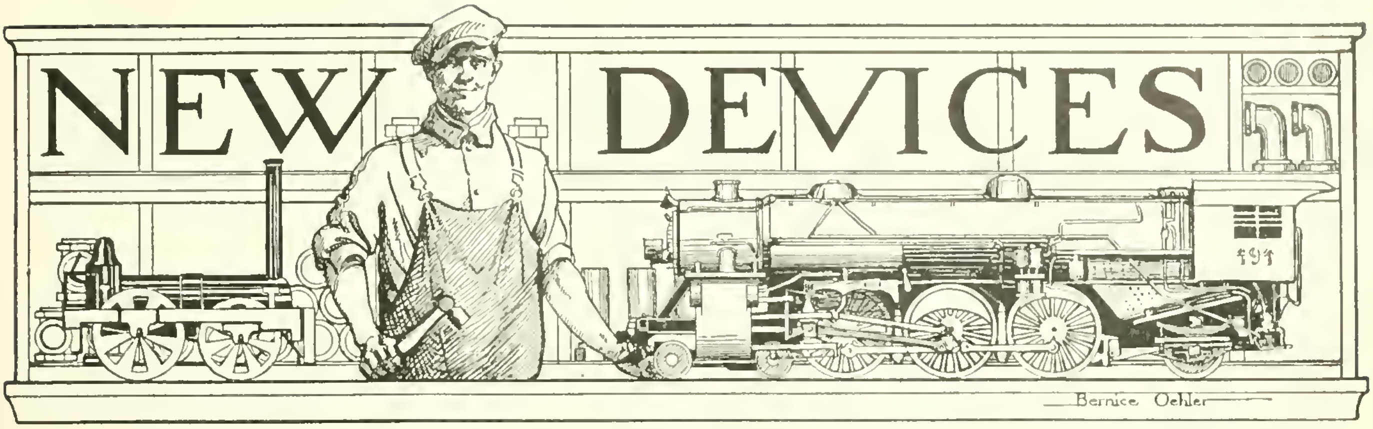
A Cheaply-Made and Efficient Locomotive Sanding Device

Sanders of the type illustrated are elevated on the coal dock, one being provided over the center line of each track, just high enough to give a little clearance over the largest locomotive. Each sander is applied to a 4-in. pipe extension from the sand storage tank, usually elevated in some high portion of the coal dock, so that the sand can work down by gravity.

Mechanical Construction

This sanding device consists of a 4-in. extra heavy butterfly valve *A*, provided with a 1-in. valve stem and operated by a counterbalanced lever *B* which makes the valve self-closing. A 3½-in. tank hose *C* about 3 ft. 10 in. long, is clamped to a 3-in. pipe nipple and applied to the bottom of the sand valve *A*. A galvanized iron pipe *D* is suspended over two pulleys and counterweighted, safety cables being provided as shown. Details of the arrangement for supporting the pulleys are shown in section *AA* and the proportions and length of cable are such that pipe *D* has a 34-in. adjustment over tank hose *C*. Two handles on pipe *D* provide for its easy handling. A copper sash chain with a suitable handle serves as an extension to operating valve handle *B*. A large sheet metal hood *E* is welded to the 4-in. pipe above the sand valve to protect the device as much as possible from weather conditions.

It is not necessary to spot locomotives on the center line of this arrangement, as the sheet iron pipe *D* permits a 24-in. adjustment in all directions from the center line. With proper care in constructing and assembling parts, this device will operate successfully for an extensive period without need of repair.

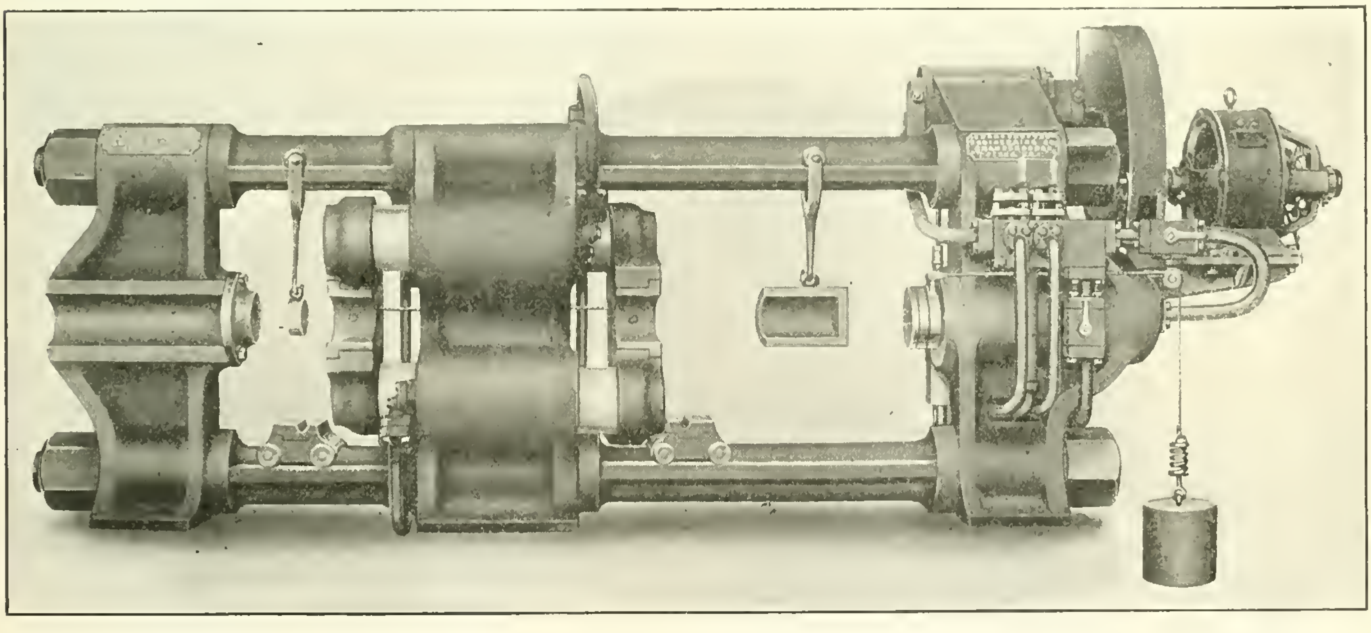


Mounting and Demounting Car Wheel Press

SIMPLICITY, ease of control and speed of operation are predominating features of the new No. 476 Chambersburg wheel press illustrated. This press is designed for mounting and demounting car wheels, being notable for few moving parts, stationary beams and single motor drive. The press is built in two sizes, one having a capacity of 200 tons for mounting and 400 tons for demounting; the other size provides 300 tons for mounting and 600 tons for demounting.

With this press, both wheels can be pressed on or off an axle simultaneously or one at a time. The press is automatic in operation, being designed for severe duty and the reduction of maintenance and repair to a minimum. All beams are stationary and have large bases, enabling the press to be bolted directly to a concrete foundation. All necessary adjustments for pressing on or off wheels are made by means of small light forcing blocks and sleeves suspended from a trolley. The cylinder beam at the right-hand end contains the ram for pressing wheels on their axles. The center beam is used for pressing wheels off. The rams have a long bearing in the beam and are provided with safety valves so that when the plungers reach an outward stroke of 12 in., the valves blow off, preventing over travel. The resistance beam at the left-hand end is provided with a removable steel facing head and is recessed to permit long shafts to be readily handled in the machine.

Two independent pumps mounted in one body are attached to the right end beam. The eccentric drive shaft and plungers are run continuously from the motor mounted on the press. When the conveniently-located operating valves on the front of the press are open, the discharged water is bi-passed to the supply tank. When either of these valves is closed the water is forced to the operating cylinders. The large plungers on each side of the pump have a release valve so that when a pressure corresponding to about 100 tons on the rams is applied, these release valves open and bi-pass water from the large plungers. The small plungers continue pumping until the maximum tonnage is reached, when a second set of release valves opens preventing an excessive pressure. Valve trips are provided on the pumps so that a variety of speeds can be obtained on the rams.



Simplicity, Ease of Control and Speed of Operation are Features of this New No. 476 Chambersburg Wheel Press

The rams are of modern construction throughout so arranged that they return rapidly after each stroke and without the loss of water. This press can be arranged for either belt or motor drive as desired. A 20-hp. motor, running at 900 r.p.m., is required for the 200-400-ton press; a 30-hp. motor for the 400-600-ton machine.

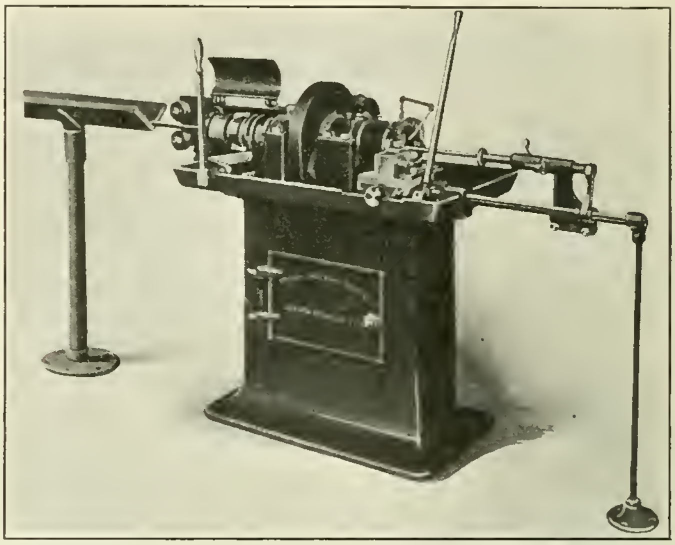
In addition to the complete press, two assembling trucks on a track and a screw jack are furnished. These assembling parts should be located a convenient distance from the front of the machine, the truck grooves being set level with the floor. One set of forcing blocks and sleeves is supplied, carried on trolleys furnished with the machine. Two trucks are provided for supporting the wheels and adjusting them longitudinally in the press. These trucks serve to line up the wheels and axles and are equipped with grooved caps spaced to suit 33 in., 36 in. and 38 in. wheels. The pressure gage is graduated to show tons pressure on the rams and lb. per sq. in. This press is made by the Chambersburg Engineering Company, Chambersburg, Pa.

Cutting-Off Machine Provided With Roller Feed

THE machine for cutting off pipe, tubing and solid bars, made by the Modern Machine Tool Company, Jackson, Mich., has recently been provided with a double live roller feed. This arrangement, applicable to 2-in. and 3-in. machines, feeds the stock through the spindle against an automatic stop for gaging the length of pieces to be cut off. The automatic stock stop is of the same general design as the old one, but is operated from the tube block. A plate, adjustable to take care of the tool setting for different sizes of stock, is attached to the right-hand side of the tool block and arranged with a lug to catch and rock the rocker block shown between the tool block and frame. As the tool block is moved out, removing the tool from the cut, the last ⅛ in. movement, the lug catches the rocker shaft and, through the lever and cam, rotates the stock stop throwing it out 3/16 in. As soon as the tool block is fed in to start the cut, the spring brings the stop back to place clear of the work so that it will not wear and the work can drop away from the tool.

The double live roller feed for feeding stock through the spindle is driven through worm and gears from the cone pulley shaft. As the machine is slowed for large stock, it also slows up the speed of the feed. The feed rolls run continuously. They are so trunnioned and connected with the collet control lever shaft that the in-movements of the collet control lever opens the collet and brings the roll simultaneously up to the stock. A slight further pressure on the collet control lever feeds the stock through the spindle against the stop. The back movement of the collet lever throws the rolls clear of the stock and closes the collet.

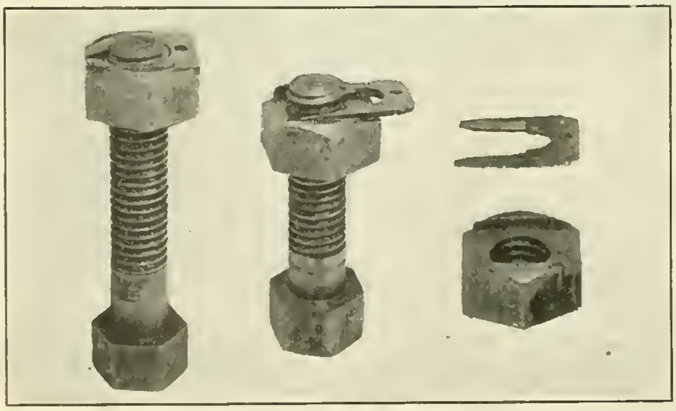
The collet control has been changed by placing the control lever in a vertical position, with a toggle action applied in such a way as to do away with the greater part of the friction encountered on the old machine. The collet control lever operates a great deal easier than on the old machine even with the added work of controlling the feed. Moreover, the operator is saved three or four motions and one step for every piece he cuts off. This is evidently an important factor in working up large amounts of piping or bar stock as frequently is necessary in large railroad shops and particularly production departments.



Modern Machine for Cutting Off Pipe, Tubing and Bar Stock

Safety Lock Nut Positive in Action

THE problem of lost nuts is one of considerable magnitude to the railroads and represents a large item of expense for replacement and damage to other parts of the equipment due to nuts working off in service. Several notable features are evident in the design of the safety lock nut illustrated. The nut is positively locked in any position desired on the bolt and cannot get loose from vibration, remaining firmly in place until removed by hand. The nut is easy to put on and take off and the threads of the bolt or nut are not destroyed unless it is attempted to remove the nut without first unlocking the patented pin. As shown in the illustration, the face of the nut is milled to receive the patented pin which has two points fitting around the bolt. There is a shoulder on each of these points and a small hole in the body of the pin.

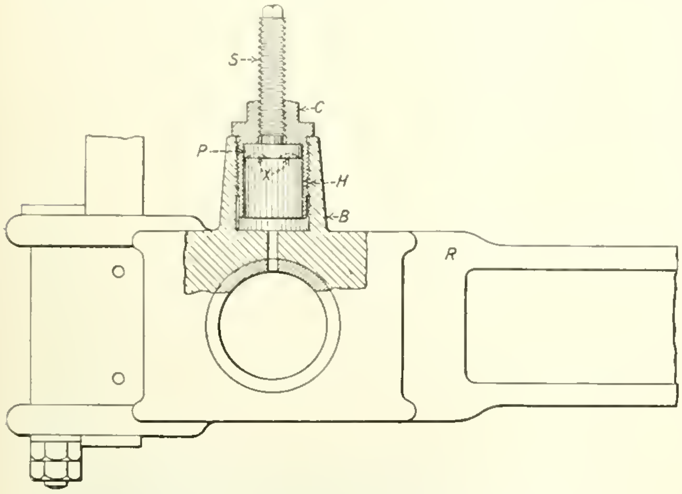


Rose-Albin Safety Lock Nut

In putting this nut on, it is turned down as far as it will go. The patented pin is driven in the slot in the nut as far as it will go until the butt end is flush with the side of the nut. The points are then pulled together as illustrated at the left in the illustration. The success of this nut depends upon the two shoulders of the patented pin digging into the thread of the bolt just enough to nick it. This does not destroy the threads unless a wrench is used to turn off the nut before first unlocking the patented pin. In removing the lock it is simply necessary to straighten the points of the pin and use a punch in the small hole indicated. This patented nut can be locked in any position on any thread. It is made by the Rose-Albin Safety Lock Nut Company, Brooklyn, N. Y.

Grease Cup for Locomotive Connecting Rods

A GREASE CUP for locomotive connecting rods, so arranged that it is not easily lost nor the threads stripped or crossed, is shown in the illustration. Grease cups sometimes are arranged with an extension threaded to turn into a suitable hole in the rod, but in this case the boss *B* is forged integral with the rod *R*. The grease cup *C*, provided with an integral nut portion at the top for application and removal, consists essentially of a cylinder in which plunger *P* is operated by screw *S*. It will be noted that the oil cup has a long threaded bearing in boss *B* and a considerable extension at the lower end, of the same diameter as the root thread diameter. This assists in starting the cup on application and practically prevents all possibility of cross threading. Two recesses *X* are shown in plunger *P*. These act as keys for the grease and tend to prevent accidental turning of the plunger. A small hole *H* is drilled near the bottom of the grease cup but above a few threads to allow hot gases, if such are formed, to escape before the plug is completely removed. This prevents boiling hot grease from being blown around as sometimes happens with solid plugs.



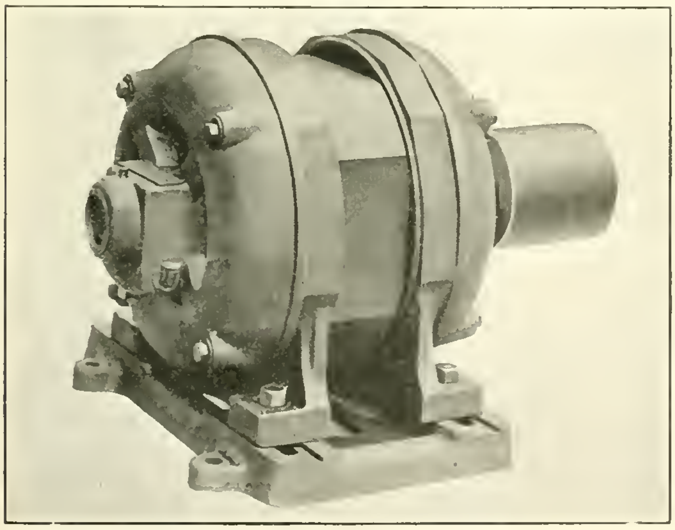
New Grease Cup with Several Meritorious Features

In operation, this grease cup is unscrewed from the rod and the plunger turned to its upper position. The cylinder is filled with grease and the cup re-applied to the rod. Turning the screw *S* then forces grease into the bearing as desired. The boss itself does not receive grease so that threads in the boss are never clogged, another fact which decreases the possibility of crossing and stripping the threads. No locking nut is needed because the shoulder on the cup contacts with the top of the boss and locks the cup in position when it is screwed down tight. As the cup is threaded over the major portion of its length there are sufficient threads so that the cup may be screwed down tight into place without danger of stripping the threads.

The advantages of this form of grease cup construction over that commonly used will be apparent at a glance. The cup has been given a severe test by several western roads under adverse service conditions and proved satisfactory. It is said that an engine in passenger service equipped with these cups ran 2,000 miles with one filling. J. W. Warden, Autocall Company, Shelby, Ohio, controls the patent.

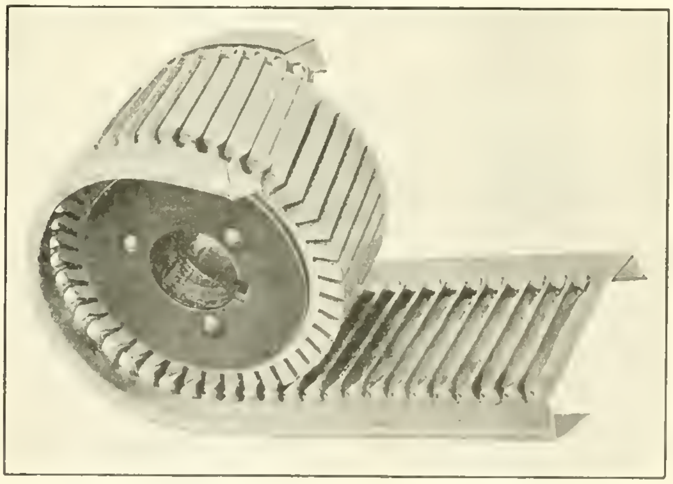
Induction Motor with One-Piece Rotor Winding

A NEW induction motor, designated as L-A type H. D., and having a one-piece rotor winding, has recently been marketed by the Louis Allis Company, Milwaukee, Wis. The entire winding of the motor consists of an integral sheet of copper, punched and formed by a special mechanical process. This one-piece winding is machine-wrapped around the rotor core, the copper bars being expanded into the core slots by swaging.



Louis Allis L-A Type H. D. Induction Motor

The single joint which extends through the two end rings is silver welded, after which the metal at both connections is processed by means of a contracting operation that rehardens the copper at the point where the heat, applied during the welding, softened it. This treatment results in a lapped, silver-welded joint of high strength.



Rotor Winding Made of One Piece of Thin Copper Stock

The rotor winding is fabricated of comparatively thin copper stock, which has a high thermal conductivity and which conducts the heat generated in it toward the ends of the rotor bars where this heat is dissipated through the action of the malleable iron fans. The rotor bars themselves also constitute an efficient blower, thus materially increasing the ventilation. The rotor core is a self-contained unit and may be pressed on and off the shaft readily, as it has a straight keyway.

In other respects the motor is largely conventional except that it employs open slots without the usual overhanging tooth tips. The manufacturer's experience has shown that so long as a suitable relation is maintained between the air gap and slot width, the performance does not suffer as regards power factor and efficiency, and that a rotor core of this construction, with a suitable winding results in exceptionally high starting and running torques. These abnormally heavy starting and running torques have led the manufacturers to increase the shaft size over and above the usual practice for a given rating which, in combination with the liberal bearings, fabricated from a phosphor bronze, should insure long life in service.

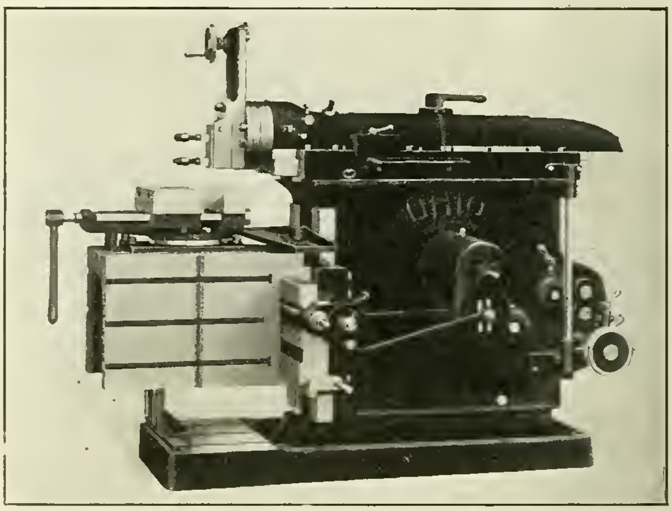
All motors are guaranteed to carry their full rated load continuously with a temperature rise not exceeding 40 deg. C., and after their ultimate temperature has been reached, to carry 25 per cent overload for two hours with a temperature rise not exceeding 55 deg. C. The motors are made in standard industrial sizes, voltages and frequencies.

Rugged Shaper With Thirty-Two Inch Stroke

A RUGGED shaper, known as the Dreadnaught, has recently been developed by The Ohio Machine Tool Company, Kenton, Ohio. The column, rail, ram and in fact all of the important parts of this shaper have been designed with generous proportions in order to meet the requirements of large plants where the work is particularly severe and where the shaper is not only required to remove metal rapidly and accurately, but to take a maximum cut at each stroke without stalling.

The Dreadnaught shaper has a stroke of 32 in. and is equipped with a large diameter pulley, having a wide face, which will efficiently transmit all the power required. The single and back gear ratios, as they denote the relation between the revolutions of the drive pulley and stroke of the ram, furnish further evidence of the power the machine can deliver, everything else being equal. The back gear ratio of this machine is 28 to 1, unusually high for a machine of this character.

The power in a crank shaper is transmitted from the gearing to the crank arm and thence to the ram and cutting tool; the higher above the center of the crank arm the center of the bullgear can be located, the greater the power delivered on account of the increased leverage. It is, therefore, advisable that the crank arm be as long as possible consistent with correct design and in the Dreadnaught shaper it is 42½ in. long. This, coupled with the high back gear ratios and large driving pulley, make this shaper especially desirable for "hogging" work. The ram bearing cannot wedge into the column bearing because it is square, flat and sufficiently high to resist the pressure exerted. This bearing is 2½ in. high and the width of the ram is 13 in. while the length of the ram is 62 in. not including the tool box. The outside diameter of the front end of the ram is 11 in. Provision is made so that even on extreme strokes a great proportion of the ram remains in contact with the column bearing.



Ohio Dreadnaught Shaper Designed for Heavy Duty

All the control levers are located on the operator's side of the shaper, thus permitting quick setup and adjustment while the shaper is in operation. The shaper can be arranged for single pulley belt drive or motor drive. Power down feed is provided as an extra attachment.

Recorder Determines Steam Turbine Economy

THE Uehling Instrument Company, Paterson, New Jersey, has just developed and placed on the market a new combined barometer and vacuum recorder primarily for determining (1) the absolute back pressure in steam turbine and condensing plants, (2) the barometric pressure, (3) the condenser vacuum, (4) the existence of air leakage into the condenser, etc., and (5) the ability of the condenser to handle the load.

High back pressure is caused by air infiltration through condenser shells, exhaust piping, turbine casings, and by infiltration through engine piston packings and engine valve packings.

The existence of an unnecessarily high back pressure represents a waste in turbine steam consumption that is astonishing. In fact this waste is ordinarily larger than all the other power plant losses combined, with the exception of the heat lost up the chimney due to low CO_2 in the products of combustion. For example, for a high pressure turbine, the relative steam consumption of the turbine per kw. hr. increases 16 per cent as the absolute back pressure increases from 1 to 4 in. of mercury (corresponding to a diminution in vacuum referred to a 30 in. barometer of from 29 in. to 26 in.). For low pressure turbines the corresponding increase in steam consumed per kw. hr. is 50 per cent. Absolute back pressure is indeed one of the most important factors affecting steam turbine economy.

The Uehling combined barometer and vacuum recorder consists merely of two float chambers, one of which is connected with a barometric mercury column, and the other with a mercury column in communication with the condenser. These columns and float chambers are secured to a recorder case, with pens actuated by means of floats resting on the mercury in the two chambers. The movements of the floats correspond exactly to the changes in barometric pressure and in vacuum.

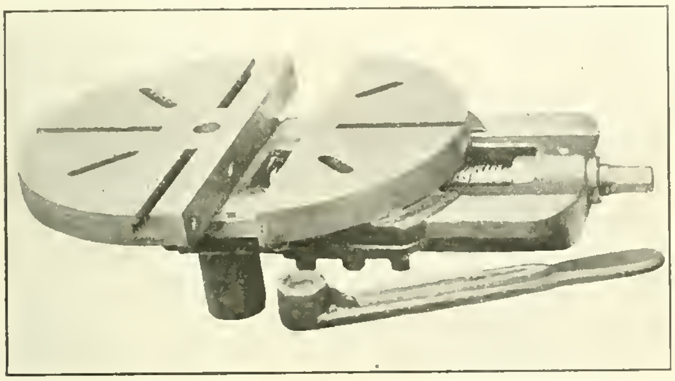
The recorder draws automatically and continuously the barometer and vacuum records on the same chart. If the vacuum falls when the barometer remains constant, either considerable air is leaking into the condenser, or the condenser is not able to handle the load.

Advantages of Baush Metal Duralumin

Mechanical engineers are watching with a great deal of interest the development of a new aluminum alloy known as Duralumin. This alloy is now being manufactured by the Baush Machine Tool Company, Springfield, Mass., under a license from the Chemical Foundation. The advantages claimed for Duralumin are high resistance to corrosion under adverse weather conditions and an unusual combination of strength and lightness. The alloy has a tensile strength and physical properties approaching those of mild steel but weighs only about one-third as much as steel sections of the same size. At the Baush Machine Tool plant, this new alloy is rolled into sheets, forged, fabricated and heat treated the same as steel, being used for a large variety of purposes. Applications have been found for its use in over 100 industries including the railroad industry. It is understood that at least one prominent western road is experimenting with this material for car doors and if used for locomotive motion work there should result an appreciable decrease in dynamic augment. The cost of manufacturing it as now produced is so high as to confine it practically to the automotive field in which high premiums are paid for the combination of light weight, strength and resistance to atmospheric action. As the methods of production are improved, however, it is quite possible that the cost may be decreased so that it will be economical to use Duralumin in the construction of certain parts of cars and locomotives.

Combination Drill Table and Vise

Arranged to fit any drill press, the combination drill table and vise illustrated has been placed on the market by the Modern Machine Tool Company, Jackson, Mich. This vise is now made in two sizes, the diameter of the table closed being 16 in. and 19 in. respectively. The latter size is made for use on 20-in., 21-in. and 24-in. drill presses. The 16-in. vise opens at the jaws 8 in. and the 19-in. vise 10 in. Either vise fits in the regular drill table socket and swivels the same as the regular table. It will turn over ¾ of a revolution and when opened forms a large handy vise. The vise jaws are faced with machine steel (hardened if desired) and are made interchangeable so they can be replaced at any time without trouble in fitting. The vise screw is of ample proportions and runs in a bronze nut. The ways are carefully machined. The table has four T-slots and is machined for accurate work.



Modern Drill Table and Vise Saves Time, Drills and Spoiled Work

The advantages of this device are the saving of time, drills, material and the prevention of accidents. The operator wastes no time hunting up a vise or bolt, bolting the vise to the table and removing it from the table when the job is finished. Drills are not broken due to the work slipping, as frequently happens with clumsy clamping devices. The combination drill table and vise clamps each piece securely and instantly into the proper position for drilling, thus tending to eliminate spoiled work and also prevent accidents. The vise opened forms a split table where work with projections can be drilled without the use of parallels. With the vise opened a small amount, a vee is formed, enabling shafts and round work to be drilled readily.

Simplicity Features New Valve Design

A new type valve, known as the "Flatplug" valve, is being manufactured by the Everlasting Valve Company, Jersey City, N. J., and distributed by the Scully Steel and Iron Company, Chicago, Ill. The valve includes all the more important features of the "Everlasting" type and, in addition, has advantages not incorporated in former types.

The valve seat, which is rectangular in shape, fits into the bottom bonnet on a circular gasket joint. It is held in place here, as may be seen from the accompanying illustration, by the pressure and a stiff spring. The disk, which is cup-shaped, has a sliding contact with the seat at all times. The disk is also held to the seat by the same spring.

In the view of the valve in the left of the illustration the fluid is shown flowing past the cup into the uncovered openings in the seat and so to the outlet. The second view shows the valve in the closed position.

In assembling, the seat is merely pushed into place by hand, no screw threads or other form of fastening being necessary. When taking the valve apart, the seat is removed by pulling it out of the body without the use of tools. When the valve is in its normal position, or on either side or end, the seat will not fall from place; for when assembled it is held in place by the disk and spring.

In order to make repairs, it is only necessary to remove the top bonnet and all parts are readily accessible. New parts for replacement may be installed without removing the valve from the line or disturbing the piping.

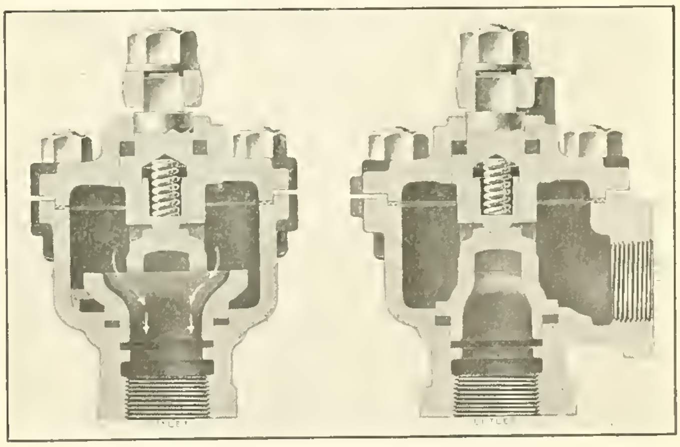


Fig. 1—Valve Open, Fluid Passing Into Uncovered Openings in Seat (left). Fig. 2—Valve in Closed Position

GENERAL NEWS

B. H. Meyer has been elected chairman of the Interstate Commerce Commission to serve for one year from January 1, 1923. He has been a member of the Interstate Commerce Commission since January, 1911, having been appointed by President Taft.

The Central of Georgia has extended the benefits of its pension plan to include the shopmen. The announcement of President Winburn, giving this information, says that under former conditions the benefit of the pension arrangement could not be conferred on the shopmen because their unions objected to physical examinations.

The New York Central reports the heaviest fall of snow in New York State since 1874; but passenger trains have been kept moving with only moderate delays. Freight locomotives, however, have been able much of the time to haul only 75 per cent of their normal loads. At times 100 locomotives have been at work in ridding the tracks of snow.

The Chicago, Rock Island & Pacific has decided to abandon the use of coal for locomotive fuel in both Arkansas and Oklahoma, and to convert its locomotives in that district into oil burners. Locomotives on the Louisiana division are already being converted and the change will be made in others as soon as possible, according to the plans of the operating officers.

The Associated Employees of Beech Grove, Inc., an incorporated organization of employees of the Cleveland, Cincinnati, Chicago & St. Louis locomotive shops at Beech Grove, Ind., which are now operated under the supervision of the Railway Service & Supply Corporation, have united with that corporation in a suit against the Railroad Labor Board. The employees' organization in their petition assert the rights of the majority at Beech Grove were ignored by the Labor Board when it handed down its decision restraining the road from contracting for its shop work at Beech Grove and Brightwood, Ind.

British Railway in Argentina Orders 340 Cars

The Central Argentine Railway, a British-owned line, has ordered 200 all-steel, high-side gondola cars and 140 all-steel box cars from Cammel, Laird & Co., the English car builders.

Germans to Rebuild Moscow-Minsk Railway

The Soviet military authorities have arranged with German engineers for the reconstruction of the Moscow-Minsk railway line, according to the Times (London). Minsk is on the Polish frontier. The line, as rebuilt, will be double track, one of which will be of Russian gage, 5 ft., and the other of standard gage to allow the operation of trains from other European countries to operate directly into Moscow.

Interchange and Loading Rules

The Mechanical Division of the American Railway Association has recently announced that because a considerable number of refrigerator cars have not yet been equipped with brine retaining devices as required by Interchange Rule 3, Section s, the effective date of this provision of the rule has been extended to January 1, 1924.

The Interchange and Loading Rules as revised in 1922 have now been issued and may be obtained from the secretary of the division.

Pacific Railway Club Admits Supplymen to Membership

The Pacific Railway Club, the only railway club in the country that has not admitted supplymen to membership, amended its constitution at its November meeting and supplymen will hereafter be admitted to associate membership upon the same basis as they are admitted to other clubs. Supplymen will pay the same dues as other members, $3 a year, but may not vote or hold office. There is no initiation fee.

Another Electrification Combine in Britain

An agreement is rumored, according to The Engineer (London), between Sir W. G. Armstrong-Whitworth & Company, locomotive builders, and the British Thompson-Houston Company, electrical manufacturers, whereby the former will undertake to build electric locomotives and rolling stock and the latter electrical equipment, power stations, etc., for railway electrification. Two other strong groups similarly organized already exist in England, viz., the Vickers group and the Power & Transport Finance Company, which is backed by the North British Locomotive Company and the English Electric Company.

I. C. C. to Investigate Railway Efficiency

The Interstate Commerce Commission has announced a proceeding of investigation into the efficiency and economy of railroad management, as to whether expenditures by the carriers for maintenance of equipment have been reasonable, the manner and method in which the business of the carriers is conducted, with special reference to the furnishing of car service, and whether the courses adopted by the carriers in the maintenance of equipment and in providing car service have been efficient and economical and whether the service provided has been reasonably adequate.

Automatic Telephone for P. & R. Shops

The Philadelphia & Reading has installed automatic telephones in its locomotive shops and storehouse at Reading, Pa. The system consists of 60 telephones in the locomotive shop and 17 in the storehouse. The central equipment is located in the main office building at the locomotive shop. It was found advisable to install the automatic system instead of increasing the size of the switchboard and employing an additional operator. It was also found that the new system is able to handle 20 per cent more calls in a given time than were formerly handled by the manual system. The average length of time to complete a call on the authomatic system is 13.3 seconds as compared with 50.6 seconds on the manual.

Belgium Gets Polish Locomotive Order

The Polish government has ordered 100 locomotives from Belgian concerns in the Liége district, according to press dispatches from Brussels. This contract has been predicated upon an agreement by the Belgians to send engineers and skilled workmen to Poland to build and organize railway repair shops.

It is reported also from Berne, Switzerland, that the Swiss Federal Railways have sold to a syndicate 200 steam locomotives which were withdrawn from service due to electrification. This syndicate, it is said, has received a bid from Russia for 50 of these locomotives.

N. Y. C. Locomotive 999 Not to Be Scrapped

Locomotive 999 of the New York Central, which was exhibited at the World's Fair in Chicago in 1893, is to be preserved as a historical relic, and will be placed on exhibition at some prominent place, along with the DeWitt Clinton, of 1831. The "999" was built in the West Albany shops in 1892 and was designed by the late William Buchanan, for many years superintendent of motive power of the New York Central. Its well-known high speed records, in 1893, were made by Charles Hogan, on the Empire State Express, on a run when the engine hauled the train through from New York to Buffalo, 440 miles; and the best speeds were made in the last 70 miles. After service on the Empire State Express for a number of years, this engine was renumbered and relegated to more humble duty. In the summer of 1920 it was taken from its regular run on the Pennsylvania division and was restored to all its pristine glory with silver lettering, to haul the

DeWitt Clinton train to Chicago for exhibition at the Pageant of Progress. It is now stored at Utica awaiting the time when it will be placed on exhibition either at Grand Central Terminal, New York, or some other suitable place.

Larger Appropriations for I. C. C.

A larger appropriation for the Interstate Commerce Commission for the fiscal year 1924 than that allowed by the House of Representatives or that recommended by the Bureau of the Budget was recommended to the Senate on January 17 in the report of the Senate appropriations committee on the independent offices appropriation bill. The House had passed the bill providing for an appropriation of $4,564,500 for the commission as recommended by the House appropriations committee, an amendment to increase the appropriation for valuation work from $1,000,000 to $1,280,000 having been rejected. The Senate committee, however, proposed an increase of $250,000 for valuation work, $200,000 for general expenses and $50,000 for safety work.

The Southeastern Carmen's Interchange Association

The Southeastern Carmen's Interchange Association is the name of an organization which is being formed by men in the Atlantic and Gulf States from Maryland to Louisiana, inclusive, and including also Tennessee, for the purpose of promoting efficiency in the work of the interchange inspectors and also to stimulate proficiency in dealing with the M. C. B. rules.

At a meeting held recently in Washington, D. C., J. A. Masters was chosen secretary-treasurer of the association. Mr. Masters is billing instructor on the Seaboard Air Line, at Portsmouth, Va. He expects, in the near future, to announce a meeting to form a permanent organization to be held at Atlanta, Ga.

It is proposed that all men having to do with the building or the maintenance of either passenger or freight cars shall be eligible to membership.

Consolidation Completed on Northeastern Group of Railways in Britain

The consolidation of the railways of the Northeastern group in Great Britain has been completed, and the new company will be known as the London & North Eastern Railway. The principal companies which have been merged to form this road are the North Eastern, the Great Central, the Great Eastern, the Great Northern, the Hull & Barnsley, the North British and the Great North of Scotland.

All the railways of Great Britain are merged into four regional systems. Details of the organization of the Northwestern, Western and Southern groups have not, however, advanced as far as have those concerning the Northeastern.

Gasoline Substitute on South African Railways

The South African Railways have just awarded to the Natal By-Products, Ltd., manufacturers of "Natalite," a gasoline substitute, a six months' contract for motor fuel for use throughout their motor transport service, according to a report to the Department of Commerce. Natalite, which is a sugarcane distillate made largely from waste materials, will be supplied to the South African Railways at one shilling four pence per imperial gallon; that is, 26.7 cents per U. S. gallon, free on rail at Mearhank, near Durban. It is understood that this is about one-third under the lowest bid for gasoline. The producers of Natalite claim that their product is 90 per cent efficient as compared with gasoline, and it is evident that even discounting this figure, the substitute must be reckoned with in the future. This is the first large contract that has been secured by any substitute, and the outcome of the trial will be awaited with interest.

Cars and Locomotives Ordered and Received in 1922

The number of freight cars actually installed in service or ordered for future delivery from car builders during the calendar year 1922 was 145,553, as compared with 69,436 during 1921, according to reports received by the Car Service Division of the American Railway Association.

The reports showed 77,221 freight cars actually placed in service in 1922 or 7,784 more than were both ordered and installed the year before. On January 1, unfilled orders called for the delivery of 68,332. The reports also showed that in 1922, a total of 2,824 locomotives were actually installed or had been ordered from locomotive builders. This exceeded the number installed and on order during 1921 by 1,442. During 1922, 1,379 locomotives were actually installed in service, only three less than the total number installed or on order the year before. On January 1 this year unfilled orders called for the delivery of 1,145 locomotives.

French-Built Electric Locomotive Undergoes Test

A trial run of a French built electric locomotive was recently conducted by the French Ministry of Public Works. This locomotive is the first of a series of 50 which are to be built on a standardized design for railroad service between Dax and Toulouse, a distance of 220 miles. They will be constructed by the Société des Construction Mécaniques, which recently established works at Tarbes where 900 men are now employed.

It is expected that the section of the Midi Railway between Dax and Toulouse will be completely electrified during 1923. Progressively the whole of the Midi, P. L. M. and Orleans systems, representing a total of about 5,750 miles of line, will be similarly transformed. This scheme for the electrification of the railways is being carried out in conjunction with the undertaking for the utilization of the rivers Rhone and Dordogne for the development of electric power, generally. The substitution of electricity for steam as a motive power on the railroads will enable France, according to official estimates, to reduce her imports of coal by about 3,000,000 tons a year.

Locomotive Output for December and for 1922

The shipments of locomotives in December, as compiled by the Department of Commerce from reports to the Bureau of the Census from the principal manufacturers, were the largest since January, 1921, and amounted to 210 locomotives. Unfilled orders on December 31 amounted to 1,592 locomotives, a slight decline from the previous month. Total shipments of locomotives for the year 1922 were smaller than for 1921 on account of the decline in foreign shipments. The following table compares the December figures and the complete yearly totals for 1921 and 1922, in number of locomotives.

	December 1922	December 1921	Year 1922	Year 1921
Shipments:				
Domestic	194	30	1.056	830
Foreign	16	59	218	519
Total	210	89	1,274	1,349
Unfilled Orders:				
Domestic	1,498	143	.....	.....
Foreign	94	122	.....	.....
Total	1,592	265	.....	.....

Effect of Manganese on Steel

A method of preparing very pure iron has been developed at the Bureau of Standards, and with this iron as a base various commercial steels and other iron alloys have been made for the purpose of testing them without the complicating effect of impurities which are usually present in commercial iron and steel. These facts are set forth in Scientific Paper No. 464 of the Bureau of Standards, Washington, D. C., which is the third of a series, and deals with the effect of manganese on the structure and properties of the steel.

The use of manganese as a strengthening agent, in addition to the carbon, is the subject with which the investigation was chiefly concerned. Manganese is also used as a deoxidizer and as a desulphurizer, but these uses are better understood.

The use of higher percentages of manganese for producing high tensile properties in low and medium carbon steels has been recommended at times by various metallurgists, and to some extent such recommendations have been carried out in commercial practice. The results obtained in this investigation of the structural effects of manganese in steel strongly confirm such recommendations.

The general effect of manganese may be concisely described as a "restraining influence," so that the pearlite or carbon-bearing constituent of steel, even after annealing exists in a very fine grained condition if considerable manganese is present. In this respect the steel resembles in structure the condition which usually obtains in similar steels of low manganese content after rather rapid cooling, for example, air-cooling. The mechanical properties of the annealed high manganese steel are quite similar to those obtained in the lower manganese steel by cooling it more quickly.

Ordinary carbon steel containing approximately 0.90 per cent carbon is termed by metallurgists, "eutectoid" steel, since it presents a uniform structure of pearlite. For many purposes such a steel is the best one to use. An additional effect of manganese upon steel is to shift the eutectoid composition to lower carbon contents by approximately 0.12 per cent for each per cent of manganese.

Manganese also appears to have a very noticeable effect upon the rate at which high carbon steels, such as carbon tool steels and file steels, assume the granular or "spheroidized" state—a condition which for many purposes is very desirable. Manganese exerts its characteristic retarding influence upon this change.

B. of L. E. to Open Bank in New York

The Brotherhood of Locomotive Engineers, having acquired a substantial interest in the Empire Trust Company of New York, will soon apply for a charter for a bank to be opened in New York City, according to an announcement made by Grand Chief Warren S. Stone of the brotherhood.

The new bank, it is said, will be conducted on the co-operative principle the same as the brotherhood's Cleveland bank, which has been remarkably successful thus far. The brotherhood and its members will own all the stock of the new institution. The name of the proposed bank and its capitalization will not be made known until the charter is applied for. It is said that the new bank will have several branches in various parts of the city.

The Central Trades and Labor Council of New York for a time had planned to join with the engineers in this banking venture but later decided to start a bank of their own. They have, accordingly, applied for a state charter for the "Federated Trust Company," capitalized at $2,000,000, and have retained W. F. McCaleb, formerly manager of the engineers' Cleveland bank, to direct their institution for them.

British Firms Secure South African Electrification Contracts

A number of British firms have secured the contracts for the railway electrification in Natal, South Africa. The total expenditure involved is placed at £4,500,000. Among the firms participating are: Metropolitan-Vickers Electrical Company, Ltd.; C. A. Parsons & Co., Ltd.; Babcock & Wilcox, Ltd.; British Thomson-Houston Company, Ltd.; Telegraph Manufacturing Company; A. Reyrolle & Co., Ltd.; South African General Electric Company. For the automatic telephone exchange equipment contracts aggregating £100,000 have been awarded to Messrs. Siemens Brothers & Co., Ltd., of Woolwich, England.

The contracts placed with the Metropolitan-Vickers Company include seventy-eight 3,000-volt, direct-current electric locomotives, according to the Times (London) Trade Supplement for November 25, 1922. The electrical equipment for the locomotives will be built at the Sheffield works of the Vickers Company. The section of railway to be electrified extends from Glencoe to Pietermaritzburg, a distance of about 200 miles. The new locomotives are expected to be capable of making a round trip from Ladysmith to Pietermaritzburg once every twenty-four hours for six days a week, the distance being 129 miles each way.

MEETINGS AND CONVENTIONS

Air Brake Association

The Hotel Albany has been selected as the convention headquarters for the 30th annual meeting of the Air Brake Association in Denver, Col., May 1, 2, 3, 4, 1923.

Master Boiler Makers' Association

Announcement has been made that Hotel Tuller, Detroit, Mich., has been selected as the headquarters and meeting place for the 14th annual convention of the Master Boiler Makers' Association, May 22 to 25 inclusive, 1923.

1923 Meeting of A. S. T. M.

The twenty-sixth annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., beginning on Monday, June 25, and ending on either Friday or Saturday of that week, depending on the development of the program.

Locomotive Design—A. S. M. E.

A paper on Recent Improvements in Steam Locomotive Design will be presented before the Eastern New York section of the American Society of Mechanical Engineers by Mr. Ashworth of the American Locomotive Company at a meeting to be held in Edison Hall, Schenectady, N. Y., on February 23. The paper will be illustrated with lantern slides and moving pictures.

Mechanical Division of the A. R. A.

The Mechanical Division of the American Railway Association will hold its annual meeting in Chicago, beginning on Wednesday, June 20. Sessions will be continued through two or three days, or until the business on the docket is disposed of. Secretary V. R. Hawthorne expects to issue the detailed program within a few weeks.

Officers of the Central Railway Club

At the meeting of the Central Railway Club held in Buffalo on January 11, the following officers were elected for the year 1923: President, C. L. McIlvaine, superintendent motive power, Pennsylvania Railroad, Buffalo, N. Y.; first vice-president, W. O. Thompson, general superintendent rolling stock, New York Central, Buffalo, N. Y.; second vice-president, A. R. Ayers, superintendent motive power, New York, Chicago & St. Louis, Cleveland, Ohio; third vice-president, E. V. Williams, superintendent of motive power, Buffalo, Rochester & Pittsburgh, Du Bois, Pa. The executive members elected were: John N. Gaiser, general foreman, Erie Railroad, Buffalo, N. Y.; T. J. O'Donnell, chief interchange inspector, Buffalo, N. Y.; Arthur N. Dugan, vice-president, Bronze Metal Company, New York, N. Y.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs

Air-Brake Association.—F. F. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, first Tuesday in May.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting Chicago, June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.; 1923 annual convention, Atlantic City, June 25, 1923.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Sectional meeting, February 8 and 9, City Club, Chicago.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting March 8.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting March 8.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.; 1923 annual convention, Detroit, Mich., May 22, 1923.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Fruenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall 605 North Michigan Ave., Chicago.

SUPPLY TRADE NOTES

F. W. Stubbs, mechanical engineer of the Chicago Great Western, has been appointed mechanical engineer of the Standard Stoker Company, with headquarters at Erie, Pa.

J. H. Schwacke, manager of William Sellers & Co., Inc., Philadelphia, Pa., has been elected president. Mr. Schwacke has been in the service of this company for more than 60 years.

Maj. J. L. Hays

Major J. L. Hays has joined the sales organization of the Safety Car Heating & Lighting Company, New Haven, Conn., as commercial engineer, and will be located at the Philadelphia Pa., office. Major Hays graduated from Lehigh University in 1909 with a degree of electrical engineer and then joined the electrical department staff of the Baltimore & Ohio, working successively as mechanic, draughtsman, inspector, general foreman and assistant engineer. He later served with the Seaboard Air Line as electrical engineer until he was commissioned as a major in the Quartermaster's Corps at the beginning of the war, in charge of the electrical section of the engineering branch, being responsible for electrical construction for the army in the United States. At the conclusion of the war he joined the Stone-Franklin Company as electrical engineer, serving until the Safety Car Heating & Lighting Company absorbed the car lighting interests of the Stone-Franklin Company on January 1 of this year.

S. G. Down

S. G. Downs, general sales manager of the Westinghouse Air Brake Company, Wilmerding, Pa., has been elected vice-president in general charge of sales and commercial activities. Previous to his appointment as general sales manager, he had been president of the Westinghouse Pacific Coast Brake Company, at Emeryville, Cal., and western district manager of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company. Mr. Down served as general air brake inspector and instructor on the Michigan Central until 1902, and then joined the Westinghouse Air Brake organization. He was for several years instructor on the company's instruction car and later was appointed mechanical expert with headquarters in Chicago. In 1910 he was appointed district engineer and transferred to San Francisco and shortly afterward he was appointed Pacific district manager. He was largely responsible for the organization of the Westinghouse Pacific Coast Brake Company in California, and when it was formed, became vice-president and later president of that company. In 1919 he made an extensive tour of the Far East and established various commercial activities which have resulted in an increased business for the Air Brake Company from the Orient.

Robert Enos Adreon, president of the American Brake Company and acting southwest district manager of the Westinghouse Air Brake Company, died suddenly of apoplexy on January 6 in St. Louis, Mo.

William N. Shaw, vice-president of the New York Air Brake Company, of New York City, has resigned and in future will devote all his time to the Eisemann Magneto Corporation, Brooklyn, N. Y., of which he has been president for the past four years, and to other interests.

R. E. Terhune has been placed in charge of the Northern New Jersey sales territory of the Uehling Instrument Company, Paterson, N. J. Mr. Terhune was formerly associated with the Uehling Laboratories, and is, therefore, well qualified to co-operate with power plant operators on the important subject of power plant economy.

T. F. Whelan has been appointed special engineer of the Franklin Railway Supply Company with headquarters in Chicago. For 26 years he served as a locomotive engineer and for the past six years was editor of the Brotherhood of Locomotive Engineers Journal. In his new position he will do educational work among railroad employees.

A. B. Landis

On December 20, 1922, death claimed another of the pioneer machine tool builders, A. B. Landis, who was perhaps best known for his work in developing the Landis grinding and threading machinery. Mr. Landis was born in 1854 and learned his trade as a machinist in the shops of Frank F. and Ezra F. Landis of Lancaster. In 1874 he became a partner of his brother under the firm name of F. F. & A. B. Landis for the manufacture of small stationary engines and portable steam engines. Mr. Landis was for a number of years in charge of the tool department of the Geiser Manufacturing Company, Waynesboro, Pa., where he developed the first Landis grinding machine which was employed in a commercial way. In 1890 a partnership was formed with his brother, F. F. Landis, under the firm name of Landis Brothers for the manufacture of cylindrical grinding machines. In 1903 the Landis Machine Company was organized to manufacture the Landis threading machines and these two companies were largely responsible for the development and growth of the town of Waynesboro. In the fall of 1910 Mr. Landis severed his connection with both the Landis Tool Company and the Landis Machine Company, taking up his residence at Chestnut Hill, Philadelphia, where he opened up an engineering laboratory for the development of many inventions, chief among which was a mechanical speed change mechanism for automobiles, machine tools, etc. In the fall of 1919 he organized the firm of A. B. Landis & Son for the purpose of commercial grinding and the development of mechanical ideas. He was actively connected with this business up to the time of his death, which was very sudden.

An announcement has been issued that the Safety Car Heating & Lighting Company has acquired the business of the Stone-Franklin Company, Inc., for the United States and Cuba, and will in the future be in a position to supply Stone-Franklin equipments where required and the necessary spare parts for the maintenance of equipments now in service.

The American Engineering Company, Philadelphia, has taken over the Standard Crane and Hoist Company and the patent and manufacturing rights to the monorail electric hoist with low headroom, formerly known as the Standard. H. S. Valentine, Chief Engineer of the Standard Crane and Hoist Company, brings to the American Engineering Company more than twenty years' experience in the design and manufacture of hoists and the solution of material handling problems in practically every industry. He is directing the sales, and supervising the manufacture of the hoists. The American Engineering Company has reorganized its No. 1 plant to accommodate the work of building and testing the hoists on a commercial basis.

Major Frank S. Robbins, who recently returned from the Orient after serving as a mechanical adviser for the Inter-Allied Technical Board at Harbin, Manchuria, has joined the forces of the Pittsburgh Testing Laboratory at Pittsburgh, Pa., having been appointed railway representative of this organization. After graduating from Purdue University, Major Robbins began his railroad work in 1900 as a machinist apprentice for the Pennsylvania Railroad at its Meadows shops, and continued in its service until March, 1921. After the time the company's locomotive testing laboratory was opened at Altoona, Major Robbins was assigned to work at that place. Subsequently, he occupied positions as motive power inspector, assistant road foreman of engines, assistant master mechanic and master mechanic, his last appointment being master mechanic of the Pittsburgh Terminal division. During the war, he served with the 19th Engineers and later was commanding officer of the 65th Engineers and acted as superintendent of motive power of the 16th Grand Division of the Transportation Corps.

W. H. Winterrowd has been appointed assistant to the president of Lima Locomotive Works, Inc., with headquarters at New York City. Mr. Winterrowd was born on April 2, 1884, at Hope, Ind. He attended the public schools at Shelbyville, Ind., and was graduated in 1907 from Purdue University. During his college vacations he was employed as a blacksmith's helper on the Lake Erie & Western, at Lima, Ohio, and as a car and air brake repairman on the Pennsylvania, Lines West, at Dennison, Ohio. After graduation in 1907 he became a special apprentice on the Lake Shore & Michigan Southern, and in 1908 he went with the Lake Erie, Alliance & Wheeling as enginehouse foreman at Alliance, Ohio. In 1909 he became night enginehouse foreman of the Lake Shore & Michigan Southern at Youngstown, Ohio, and in 1910 was made roundhouse foreman at Cleveland. Later in the same year he was promoted to assistant to the mechanical engineer of the Lake Shore. Since September, 1912, he has been with the Canadian Pacific at first as mechanical engineer, in 1915 he was appointed assistant chief mechanical engineer and in 1918 was appointed chief mechanical engineer, which position he held to the time of his appointment as above noted. Mr. Winterrowd is active in the Mechanical Section of the American Railway Association, being a member of the General Committee. He is also active in the American Society of Mechanical Engineers. Together with H. H. Vaughan and Frank H. Clark he contributed greatly to the success of the boiler code of the society. Among the papers he has presented is a noteworthy article on refrigerator cars. He has taken particular interest in the railroad section, serving as vice-chairman of the executive committee last year and is still a member of this committee.

W. H. Winterrowd

C. J. Burkholder, supervisor of service of the Franklin Railway Supply Company, Inc., New York, died on December 22 in St. Mary's Hospital, Kansas City, following an operation. Mr. Burkholder was born on May 9, 1870. He began railroad work at Tyrone, Pa., and subsequently was a locomotive fireman and engineman on the Union Pacific. He then went to the Kansas City Southern as a locomotive engineman, later serving consecutively as traveling engineer, trainmaster, general road foreman of engines and division superintendent. He left the Kansas City Southern to become a mechanical representative of the Economy Devices Corporation, which was afterwards merged into the Franklin Railway Supply Company, Inc. During the period of the war, Mr. Burkholder returned to railroad work, leaving the Franklin Railway Supply Company, of which he was then western sales manager, on November 1, 1918, to become master mechanic of the Kansas City Southern. On January 1, 1921, he returned to the Franklin Railway Supply Company as special engineer assigned to work in connection with the locomotive booster, and since the following October was supervisor of service.

The Westinghouse Air Brake Company, Wilmerding, Pa., has made the following appointments in the Eastern district: E. W. Davis, representative at New York of the Westinghouse Traction Brake Company, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company, in charge of the Boston, Mass., office. G. H. Martin, mechanical expert for the Westinghouse Traction Brake Company, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company, with headquarters at Boston. F. H. Whitney, representative of the Westinghouse Air Brake Company, has been promoted to export representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company, with headquarters at New York, and H. B. Gardner has been appointed representative, Westinghouse Air Brake Company, reporting to the New York office. Mr. Gardner was formerly with the Locomotive Stoker Company, Pittsburgh, whose service he entered in June, 1916. After serving for some time in the Stoker Company's shops, he was made mechanical expert and during the last few years was attached to the sales department of that company.

Decision in Locomotive Stoker Patent Suit

The United States Circuit Court of Appeals for the Third Circuit, at Philadelphia, on January 3, handed down a decision in the suit of the Locomotive Stoker Company vs. The Elvin Mechanical Stoker Company, which was brought in the United States District Court for the District of Delaware. Infringement was charged of the Gee and the Street patents for locomotive stokers, and Judge Morris, in the District Court, held that there was no infringement of the Gee patent, but that the Street patent was infringed. The Court of Appeals affirmed this decision as to the Gee patent, and reversed it as to the Street patent, holding that neither patent was infringed by The Elvin Mechanical Stoker Company and ordering the suit to be dismissed as to both patents.

TRADE PUBLICATIONS

Elvin Mechanical Stoker.—A Service Hand Book and Shop Manual No. 2 has been issued by The Elvin Mechanical Stoker Company, 50 Church street, New York. This booklet, which is of pocket size and contains 130 pages, describes the various parts of the stoker and gives instructions for operation, inspection and maintenance. A series of plates with part numbers and tables of the proper names of all pieces will be of assistance to those who have to call for or order repair parts.

Self-Opening Die Heads.—The Eastern Machine Screw Corporation, New Haven, Conn., has published a pocket size edition of its ninety-six page catalog, descriptive of the H&G self-operating die heads. The book contains fifty-six illustrations and deals in a most interesting manner with the design, workmanship and adaptability of H&G die heads. The publication contains a great deal of information and many tables of value to the manufacturer or whoever is cutting threads. The book has been put out in this size especially for the man in the shop and to make wider distribution of this data possible.

Protecting Pipe Against Internal Corrosion.—In recent years engineers have given considerable study to eliminating the rapid corrosion which occurs in iron and steel pipes carrying hot water under pressure. The result of recent research on this subject is well set forth in a bulletin entitled "The Protection of Pipe Against Internal Corrosion" recently issued by the National Tube Company, Pittsburgh, Pa. The bulletin contains a number of papers on the fundamental causes of corrosion, details of the mechanism of corrosion, practical means of preventing corrosion and typical results of corrosion prevention. The methods discussed include mechanical de-aerating of water, fixing free oxygen by chemical combination, combined mechanical and chemical deaeration and the use of protective coatings.

EQUIPMENT AND SHOPS

Locomotive Orders

The Canadian National has ordered 43 locomotives from the American Locomotive Company.

The Grand Trunk has ordered eight switching locomotives from the Lima Locomotive Works.

The Virginian has ordered 15 2-8-8-2 Mallet type locomotives from the American Locomotive Company.

The Canadian Pacific has ordered 16 4-6-2 type locomotives from the American Locomotive Company.

The St. Louis Southwestern has ordered 15 2-8-0 type locomotives from the Baldwin Locomotive Works.

The Chicago & Eastern Illinois has ordered 10 2-8-2 type locomotives from the American Locomotive Company.

The Central of New Jersey has ordered six 2-6-2 type suburban locomotives from the Baldwin Locomotive Works.

The New York, Chicago & St. Louis has ordered six 4-6-2 type locomotives from the American Locomotive Company.

The Louisville, Henderson & St. Louis has ordered five 4-6-2 type locomotives from the American Locomotive Company.

The Illinois Central has ordered 35 2-8-2 type from the Baldwin Locomotive Works and 15 4-8-2 type from the American Locomotive Company.

The Chicago & North Western has ordered 18 2-8-2 type, 12 4-6-2 type and 20 0-6-0 type switching locomotives from the American Locomotive Company.

The Central of Georgia has ordered five 4-8-2 type locomotives from the American Locomotive Company and 10 2-8-2 type from the Lima Locomotive Works.

The Union Pacific has ordered 18 2-10-2 type locomotives from the Baldwin Locomotive Works; 37 2-10-2 type from the Lima Locomotive Works, and 18 2-10-2 type also 5 Mallet type from the American Locomotive Company.

The Pennsylvania has authorized the placing of orders for 300 locomotives to be constructed and delivered during the present year. Of the total number, 125 will be constructed at the company's Altoona Works. They will consist of 42 heavy passenger locomotives, 40 medium weight passenger locomotives, and 43 switching locomotives. The remainder of the authorization covers 175 heavy freight engines. Arrangements for construction of 100 of these have been made with the Baldwin Locomotive Works. The allotment of the other 75 will be determined later.

Passenger Car Orders

The Baltimore & Ohio has ordered four dining cars from the Pullman Company.

The Union Pacific has ordered 21 baggage and mail cars from the Standard Steel Car Company.

The Missouri Pacific has ordered 17 steel coaches from the American Car & Foundry Company.

The New York Central is having 60 milk cars built at the shops of the Merchants' Dispatch and is having a dynamometer car built in its West Albany shops.

The American Railway Express has ordered 150 express refrigerator cars from the General American Car Company. These are in addition to the order for 150 placed last year.

The Union Pacific has ordered 200 50-ft. refrigerator cars equipped for passenger train service from the American Car & Foundry Company and 100 from the General American Car Company.

The Canadian National has ordered 50 express refrigerator cars and 10 baggage cars from the National Steel Car Corporation; 10 mail and express cars 35 coaches, 20 sleeping cars and 20 baggage cars from the Canadian Car & Foundry Company.

Freight Car Orders

The Illinois Central has ordered 500 ballast cars from the Rodger Ballast Car Company.

The Southern Pacific has ordered 575 general service cars from the General American Car Company.

The Union Tank Car Company has ordered 500 tank cars from the American Car & Foundry Company.

The Atlanta & West Point has ordered 150 hopper cars of 55 tons' capacity from the American Car & Foundry Company.

The Phillips Petroleum Company, Bartlesville, Okla., has ordered 100 tank cars from the Standard Tank Car Company.

A. B. C. Refrigerator Transit Company, New York City, is having 500 refrigerator cars built at the shops of the Merchants' Dispatch.

The Chicago, Indianapolis & Louisville has ordered 300 steel underframes and steel superstructures for gondola cars from the Pullman Company.

The Central of Georgia has ordered 100 stock cars, 300 hopper cars, 200 composite gondola cars and 500 box cars from the Chickasaw Shipbuilding Company.

The Great Northern has ordered 1,000 U. S. R. A. standard box cars from the Pullman Company and has also ordered 500 automobile cars from the American Car & Foundry Company.

The Chicago, Rock Island & Pacific has ordered 500 automobile cars from the Bettendorf Company, 250 flat cars from the American Car & Foundry Company and 250 refrigerator cars from the General American Car Company.

The United Fruit Company has ordered 100 flat cars of 20 tons' capacity from the Magor Car Corporation for use on the Truxillo Railroad, Honduras. A contract for 10 flat cars of 20 tons' capacity has been given to the Gregg Company, Ltd.

The Chicago & North Western has ordered 3,000 single sheath box cars of 80,000-lb. capacity, divided equally between the General American Car Company, the American Car & Foundry Company and the Western Steel Car Company, and has placed an order for 200 steel underframe milk cars with the Pullman Company.

The Canadian National has ordered 1,000 box cars from the National Steel Car Corporation; 1,000 box cars and 100 ballast cars from the Canadian Car & Foundry Company; 500 box cars, 100 general service cars and 100 steel coal cars from the Eastern Car Company, and will also have 276 general service cars repaired at the shops of the Eastern Car Company.

The Baltimore & Ohio has ordered 4,000 all steel hopper cars from the following companies: Pressed Steel Car Company 1,500, American Car & Foundry Company 1,000, Standard Steel Car Company 500, Youngstown Steel Car Company 500, and Ralston Steel Car Company 500. Contracts were also let for the 1,000 steel gondola cars to the Cambria Steel Car Company and for 1,000 box cars to the Standard Steel Car Company and 1,000 box cars to the Liberty Car & Equipment Company.

Machinery and Tools

The Southern Pacific has placed an order for an axle lathe.

The Louisville & Nashville has placed an order for a 40-in. planer.

The Missouri Pacific has ordered a 200-ton locomotive hoist from the Whiting Corporation.

The Pennsylvania Coal Company has ordered a rotary shear from Joseph T. Ryerson & Son.

The Texas & Pacific has placed orders for a set of bending rolls, also for two plate flanging clamps.

The New York, New Haven & Hartford has placed orders for a 2,000-lb. steam hammer and a 36-in. lathe.

The Kansas City Southern has ordered one 250-ton, 70-ft. traveling crane and one 15-ton locomotive crane from the Whiting Corporation, Harvey, Ill.

The Delaware, Lackawanna & Western has placed orders for tools as follows: A 54-in. Chambersburg 500-ton, single end car wheel press; one Winton 6-in. and one Winton 4-in. double spindle centering machine; two 14-in. Allen double spindle sensitive drilling machines; one Chicago steel power bending brake; two 42-in. vertical drilling machines; one 72-in. Bement duplex control, motor driven boring and milling machine; one Niles-Bement-Pond rapid production standard 48-in. planer; two Ryerson-Conradson 5-ft., high power, plain radial drills; two Ryerson-Conradson 30-in. selective geared engine lathes; two Ryerson-Conradson 17-in. selective geared hand portable engine lathes; seven 21-in. Ryerson-Conradson selective geared head engine lathes; one McCabe pneumatic flanging machine; one 36-in. Morton new type, heavy duty draw cut railroad shaper; one Buffalo universal No. 25 slitting shear, punch and bar cutter; one Brown & Sharpe No. 5B heavy plain milling machine; four Gould & Eberhard universal type crank shapers; one Warner & Swazey No. 2A universal hollow hexagon turret lathe.

Shops and Terminals

The St. Louis-San Francisco is constructing an 80-ft. by 100-ft. tank shop with company forces at Sherman, Tex.

The Missouri, Kansas & Texas has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a six-stall addition to the roundhouse and a new power house at Franklin, Mo.

The Southern Pacific is constructing with company forces two 40-ft. by 60-ft. one-story, frame shop buildings, with concrete floors, to cost approximately $11,000. This company is also constructing a 44-ft. by 625-ft. frame car repair shop to cost approximately $26,000.

The Union Pacific has completed plans for the construction of new shop and yard facilities at Los Angeles, Cal., and will begin work on the first unit of the improvements at once. The new terminal is to be located between Jaboneria road and Telegraph road, south of Ninth street on the main line in the eastern part of Los Angeles. The principal structures of the first unit, which will cost approximately $1,750,000, are a 20-stall brick engine house, a 100-ft. turntable, a locomotive erecting and boiler shop, a coach, car and blacksmith shop and a car repair shop with related facilities, including transfer table, storehouse, lumber and iron sheds, office buildings, power house, oil house and oil supply system.

PERSONAL MENTION

General

J. W. Small, formerly superintendent of motive power of the Seaboard Air Line and later superintendent of motive power and shops of the Cuba Railroad, has been appointed chief mechanical officer of the Chesapeake & Ohio. He will have entire charge of the mechanical department and his headquarters will be at Richmond, Va. Mr. Small was born on September 24, 1870, at Chatham, Ont., and was educated in the high schools of that city and at the Collegiate Institute. He began railway work in 1887 as a machinist's apprentice on the Northern Pacific. In 1892 he went to Pocatello, Idaho, as a machinist for the Oregon Short Line. The following year he went to Tacoma, Wash., as a machinist for the Northern Pacific. Later in the same year he entered the service of the Southern Pacific as a machinist and served subsequently as gang foreman, roundhouse foreman, assistant master mechanic and master mechanic for that company. In 1906 he became superintendent of motive power of the Mexican lines of the Southern Pacific. In 1910 he went to the Kansas City Southern in a similiar capacity and the following year became superintendent of motive power for the Missouri Pacific. The same year he went with the Sunset Central Lines (Galveston, Harrisburg & San Antonio, Houston & Texas Central, Morgan's Louisiana & Texas, Texas & New Orleans, etc.) as assistant general manager. In 1913 he was appointed superintendent of motive power of the Seaboard Air Line. Mr. Small, during federal control, served first as mechanical assistant to the regional director, Southern region, and later as mechanical staff officer to the regional director of the same region. In April, 1921, he was appointed superintendent of motive power of the Cuba Railroad with headquarters at Camaguey, Cuba, from which position he resigned in July, 1922.

J. W. Small

A. L. Moler has been appointed mechanical inspector of the Chesapeake & Ohio, reporting directly to the chief mechanical officer.

Robert Collett, superintendent of fuel and locomotive performance, has been appointed fuel agent of the St. Louis-San Francisco, with headquarters at St. Louis.

C. C. Cannon, roundhouse foreman of the Chicago Great Western at Kansas City, Mo., has been promoted to system fuel supervisor, with headquarters at Chicago.

R. W. Retterer, acting mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, has been appointed mechanical engineer with the same headquarters.

George H. Rusbuldt, valuation engineer of the mechanical department of the Chicago Great Western with headquarters at Oelwein, Ia., has been appointed mechanical engineer, succeeding F. W. Stubbs, resigned.

Master Mechanics and Road Foremen

J. L. Brennan has been appointed acting master mechanic of the Delaware & Hudson with headquarters at Carbondale, Pa.

C. H. Womack has been appointed road foreman of engines of the Chesapeake & Ohio with headquarters at Peach Creek, W. Va.

I. J. Callaham has been appointed road foreman of engines of the Chesapeake & Ohio with headquarters at Huntington, W. Va.

A. R. Numbers has been appointed road foreman of engines of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters at Ottawa, Kan.

J. J. Mellen has been appointed master mechanic of the Cincinnati Northern, with headquarters at Van Wert, Ohio, succeeding W. R. Beck, who has resigned.

Shop and Enginehouse

W. H. Piper, who has had charge of the enginehouse at Mifflin, Pa., for several years, has been appointed foreman of the Enola, Pa., enginehouse of the Pennsylvania, succeeding P. L. Binghaman, transferred.

P. L. Binghaman, foreman of the Enola, Pa., enginehouse of the Pennsylvania, has been appointed foreman of roundhouse No. 2 at Harrisburg, Pa., succeeding W. H. Bickley, who has been transferred to the new Juniata shops.

Purchasing and Stores

H. C. Stevens has been appointed general storekeeper of the Wabash, succeeding R. F. Augsburger, who has resigned.

W. H. King, Jr., has been appointed assistant to vice-president of the Seaboard Air Line with headquarters at Norfolk, Va. He will perform such duties in connection with purchases as may be assigned to him by Vice-President M. J. Caples, to whom the direction of the department of purchases and stores has been assigned in addition to his other duties. The office of general purchasing agent has been abolished.

Obituary

C. E. Nutter, electrical engineer of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., died on January 20.

H. McClure, general inspector of freight car equipment of the Missouri Pacific, died of heart disease on January 5, while at work in his office at St. Louis, Mo.

Railway Mechanical Engineer

Volume 97 March, 1923 No. 3

Send in Your Ideas

The competition on car inspection which was announced in the February issue of the *Railway Mechanical Engineer* will close on March 30. There is still time for any who are interested in this subject to send in articles to be considered for the two prizes. The editors desire especially to emphasize the fact that in addition to the prize articles any other contributions containing meritorious ideas will be published and paid for at the regular space rates. It is hoped that a considerable number of our readers will discuss this subject in order that we may be able to present a comprehensive review of car inspection practices on various railroads. The prizes, as announced last month, are $50 and $35, for the best articles on car inspection received at the New York office on or before March 30.

How to Get Results

A well-informed engineer who had spent considerable time investigating manufacturing shops recently made the statement that the results obtained in almost all plants are largely independent of the methods and equipment. This is a rather extreme statement and one which many people will be inclined not to accept. Nevertheless it must be recognized that many factors which influence the efficiency of a plant are not controlled by the quality of its equipment but rather by the degree of effectiveness with which available facilities are used. Almost anyone who has visited different railroad shops can call to mind certain plants that stood out from the rest because of systematic methods which made it possible to obtain high output. It would not be difficult to find examples to illustrate the opposite condition where shops have relatively good equipment but due to lack of system and absence of co-operation between departments, the employees fail to work together toward a definite goal and regardless of how urgently equipment is needed or how much attention the supervising officers give to rushing work through the departments the output does not come up to the standard for a well organized shop of the same size.

The majority of railroad shops are handicapped with machine tools and equipment that should have been replaced years ago. While numerous projects are now under way for additions and improvements to shops, it will be a long time before the general situation can be greatly improved. In the meantime shop foremen should not allow the poor facilities to discourage them from making every effort to get the best possible results with the equipment at hand. Often shop conditions can be materially improved by simple home-made appliances. The biggest single factor in the efficiency of a shop is the attitude of the individual workman. The foreman who combines fairness, courage and enthusiasm can usually succeed in getting men interested in their work and obtain co-operation which will get results under the most trying conditions.

Repairing Locomotives for Economy

Practically all railroad shops are now crowded to their full capacity with locomotives undergoing repairs. With insistant demands for motive power and with forces in many cases still disorganized from the strike, the situation is very trying to the foremen. When work is rushed, there is always a tendency to neglect details, and for that reason every foreman should impress upon his men that a locomotive poorly repaired usually wastes many times the amount that is saved by rushing it out of the shop. Some mechanics fail to realize how their work affects the operation of the locomotives, and the lack of such knowledge often leads to serious mistakes. For example, a boiler-maker repairing ash-pans found that the section over the trailer wheel was sometimes cut by the flange on the trailer tire. To overcome the trouble, he raised the entire ash-pan closer to the mudring, not realizing that by so doing he was reducing the efficiency of the boiler and decreasing the capacity of the locomotive. Few men, unless they have had considerable experience, understand the necessity for accurately locating the stack and alining the exhaust nozzle so that the jet will be exactly in the center. Foremen should also impress upon the men the importance of careful work in applying cylinder and valve rings, in setting valves properly, in fitting up superheater units and steam pipes so that they will stay tight, and in fact all work that affects steam consumption. The price which the railroads pay for coal at present ranges from $3 to $6 per ton, so the cost of fuel for a single trip with a large locomotive may be from $60 to $120. Giving the shopmen an understanding of the cost of locomotive fuel and the extent to which slight errors may affect the coal consumption, should have a good effect in making them more accurate in their work, and insure that locomotives which have received repairs will operate with maximum economy.

Boiler Operating Factors

The determination of factors vital to efficient boiler operation is the subject of an article in this issue worthy of special study. Considering the investment involved and the possibilities of economy or waste, too little attention is ordinarily given to the operation of railway boiler rooms by higher mechanical department officers. Unless the higher officers show a continual interest in economical boiler operation it is useless to expect the rank and file of employees to give the subject much attention, or care how much coal is wasted. In a specific case a supposedly expert fireman was shown the bad effects on furnace efficiency of too much excess air. A surprise visit two hours after giving the instructions showed him reverting to his old practice of opening the fire-doors unnecessarily. Continued effective supervision is the price of economical boiler operation.

Obviously the first place to start in saving coal (which is money) in the boiler room is at the furnace. The article referred to contains interesting data regarding combustion rates and furnace efficiencies, conditions essential to the best operation of stoker equipment, and the prevention of clinker formation. The need of simple instruments such as draft gages, recording or indicating CO_2 apparatus, steam flow meters and pyrometers is pointed out as enabling furnace conditions to be controlled so that maximum economy will result. According to the author an elaborate set of instruments is not necessary but in view of the large investment in boiler room equipment, there should be no hesitation in appropriating the relatively insignificant amount of money needed for instruments to make the investment profitable.

Records of the percentage of CO_2 obtained during two 24-hour test periods by two men firing the same boiler unit are included, and afford an interesting comparison. The relative efficiency of the two men is apparent and also the effect of excess air at fire cleaning periods, emphasizing the value of mechanical dumps which speed up the operation. The balance of the article, devoted to the importance of high CO_2, methods of finding the combined boiler efficiency, heat balance calculations, and curves showing the cost of steam will be published next month.

Waiting To Go

Attention has been called so frequently to the large amount of idle time of locomotives and cars that some are rather weary of the repetition and others are wondering why somebody does not really do something in regard to the matter. It would be a good thing if every railroad man would ask himself whether there is not some way in which he might assist in bettering the situation. We all know that in periods of so-called car shortage, as well as in periods of car surplus, a large number of freight cars are in shops waiting to be repaired, on sidings to be unloaded or loaded, in yards waiting to be made up into trains or waiting for trains to go, or on the road waiting for cars in other trains to pass or get out of the way. Locomotives are waiting at terminals to be cleaned, coaled, inspected, repaired or are kept idle because trains are not ready for them. But little will ever be accomplished by the mechanical department putting the responsibility on the operating department—or vice versa—or by calling attention in a general way to the large part that the general shipping public play in responsibility for the unsatisfactory condition.

In this, as in so many other matters that are worth while, results can best be accomplished by direct action and by the co-operation of all parties or departments. In some places idle locomotive hours may be increased by a lack of terminal facilities—poorly arranged buildings, antiquated machine tools or an insufficient number of the proper tools. Where the size and number of locomotives have outgrown terminal facilities more lasting good can be accomplished by investments at these points than by purchasing more power. In other cases there may be a pressing need for improvements in the design of locomotives or cars, of the selection and purchase of power and rolling stock better suited for changed conditions of traffic. In still other places the standards of maintenance may be such that engine failures delay or upset plans for the movement of traffic. Hot boxes on cars are another source of annoyance and delays. Men in the mechanical department can aid materially in making it possible for a freight locomotive to average more than 80 or 90 miles a day, spending seven or eight hours on the road and the balance of the time at terminals. Freight cars also would earn far more revenue if they could be made to travel 30 miles or more a day. All indications point to a continuance of the present heavy railroad traffic. The men in the mechanical department should take this into consideration and should not try to handle their work as if this was a temporary condition but should plan to make whatever changes are necessary in facilities and methods to enable them to take care of the increased business promptly and efficiently.

Advantages of Railroad Employment

In the course of a conversation with a railroad officer the manager of a large restaurant made some comments on the railroad labor situation in which he presented a viewpoint that deserves careful consideration. Contrasting the conditions in restaurants with those on railroads he said: "I don't see why there should ever be a strike on the railroads or why the roads should have difficulty in getting high-grade men. In hiring employees for a restaurant there are very few inducements that can be offered. The work is unpleasant and monotonous, there is practically no chance for advancement and wages are low. Railroads should be able to get the pick of high-grade men because railroad work is interesting, wages are high, the pass privilege is of real value, employment is regular and the example of the men who have started at the bottom and become railroad presidents should appeal to and inspire every ambitious employee."

If the real facts regarding railroad employment could be brought to the attention of shopmen at regular intervals it would, no doubt, have a good effect in counteracting the misleading statements of those who are constantly trying to stir up discord between the managements and the employees, because the actual conditions bear out the statements quoted in the preceding paragraph. For example the report of weekly earnings in New York State factories shows that throughout the state wages of employees in railroad repair shops ranked fourth out of 64 industries and outside of New York City they ranked second. Government statistics also show that railroad shop employees have a greater continuity of employment than the workers of almost any other industry. A great deal of money is spent by propagandists to put before the workers misleading statements regarding excessive profits of the railroads and the ill feeling thus created is responsible not only for strikes but also for lessened production while the men are at work. It is time that the railroads adopted a more aggressive policy. Instead of allowing these misstatements to go unanswered railroad officers should refute them by giving publicity to reliable statistics to make railroad employees realize the fact that they are now a favored class both in the matter of wages and working conditions.

Importance of Thorough Inspection

The annual report of the Bureau of Locomotive Inspection for the year ending June 30, 1922, is gratifying in that it shows a decrease in the number of defects found by the inspectors of the bureau together with a noticeable reduction in the number of accidents, this in spite of a considerable increase in the number of locomotives inspected. These results would indicate an attempt on the part of the roads to bring their power up to a higher stage of maintenance and also good work on the part of the numerous railroad inspectors at terminal points. If the report is examined in detail it will be noted that the gain is by no means a uniform one, there being increases due to defects of certain parts, among which may be mentioned rods, motion work and trucks—leading, trailing and tender.

For some months practically all roads have been having a hard struggle to keep their motive power in operative condition and to restore conditions as soon as possible to those prevailing before the strike. The inspector is a vital factor in accomplishing this for dependence must be placed upon the carefulness with which he performs his work and makes out his reports. Thoroughness, a knowledge of where to look and how to inspect combined with eternal vigilance, are indispensable requisites for a person in this position. A recent occurrence which might have resulted in a disastrous passenger wreck, was caused by the failure to detect a flaw and will serve as an illustration of the responsibilities and importance of the work of the inspector. While running at a high speed the rear truck on the tender of a locomotive hauling a passenger train broke down. This tender truck was immediately derailed and the locomotive broke loose from the train. Fortunately the tender did not overturn and the parts torn off the truck did not cause derailment of the cars. The truck was of the arch-bar type and the failure was due to a break in the bottom arch-bar at the point where the sharp upward bend occurs. There was an old crack more than half through the bar which must have been of long standing and yet probably had not been noticed by an inspector. This, despite the fact that failures in a truck of this type at this point are by no means so unusual that well posted inspectors would neglect to note conditions at this point. In building up a terminal force particular attention should be given to the selection and instruction of new inspectors.

New Books

Sampling and Analysis of Coal, Coke and By-Products; *By the Chemists' Committee of the United States Steel Corporation. 184 pages. 5 in. by 7½ in. Bound in cloth. Published by the Carnegie Steel Company, Pittsburgh, Pa.*

In order to determine accurately the properties of coal, it is essential that the right method be used in the sampling and analysis, because of the large amount of fuel bought on the basis of the contents as determined in the laboratory. The subjects treated in this book are especially important to the railroads. The fact that the method described has been approved by the foremost chemists of the constitutent companies of the Steel Corporation is sufficient evidence that the work can be considered as the best modern practice. While prepared primarily for by-product coke plants, it is well adapted for the use of railroad chemists and coal inspectors.

The first part of the book describes the method of sampling coal both at the mine and from railroad cars or belt conveyors. This is followed by a section on physical tests of coal and coke following which the methods of making approximate analyses of coal are described. The section on ultimate analysis includes methods for the determination of the different forms of sulphur in coal. The analysis of the ash is treated in detail and methods are given for determining the clinkering temperature range. The determination of the calorific value of coal and coke by the bomb calorimeter or from the ultimate or approximate analysis is discussed. The remainder of the book covers the sampling and analysis of by-products which is not of direct interest to the majority of railroad readers.

American Malleable Cast Iron. *By H. A. Schwartz. 416 pages. 6 in. by 9 in., illustrated, bound in cloth. Published by the Penton Publishing Company, Cleveland, Ohio.*

The American "black heart" malleable iron industry, which now has an annual capacity for one and a quarter million tons of castings, dates back to the discovery of the process in 1826 by Seth Boyden in a small foundry in Newark, N. J. The process is quite different from that employed in Europe for making "white heart" iron, which was first described by Reaumur in 1722. This book, which is the first complete treatise on "black heart" malleable, has been written by a recognized authority on the subject. There are chapters on the history of the industry, methods of manufacture, principles of metallurgy, procedure for tests and an outline of properties. It is made more comprehensive by the addition of a bibliography of nearly 200 references to chapters and articles in English and foreign books and periodicals, and by a well-prepared index.

From its scope, the book has evidently been written to meet the needs of the user, as well as those of the practical foundryman and the metallurgist. For the producer there are chapters in melting stock, fuel, refractories, furnaces and their operation, annealing practices, molding, patternmaking, cleaning and finishing. Inspection, tests and metallurgy are well covered together with information relative to physical, thermal and electrical properties.

As a hand book of modern malleable practice, a record of past and present metallurgical investigation, and a compendium of information on the permissible uses of the product, it should be of value to the many railroad men responsible for the design, purchase or use of malleable castings.

What Our Readers Think

A New Induced Draft Arrangement for Locomotives

San Francisco, Calif.

To the Editor:

A contrivance that would set up an induced draft without entailing any expense either to operate or to maintain and that would prevent the smoke from wreathing about the rim of the smokestack when the throttle valve is shut, obviously would be an improvement over the present blower of the steam-jet type. It also would make for safety, especially

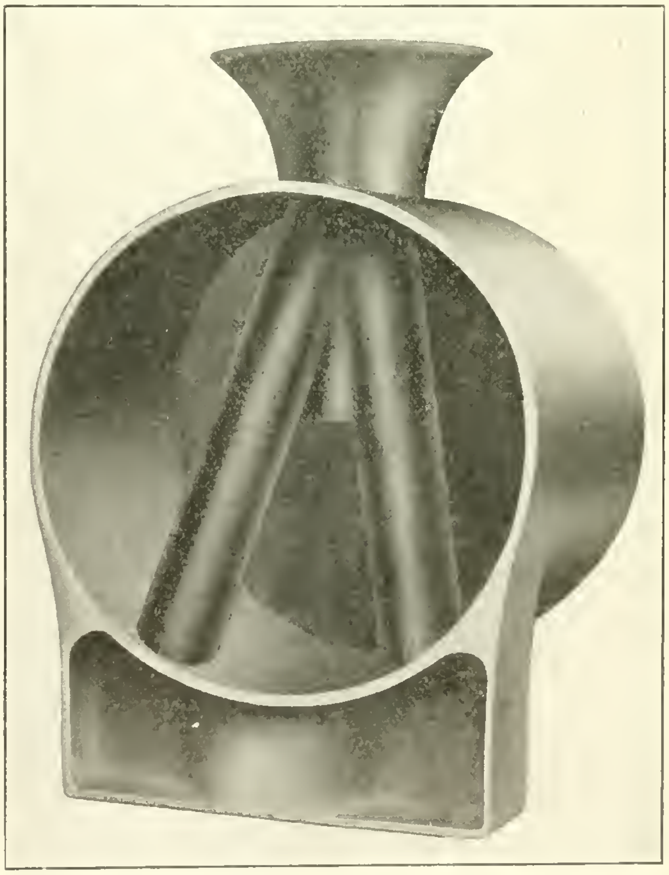


Fig. 1- Model of Front End with Air Collector and Connections to Petticoat Pipe

with coal or wood fuel, since the higher the smoke as it floats past the cab, the less the chance for those riding in it to have their vision impeded or eyes injured by cinders. All known designs depend for maximum efficiency upon the current of air moving in a direction parallel to the axis of the boiler and against the front end.

The arrangement that I have devised will elevate the smoke, whether the stack is of the ordinary straight type or of my design, and, with a brisk wind, the clear distance between the boiler and the smoke as it floats to the rear will be about two-thirds again as high as the smokestack, judging from experiments with the model illustrated in Fig. 1. With the ordinary straight stack, the smoke was only slightly elevated, but the issuing smoke showed distinctly that it was moving under the influence of a strong evacuating force inside the smokebox.

Referring to Fig. 1, a broad, box-like projection will be noticed underneath the smokebox divided in the middle in such a way as to make a cavernous space as large as possible on each side. The partition should preferably taper to a sharp edge in front, instead of as shown. This attachment to the smokebox is for the purpose of catching the wind while the locomotive is running, and is connected to the petticoat pipe by two pipes which lead from the cavernous spaces to that pipe a short distance above its base, forming an acute angle therewith so that the stream of air will be diverted as little as possible in its passage to the smokestack. These branch pipes are of the same diameter and their cross-sectional areas are equal in sum to that of the smokestack. They should be easily removable in order to facilitate withdrawal of the tubes.

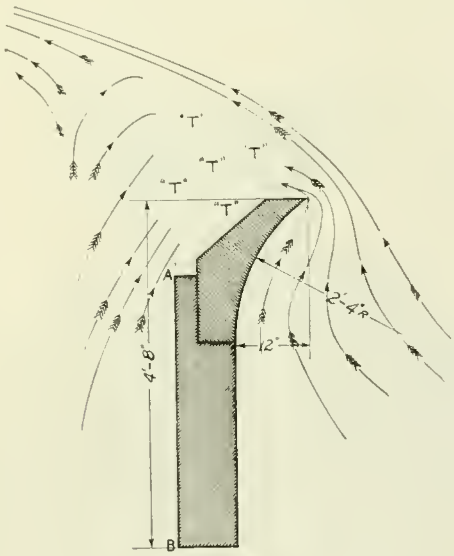
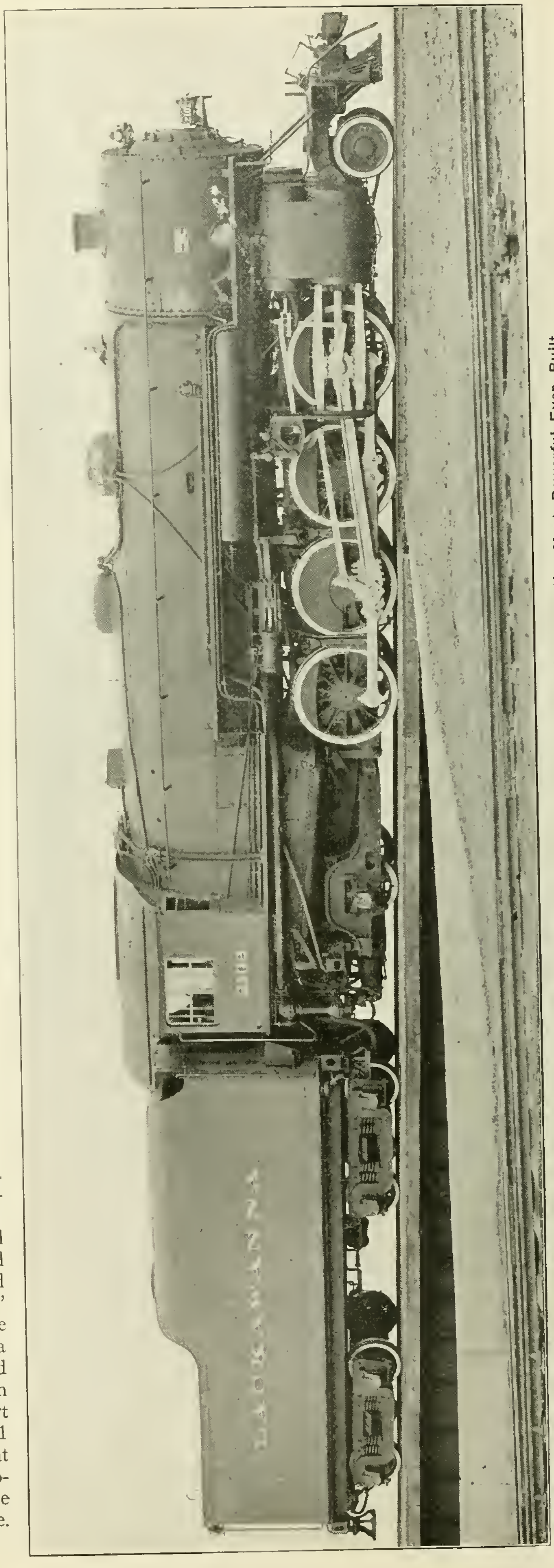


Fig. 2—Effect of Wind-Shield

Fig. 2 shows diagrammatically the results of the wind tunnel experiments with a wind-shield which were conducted by the Navy Department. The wind-shield is shaded, and the arrows indicate the direction of stream lines; while "T" denotes turbulence, where the air is practically still. The wind blew from right to left at right angles to AB with a velocity of 40 m.p.h. A wind-shield of this form is applied to the bridge of the battleship *California* to protect the men standing behind it and relieve them from the discomfort resulting from a strong wind. The model shown in Fig. 1 is provided with the same kind of wind-shield on the front of the smokestack. It would perhaps be better on a locomotive for the sake of looks, to have the wind-shield encircle the smokestack or to make the smokestack itself of that shape.

A Mechangineer.



The Delaware, Lackawanna & Western Mikado Type Locomotives are the Most Powerful Ever Built

Heavy Mikado Locomotive for the D. L. & W.

Lackawanna Purchases 40 of the Most Powerful Mikado Locomotives Ever Built and Postpones Contemplated Electrification

About 40 per cent of the traffic of the Delaware, Lackawanna & Western consists of anthracite coal mined in the vicinity of Scranton. Normally about 900 to 1,000 cars of coal are handled per day, part of this going west in the direction of Buffalo and more than half east to New York. Scranton and the coal mines are located in a valley, and, while there are heavy grades, about 1½ per cent, in both directions, that toward the east over the Pocono mountains is considerably longer than the westbound grades. From Scranton east to Nay Aug, about 6 miles, the grade is 77 ft. to the mile and from Nay Aug to Gouldsboro, about 14 miles, the grade is 51 ft. to the mile. These grades out of Scranton present the most difficult operating situation on the line between New York and Buffalo.

In order to equalize the operative capacity of the road plans were drawn for the electrification of some 40 miles of gradients near Scranton, the intention being to furnish electric locomotive helper and pusher service, to the summits for east and west bound traffic. The first set of bids were rejected in the summer of 1921, and later new bids were called for. As the cost of this project was in excess of $5,000,000 it was finally decided to postpone electrification for the time being and to purchase 40 powerful Mikado type locomotives at a very much smaller investment, these locomotives to be used for helper and pusher service as well as for regular road duty.

Coal trains are made up and taken through solid from Scranton to the west or to the seaboard, the necessary additional helper and pusher service being given out of Scranton. The new Mikado locomotives with the helper service mentioned are now hauling trains of 2,900 tons through from Scranton to Secaucus yard, near Hoboken.

With these powerful locomotives a larger tender is used, the capacity having been increased from 10,000 gal. of water and 12 tons of coal to 12,000 gal. of water and 14 tons of coal. This increased capacity enables the locomotives under ordinary conditions to take a train to the summit east of Scranton without taking water and to run 130 miles from Scranton to Secaucus yard without taking coal.

The 40 new locomotives for the Delaware, Lackawanna & Western are noticeably heavier than those already in service and in terms of tractive force are the most powerful Mikado locomotives ever constructed. They were designed by the American Locomotive Company to meet the special traffic conditions on the D., L. & W. and were built at the Schenectady Works. These engines bear the road numbers of 2101 to 2140 inclusive. Their weight in working order is 356,500 lb. and their normal rated tractive force is 67,700 lb. Being equipped with boosters having a rated tractive force of 11,500 lb. the total available tractive force for starting or heavy pulls is 79,200 lb. or 17 per cent over that of the locomotive cylinders alone. The locomotive cylinders are 28 in. by 32 in. and the driving wheels are 63 in. in diameter.

The D., L. & W. has been a user of heavy Mikado locomotives in the past, having purchased 74 locomotives of the 1200 class which are essentially alike. The last order from this design was for 10 locomotives placed in 1920. These also were built by the American Locomotive Company. A comparison of the dimensions, weights, and proportion of the two designs will be found in the accompanying table.

It will be noticed from this table that the new Mikado locomotives have 10,600 lb. greater tractive force than those previously used, an increase of 18½ per cent for the main cylinders, and an increase of 22,100 lb. or 38½ per cent if the booster is included. The increase in tractive force of the main cylinders was obtained by changing the piston travel from 30 in. to 32 in. and raising the steam pressure from 180 lb. to 200 lb. The weight of the engine in working order was raised from 328,000 lb. to 356,500 lb., an increase of 8.7 per cent and the weight on the drivers from 256,000 lb. to 271,500 lb., an increase of slightly over 6 per cent. An axle load of 68,000 lb. would of course not have been permissible except for the favorable track and bridge conditions prevailing on the Lackawanna. The fact that an increase of 38½ per cent in total available tractive force was obtained by an increase of only 8.7 per cent in the total weight of the engine is an excellent example of what can be done by good designing combined with the introduction of the booster.

The diameter of the boiler was increased from 84¼ in. to 90-5/16 in., inside the first ring, while the length of the firebox was increased 12⅛ in. without change in width, the grate area thereby being increased from 63.2 sq. ft. to 70.4 sq. ft. The length over the tube sheets of 18 ft. was retained but the number of 2 in. tubes was decreased from 303 to 300 and the number of 5⅜ in. flues increased from 43 to 50. The total evaporative heating surface was increased 3.9 per cent while the increase in superheating surface was 16.75 per cent. In the new locomotives the superheating surface is 25.2 per cent of the evaporative heating surface, a liberal allowance. Superheated steam is used not only for the main cylinders but also for the booster, the connection for the latter being made from the outside steam pipes. A combination exhaust stand is used for the locomotive and the booster cylinders.

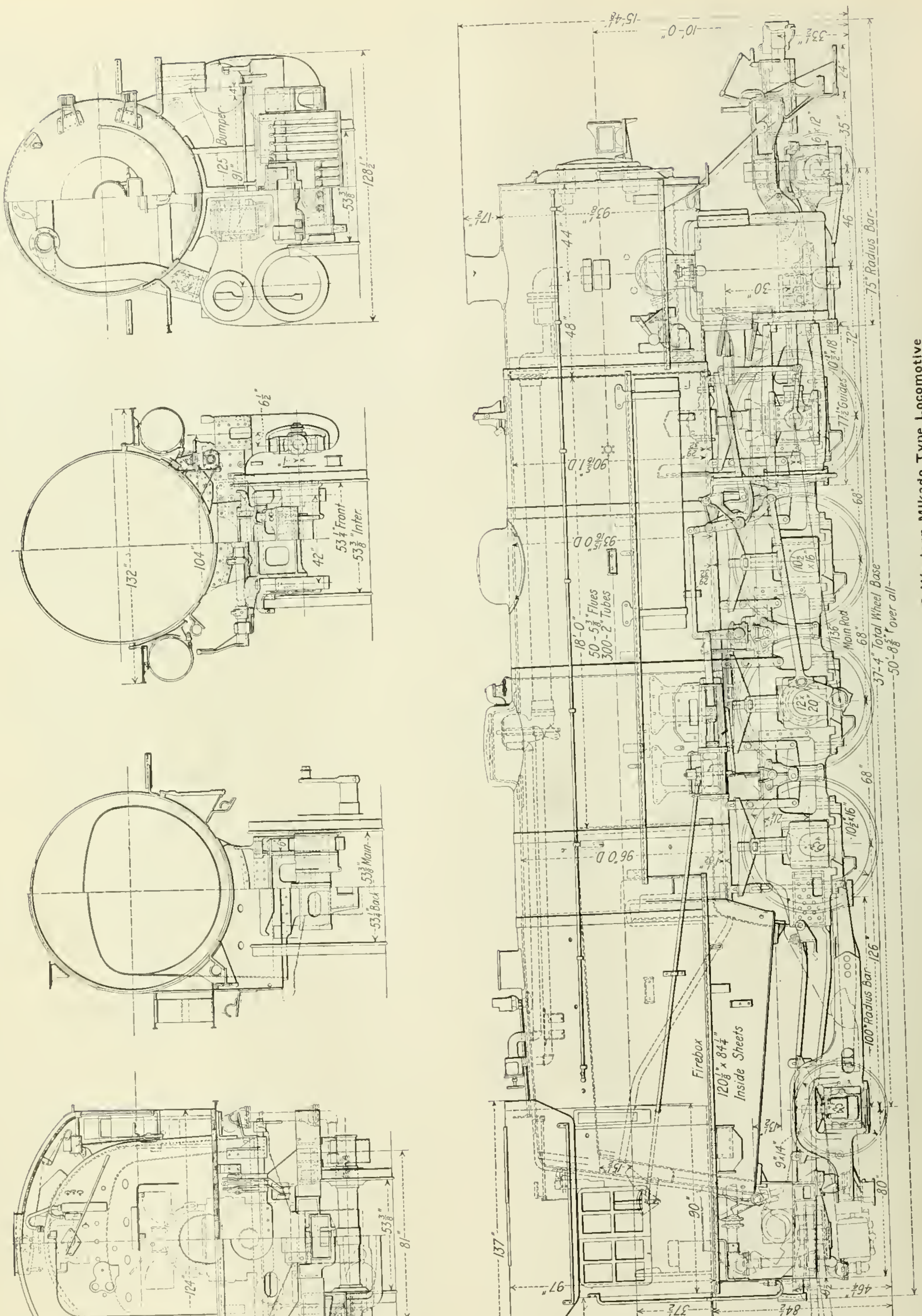
A comparison between the calculated cylinder horsepower, and the calculated boiler horsepower shows they are practically the same and would indicate that these locomotives could be relied upon to be excellent steamers. The estimated coal rate when working at full capacity is 130 lb. per square foot of grate per hour. Stokers are provided, those for the new engines being furnished by The Elvin Mechanical Stoker Company.

The driving wheels of both the old and the new design are 63 in. in diameter. The main driving journals of the new engines are 12 in. by 20 in., the front journals 10½ in. by 18 in. and the others 10½ in. by 16 in. By using lateral motion driving boxes for the forward drivers the rigid wheel base is reduced to 11 ft. 4 in. The front trucks are of the Woodard type and the trailing trucks of the Delta type. Baker valve gear with 14 in. piston valves is used on both designs. Chrome-Vanadium steel was used for the main and side rods in order to keep their weight as low as possible and thus minimize the dynamic augment.

The height of the new D., L. & W. Mikado locomotive is 15 ft. 4⅛ in., the extreme width 11 ft. and the coupled length of locomotive and tender 84 ft. 5½ in. The smoke stack is 18 in. in diameter and the single exhaust nozzle 7 in. in diameter.

In addition to the booster, Elvin mechanical stoker and Baker valve gear other special equipment on these locomotives are the Alco power reverse gear, power grate shaker, automatic fire door of the Butterfly type, Pyle electric headlight and Cleveland low water alarm.

While the curvature on the main line of the Lackawanna



Cross-Sections and Elevation of the Deleware, Lackawanna & Western Mikado Type Locomotive is moderate and while lateral motion driving boxes and a short rigid wheel base have reduced hub wear and flange wear to a relatively small amount, Chicago hydrostatic flange lubricators are installed to still further reduce the flange wear and decrease the friction on curves.

Conditions on the Lackawanna call for considerable drifting of locomotives. For this reason Talmage drifting valves have been applied to the new Mikados so that it is not necessary to run with a cracked throttle.

To avoid breakage and damage of the pilot drawgear when locomotives are used in pusher and helper service Miner friction draft gear is employed on the head end of these locomotives.

These D., L. & W. Mikado locomotives will naturally be compared with those for the New York Central Lines, one of the most striking designs brought out in 1922 and for which orders were placed for 191 for the various roads comprising that system. The New York Central engines weigh 334,000 lb. in working order, have 28 in. by 30 in. cylinders, and 63 in. driving wheels. They also are equipped with boosters and have a total rated tractive force of 74,500 lb. or 63,500 lb. without the booster. They were fully described in the *Railway Mechanical Engineer*, September, 1922. Other heavy Mikado type locomotives recently ordered are those for the Central of New Jersey weighing 342,500 lb., having 27 in. by 32 in. cylinders and a rated tractive force of 59,000 lb. and those for the Northern Pacific weighing 337,000 lb., having 28 in. by 30 in. cylinders, and a rated tractive force of 57,000 lb. But few Mikado locomotives having a tractive force of over 60,000 lb. have been built.

DIMENSIONS, WEIGHTS AND PROPORTIONS—D., L. & W. MIKADO LOCOMOTIVES

	2100 class	1200 class
Type of locomotive	2-8-2	2-8-2
Cylinders, diameter and stroke	28 in. by 32 in.	28 in. by 30 in.
Valve gear, type	Baker	Baker
Valves, piston type, size	14 in.	14 in.
Maximum travel	7 in.	6¾ in.
Outside lap	1 3/16 in.	1 3/16 in.
Exhaust clearance	0	0
Lead in full gear	⅛ in.	⅛ in.
Weights in working order:		
On drivers	271,500 lb.	256,000 lb.
On front truck	25,500 lb.	23,500 lb.
On trailing truck	59,500 lb.	48,500 in.
Total engine	356,500 lb.	328,000 lb.
Tender	217,600 lb.	178,000 lb.
Wheel bases:		
Driving	17 ft. 0 in.	17 ft. 0 in.
Rigid	11 ft. 4 in.	11 ft. 4 in.
Total engine	37 ft. 4 in.	35 ft. 2 in.
Total engine and tender	73 ft. 2½ in.	70 ft. 9½ in.
Wheels, diameter outside tires:		
Driving	63 in.	63 in.
Front truck	33 in.	33 in.
Trailing truck	43 in.	43 in.
Journals, diameter and length:		
Driving, main	12 in. by 20 in.	11 in. by 21 in.
Driving, front	10½ in. by 18 in.	10½ in. by 18 in.
Driving, others	10½ in. by 16 in.	10½ in. by 13 in.
Front truck	6 in. by 12 in.	6 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Straight top	Conical con.
Steam pressure	200 lb.	180 lb.
Fuel	Bit. coal	Bit. coal
Diameter, first ring, inside	90⅞ in.	84¼ in.
Firebox, length and width	120⅛ in. by 84¼ in.	108 in. by 84¼ in.
Height mud ring to crown sheet, back	72½ in.	......
Height mud ring to crown sheet, front	92½ in.	......
Arch tubes, number and diameter	4—3 in.	4—3 in.
Combustion chamber, length	45 in.	36¾ in.
Tubes, number and diameter	300—2 in.	303—2 in.
Flues, number and diameter	50—5⅜ in.	43—5⅜ in.
Length over tube sheets	18 ft. 0 in.	18 ft. 0 in.
Tube spacing	13/16 in.	¾ in.
Gas area through tubes	730 sq. in.	737 sq. in.
Net gas area through flues	659 sq. in.	567 sq. in.
Total gas area through tubes and flues	1,389 sq. in.	1.304 sq. in.
Grate type	Rocking	Rocking
Grate area	70.4 sq. ft.	63.2 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	315 sq. ft.	300 sq. ft.
Arch tubes	30 sq. ft.	28 sq. ft.
Tubes	2,813 sq. ft.	2,840 sq. ft.
Flues	1,260 sq. ft.	1,083 sq. ft.
Total evaporative	4,418 sq. ft.	4,251 sq. ft.
Superheating	1,112 sq. ft.	953 sq. ft.
Comb. evaporative and superheat'g	5,530 sq. ft.	5,204 sq. ft.
Special equipment:		
Brick arch	Yes	Yes
Superheater	Type A	Type A
Feedwater heater	No	No
Stoker	Elvin	Duplex
Booster	Yes	No
Tender:		
Style	Waterleg [illegible]	Waterleg
Water capacity	12,000 gal.	10,000 gal.
Fuel capacity	14 tons	12 tons
General data, estimated:		
Rated tractive force, 85 per cent	67,700 lb.	57,100 lb.
Rated tractive force with booster	79,200 lb.	......
Cylinder horsepower (Cole)	2,824	2,542
Boiler horsepower (Cole) (est.)	2,805	2,645
Speed at 1,000 ft. piston speed	35.2 m.p.h.	37.5 m.p.h.
Steam required per hour	58,700 lb.	55,100 lb.
Boiler evaporative capacity per hr.	58,330 lb.	52,900 lb.
Coal required per hour, total	9,180 lb.	8,260 lb.
Coal rate per sq. ft. grate per hr.	130 lb.	131 lb
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	76.1	78.0
Weight on drivers ÷ tractive force	4.01	4.48
Total weight engine ÷ cylinder hp.	126 lb.	129 lb.
Total weight engine ÷ boiler hp.	127 lb.	124 lb.
Total weight engine ÷ comb. heat. surface	64.5 lb.	63.0 lb.
Boiler proportions:		
Boiler hp. ÷ cylinder hp., per cent	99.3	104
Comb. heat. surface ÷ cylinder hp.	1.96	2.05
Tractive force ÷ comb. heat. surf.	12.23	10.97
Tractive force × dia. drivers ÷ comb. heat. surface	771	691
Cylinder hp. ÷ grate area	40.1	40.2
Firebox heat surface ÷ grate area	4.9	5.2
Cylinder hp. ÷ gas area (tubes and flues)	2.03	1.95
Firebox heat. surface, per cent of evap. heat. surface	7.8	7.7
Superheat. surface per cent of evap. heat. surface	25.2	22.4
Tube length ÷ inside diameter	122.7	122.7

COMMON INTERESTS OF ROADS AND EMPLOYEES.—W. G. Lee, president, Brotherhood of Railroad Trainmen, in an address before the Western Railway Club, Chicago, February 19, 1923, called attention to the need of better acquaintance between managers and employees and the fact that as long as the public believes the charges of each against the other, both managements and men will suffer. "You ask, 'What else have you to offer in place of the strike?' Gentlemen, I have the greatest confidence in the personal acquaintance of men with each other. I realize how impossible it is for the managers of our great railway corporations to be acquainted with their employees, but if you ever can reach the time when the men can understand that the company for which they work is not represented solely by so many engines and box cars, but is represented by men like themselves, who have an interest in the employees as well as in the revenues, you will have accomplished something that as yet has not entirely been done. It is useless to denounce the strike as a barbaric method for adjusting disputes so long as there are no more humane methods. We agree that the court of force is an unjust court, but we have not yet found a better one when both sides fail to agree. Railroad employees are not unreasonable. They are willing to go half way at any time, but they realize their necessities and are not slow in endeavoring to provide for them. The public has been diverted in the past few years by public statements made by railroad companies and their employees. The roads have said that transportation employees were extravagantly paid, that they had the easiest positions and the highest pay of any employees in the country, and that further concessions granted them simply meant robbing the public pocketbook, which, in this instance, the railroad companies were quite prepared to protect. The railroad employees have countered by setting forth that the railway companies were extravagantly operated, that because of watered stocks, dishonest management and inefficient operation they were, in very many instances, not showing the revenues they should, and insisting that if they were given honest management, there would be no difficulty in meeting the wage demands of their employees. Whether we agree on all subjects that come between us or not, we must agree that in the public estimation the railroad companies and their employees are not separated. The public accepts both statements as gospel truth and exacts its toll of transportation service at its own price against both of them. Let us satisfy the public that the railway companies and their employees are not what they have called each other, but that they are exactly the contrary; that they are serving the transportation needs of this country in a more efficient manner than they are being served in any other country in the world; that the railroad companies are efficiently managed; that their employees are giving efficient service, and that both of them are worthy of their hire."

Freight Train Resistance and Tonnage Ratings

Part II

Formula for Adjusted Ratings, Selection of Values and Analysis of the Adjustment

By Richard J. McCarty, Jr.
Division Superintendent, Delaware & Hudson

ADJUSTED tonnage ratings can be established either by test or by calculation. In either case it is first necessary to select as a basis for the adjustment two cars of unequal weight, one to represent light weight cars and the other, loaded cars. The weight of these cars should represent closely the operating conditions under consideration.

When by test the number of tons and cars of light cars and the number of tons and cars of heavy cars that can be moved over a given district with a given unit of motive power have been found, divide the difference in tons by the difference in the cars to get the adjustment in tons per car. Then multiply the adjustment by the number of light cars and add the result to the actual tons of light cars which gives the adjusted rating. The same result can be obtained by multiplying the number of heavy cars by the adjustment and adding the result to the actual tons of heavy cars. From this method it will be seen that after the adjustment has been obtained, the adjusted rating may be derived from the data of either train. The efficiency of ratings secured in this manner depends on selecting car weights that properly represent the conditions of traffic for the particular district.

Formula for Adjusted Ratings

Ordinarily, to obtain an adjusted rating by calculation it would be necessary to select the proper unit values of resistance to represent the two cars of unequal weight, above mentioned, and then work out the actual tons of the train of light cars and the actual tons of the train of heavy cars and proceed as shown above, where the data is obtained by test. A formula can be developed, however, that will simplify this process, and the manner in which it is done will now be described.

In order that the formula in question will represent all conditions the symbols of Table V* will be used. The number of tons a given drawbar pull will move is found by dividing the drawbar pull by the sum of the different elements of resistance in pounds per ton. As either weight car may be taken as a basis on which to calculate the adjusted rating, a train of light weight cars will be taken.

Then the tons may be represented by the following formula:

$$T = \frac{f}{E + G} \quad \ldots\ldots (27)$$

From equation (5) the number of cars is as follows:

$$C = \frac{T}{W} \quad \ldots\ldots (28)$$

Having now developed the part of the formula for the actual tons and the number of cars, it is next in order to develop a formula for the adjustment for use in connection with equation (27) and (28).

From fundamental equations (6) and (10)

$$T(E + G) = (T + t)\,(E - e + G) \quad \ldots\ldots (29)$$

Therefore

$$t = \frac{fe}{(E + G)\,(E - e + G)} \quad \ldots\ldots (30)$$

From (7) and (11)

$$C(R + D) = (C - c)\,(R + r + D + d) \quad \ldots\ldots (31)$$

Therefore

$$c = \frac{f\,(r + d)}{(R + D)\,(R + r + D + d)} \quad \ldots\ldots (32)$$

Then from (30) and (32) any adjustment may be expressed as follows:

$$\frac{t}{c} = \frac{e\,(R + D)\,(R + r + D + d)}{(r + d)\,(E + G)\,(E - e + G)} \quad \ldots\ldots (33)$$

$$= W(W + w)\,\frac{e}{r + d} \quad \ldots\ldots (34)$$

$$= \frac{Rw - rW}{r + d} \quad \ldots\ldots (35)$$

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* See February issue, page 85.

As between any two trains of the same total resistance on any given district, but of different weight cars, respectively,

Equation (30) represents the difference in the tons.

Equation (32) represents the difference in the number of cars.

Equations (33), (34) and (35) represent the adjustment.

As equations (33) to (35) inclusive provide for all conditions of operation either of them may be used for obtaining the adjustment from fundamental unit values, although the most convenient formula is equation (34). Therefore, the formula for the adjustment may be expressed as follows:

$$\text{Adjustment} = W(W + w) \frac{e}{r + d} \ldots\ldots (36)$$

From the above it will be seen that the value of the adjustment depends on the weights of the two cars selected and on the value of the corresponding units of mechanical and grade resistance, also it is independent of drawbar pull. Stated in general terms, which will be sufficient for the present, it represents in tons the relation that exists between the values of mechanical resistance and the value of grade resistance for cars of unequal weight.

By combining equations (27), (28) and (36) the adjusted tonnage rating for any given unit of motive power over any given district may be expressed in the following formula:

$$\text{Adjusted tons} = \frac{f}{E + G} + CW(W + w) \frac{e}{r + d} \ldots\ldots (37)$$

in which

$$\frac{f}{E + G} = \text{Actual tons} \ldots\ldots (38)$$

$$W(W + w) \frac{e}{r + d} = \text{Adjustment} \ldots\ldots (39)$$

and

$$CW(W + w) \frac{e}{r + d} = \text{Potential tons} \ldots\ldots (40)$$

Equation (37) is the basic formula and represents all the conditions that are involved in adjusted ratings. When this formula is applied to practical purposes, however, it is necessary to select car weights and resistances that fit the conditions of operation, and therefore a number of the unknown quantities become known, which makes it possible to reduce the formula so it can be easily applied. For example, suppose car weights and units of resistance for a given division are selected as follows:

Light cars	20 tons
Heavier cars	60 tons
Mechanical resistance of lighter cars	6.8 lb. per ton
Mechanical resistance of heavier cars	3.3 lb. per ton

By substituting these values in equation (37)

$$\text{Adjusted tons} = \frac{f\,(d + 272)}{(G + 6.8)\ (d + 62)} \ldots\ldots (41)$$

A formula similar to equation (37), and one that will produce the same result, may be derived by using as a basis the resistance of the heavier cars instead of the lighter cars, by which

$$\text{Adjusted tons} = \frac{f\,(d + 132)}{(G + 3.3)\ (d + 62)} \ldots\ldots (42)$$

Equations (41) and (42) both give the same result and the adjustment in both cases is the same.

After the proper car weights and car resistances have been selected for a given railroad, a simple formula for the adjustment for any grade may be derived from equation (39). For example, the use of the same values in equation (39) as were used in equation (37) gives,

$$\text{Adjustment} = \frac{4200}{d + 62} \ldots\ldots (43)$$

in which there is only one unknown quantity of easy determination.

Any adjusted rating is made up of two parts; *viz.*, the actual tons and the potential tons. In order to make up a train of a given adjusted rating the adjustment should be added to the actual weight of each car as the car weights are added up until the sum of the actual weights and the adjustments equals the adjusted rating.

Assuming that the rate of grade is accurately known, the efficiency of any adjusted rating depends on selecting car weights that closely represent the conditions of operation, and on selecting values of resistance to represent such cars. If this is properly done an adjusted rating and an adjustment can be developed for any given district that will produce trains of approximately the same total resistance regardless of car weights.

Selection of Values for Use in Adjusted Tonnage Formula

In discussing this phase of the subject, equation (38) which gives the actual tons, will be taken first, after which the adjustment will be analyzed.

In selecting values for mechanical resistance, grade resistance and curve resistance, a great deal depends on conditions and, therefore, care should be taken to see that the values selected fit the physical characteristics and operating conditions as near as possible.

Although the mechanical resistance from the time a train starts until it reaches the speed of minimum friction is greater than the mechanical resistance at 5 or 10 miles per hour, it is not necessary to consider the higher resistances, because they are overcome by the proper handling of the slack as previously explained, and by a temporary advantage of low piston speed. In this way mechanical resistance in pounds per ton for the speed of minimum friction, which is between 5 and 10 miles per hour, becomes the governing feature.

There are in existence a good many tables of mechanical resistance for freight cars of different weights at various speeds and in a large number of them there is considerable difference in the respective values. In view of this it is important to know under what conditions any given values of mechanical resistance were obtained before adopting them as a basis for adjusted ratings.

The amount to allow for acceleration depends on the physical characteristics of the railroad and on the density of traffic. It has been assumed, however, that in the present treatment of the subject, no allowance will be made for acceleration.

Grade resistance and curve resistance are constant amounts for any given grade or curve and, therefore, the selection of these amounts should be governed by the remarks given under "Grades and Curves." In cases where the ruling grade can be approached at high freight train speed and where it is safe to assume that this can be done, as a general proposition, it is proper to consider such a grade as a momentum grade and take credit for the difference. This difference can be calculated by the usual formula,

$$g = 3.5 \times \frac{V_2^2 - V_1^2}{L} \ldots\ldots (44)$$

where g = Per cent of grade to be deducted from the actual grade.
V_2 = Initial speed in miles per hour.
V_1 = Speed at top of grade in miles per hour.
L = Length of grade in feet.

When the value of (g) in such cases has been obtained it should be deducted from the value of the ruling grade in per cent, and the balance which represents the per cent of the momentum grade, used to obtain the grade resistance for use in the formula previously described.

When the car weights and values of resistance have been decided upon in connection with the calculation of the actual tons, the same values should be used as a basis for obtaining the adjustment, for otherwise the ratings will be over-adjusted or under-adjusted, the effects of which will appear presently.

Unless these features in connection with the selection of values are properly handled, the adjusted ratings are apt to prove inefficient.

The adjustment, which embodies the principles of adjusted ratings, will now be analyzed so as to show the fundamental values by which it is produced, and so as to show what effect any variation in each value has on the adjustment.

Analysis of the Adjustment

A general description of what the adjustment represents will now be given after which it will be analyzed with respect to its value under different conditions.

The difference in the units of mechanical resistance produce the difference in the tons of trains of the same total resistance as previously explained, but grade resistance tends to offset this condition and, as will be seen later, the steeper the grade the less will be the effect of the difference in mechanical resistance per ton as between cars of different weight.

A complete analysis of the adjustment divides itself naturally into two steps, the first of which takes into consideration its value with respect to straight and level track conditions only, while the second step involves grades and curves. This process would be beneficial to the student but it involves considerable duplication, and therefore as space will not permit, the analysis will be based on conditions that involve both mechanical and grade resistance.

The first step, however, can be followed by referring to Table III* and particularly to Exhibit A specially prepared to illustrate conditions when only mechanical resistance is considered, while Table IV* and Exhibit B should be referred to as the basis for the following analysis.

Before taking up the analysis, however, a few words of explanation may help to an understanding of Exhibits A and B.

In Exhibit A, the train of lighter cars exceeds the train of heavier cars in regard to the number of cars, while the train of heavier cars exceeds the train of lighter cars in regard to the number of tons.

The mechanical resistance per ton of the lighter car train exceeds the mechanical resistance per ton of the heavier car train.

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* See February issue, page 85.

EXHIBIT "A"

COMPARATIVE ANALYSIS OF THE MECHANICAL RESISTANCE OF THE LIGHTER CAR TRAIN AND THE HEAVIER CAR TRAIN AS PER TABLE III. STRAIGHT AND LEVEL TRACK—SPEED 5 MILES PER HOUR

	No. of cars involved in each item	Weight per car in tons: Car	Weight per car in tons: Contents	Tons involved in each item	Rate at which tons or cars are moved—mechanical resist.: Lb. per ton	Rate at which tons or cars are moved—mechanical resist.: Lb. per car	Total M. R. for each component item—tons or cars	Diff. in M. R. that moves the incr. in tons of the heavier train	Expression by formula
A	Lighter Car Train:								
	68	20	....	1,360	3.3	66	4,488	.....	
	68	20	....	1,360	3.5	70	4,760	4,760	(C — c)We
	Total ..	20	....	1,360	6.8	136	9,248	.....	
B	Excess Over Heavier Car Train (Cars):								
	31	20	....	620	3.3	66	2,046	.....	
	31	20	....	620	3.5	70	2,170	2,170	cWe
	Total ..	20	....	620	6.8	136	4,216	.....	
	Total train (99 cars)	20	....	1,980	6.8	136	13,464	6,930	CWe = Te = t(E — e)
C	Heavier Car Train:								
	68	20	....	1,360	3.3	66	4,488	.....	
	68	.	9.11	620	3.3	132	2,046	.....	
	Total ..	20	9.11	1,980	3.3	...	6,534	.....	
D	Excess Over Lighter Car Train (Tons):								
	68	..	21.21	1,442	3.3	...	4,760	4,760	(C — c)We
	63	..	9.68	658	3.3	...	2,170	2,170	cWe
	63	..	30.89	2,100	3.3	132	6,930	6,930	CWe = te = t(E — e)
	Total train (68 cars)	20	40	4,080	3.3	198	13,464	.....	

$\frac{t}{c} = \frac{2100}{31} = 67.74$ tons per car = Adjustment for above conditions.

EXHIBIT "B"

COMPARATIVE ANALYSIS OF THE MECHANICAL RESISTANCE AND GRADE. RESISTANCE OF THE LIGHTER TRAIN AND THE HEAVIER TRAIN, AS PER TABLE IV. GRADE 1 PER CENT—SPEED 5 MILES PER HOUR

	No. cars involved in each item	Weight per car in tons: Car	Weight per car in tons: Contents	Tons involved in each item	Rate at which tons and cars are moved: Mech. Resis.: Lb. per ton	Rate at which tons and cars are moved: Mech. Resis.: Lb. per car	Rate at which tons and cars are moved: Grade. Resis.: Lb. per ton	Rate at which tons and cars are moved: Grade. Resis.: Lb. per car	M. R. for each component item—tons or car	G. R. for each component item—tons or car	Total res. for each component item—tons or car	Distribution of dif. in M. R. that moves the incr. in tons of the heavier train	(Formula)
A	Lighter Car Train:												
	9.63	20	.....	192.6	3.3	66	20	400	636	.....	.....	.....	
	9.63	20	.....	192.6	3.5	70	20	400	674	.....	.....	674	(C — c)We
	Total	20	.....	192.6	6.8	136	20	400	1,310	3,852	5,162	.....	
B	Excess Over Heavier Car Train (Cars):												
	15.49	20	.....	309.8	3.3	66	20	400	1,022	.....	.....	.....	
	15.49	20	.....	309.8	3.5	70	20	400	1,084	.....	.....	1,084	cWe
	Total	20	.....	309.8	6.8	136	20	400	2,106	6,196	8,302	.....	
	Tot. 25.12	20	.....	502.4	6.8	136	20	400	3,416	10,048	13,464	1,758	CWe = Te = t(E — e + G)
C	Heavier Car Train:												
	9.63	20	.....	192.6	3.3	66	20	400	636	3,852	4,488	.....	
	9.63	..	32.17	309.8	3.3	132	20	400	1,022	6,196	7,218	.....	
	Total	20	32.17	502.4	3.3	...	20	...	1,658	10,048	11,706	.....	
D	Excess Over Lighter Car Train (Tons):												
	9.63	..	3.00	28.9	3.3	...	20	...	96	578	674	674	(C — c)We
	9.63	..	4.83	46.6	3.3	...	20	...	152	932	1,084	1,084	cWe
	9.63	..	7,83	75.5	3.3	132	20	800	248	1,510	1,758	1,758	CWe = Te = t(E — e + G)
	Tot. 9.63	20	40.00	577.9	3.3	198	20	200	1,906	11,558	13,464	.....	

$\frac{t}{c} = \frac{75.5}{15.49} = 4.87$ tons per car = Adjustment for above conditions.

The items opposite A show the resistances involved in the same number of lighter cars as are involved in the total number of cars of the heavier car train divided so as to show mechanical resistance resulting from the same resistance in pounds per ton as the heavier cars and also mechanical resistance resulting from the increase in mechanical resistance of the lighter cars as compared to the heavier cars.

Item B covers the same features as item A except that the items apply to the excess number of cars of the lighter car train as compared to the number of cars of the heavier car train.

The items opposite C show the resistance involved in the same number of tons of the heavier car train as compared to the total number of tons of the lighter car train divided as between the empty cars and the contents, both of which, however, are carried at the same mechanical resistance in pounds per ton.

Item D covers the same features as item C except that the items apply to the excess number of tons of the heavier car train as compared to the lighter car train which, however, involve only the contents of such cars for the reason that the cars themselves are covered under item C.

The details thus developed under items A, B, C and D show the distribution of the details of mechanical resistance involved in comparing the lighter car train to the heavier car train without any change in numerical values of the details.

Exhibit B is built up on the same principle as that involved in Exhibit A and although Exhibit B includes grade resistance, the explanations relative to Exhibit A may be applied to this exhibit, bearing in mind that the grade resistance changes the distribution of various items of resistance as between details.

With these explanations an analysis of the adjustment can be taken up.

The fundamental equations give a comparison of the total resistance of these trains as follows:

$$\text{From (8) and (12)}\quad CW(E + G) = (C - c)(W + w)(E - e + G) = f \ldots (45)$$
$$\text{From (6) and (10)}\quad T(E + G) = (T + t)(E - e + G) = f \ldots\ldots (46)$$
$$\text{From (7) and (11)}\quad C(R + D) = (C - c)(R + r + D + d) = f \ldots (47)$$

From equation (46) it will be seen that the increase in tons (t) of the heavier car train is the result of a decrease in the mechanical resistance in pounds per ton (e) of the heavier cars compared to the lighter cars.

Therefore, from equations (45) and (46)

$$t(E - e + G) = CW(E + G) - CW(E - e + G) = CWe = Te \ldots (48)$$

$$\text{or, } t = \frac{CW(E + G) - CW(E - e + G)}{(E - e + G)} = \frac{CWe}{(E - e + G)} = \frac{Te}{(E - e + G)} \quad (49)$$

which means that the increase in the tons of the heavier car train as compared to the lighter car train has the same mechanical and grade resistance per ton as the heavier cars and that the total mechanical and grade resistance of this difference in the tons, is equal to the mechanical resistance that is caused in the lighter car train by the increase in mechanical resistance per ton of the lighter cars as compared to the heavier cars.

From equation (47) it will be seen that the decrease in the number of cars (c) of the heavier car train is the result of an increase in the mechanical and grade resistance in pounds per car (r + d) of the heavier cars compared to the lighter cars.

Therefore from equations (45) and (47)

$$c(R + D) = cW(E + G) = (C - c)(r + d) \ldots\ldots (50)$$

$$\text{or, } c = \frac{cW(E + G)}{R + D} = \frac{(C - c)(r + d)}{R + D} \ldots\ldots (51)$$

which means that the mechanical and grade resistance of the difference in the number of cars is equal to the increase in the mechanical and grade resistance of the heavier cars of the heavier car train compared to the same number of lighter cars.

The relation of these items of resistance to each other as between trains of unequal weight is shown in Exhibit "B."

From the above it follows that the difference in the tons (t) divided by the difference in the cars (c) represents the amount of tons the heavier car train is increased in weight for every car of the difference in the number of cars.

$$\text{From (34)}\ \frac{t}{c} = W(W + w)\frac{e}{r + d}\qquad \text{Adjustment.}$$

$$\text{Therefore}\ t = cW(W + w)\frac{e}{r + d} \ldots\ldots (52)$$

In other words, each car of the lighter or longer train in excess of those in the heavier or shorter train is represented in the actual tons of the heavier or shorter train by $\frac{t}{c}$ tons, or all the cars in excess are represented by $c\frac{t}{c}$ tons which equals (t) as shown in equation (13).

The value of the adjustment for a 1 per cent grade, with the unit values given in Table IV*, is 4.87 tons per car which will adjust the ratings so they will produce trains of the same total resistance regardless of whether the trains are made up of 20-ton cars, 60-ton cars or both kinds of cars.

EXHIBIT "C"

Application of Adjusted Ratings to Trains Made Up of Cars of Unequal Weight. Straight and Level Track—Speed 5 Miles Per Hour

Items (resist. in lb.)	Basis of adjustment: 20 ton cars	Basis of adjustment: 60 ton cars	Trains of 20 and 60 ton cars	Diff. compared to: Tr. of 20 ton cars	Diff. compared to: Tr. of 60 ton cars
M. R. per ton	6.8	3.3	6.8 & 3.3	.....	.....
Grade res. per ton	.....	.....	.....	.....	.....
M. R. per car	136	198	136 & 198	.....	.....
Grade res. per car	.....	.....	.....	.....	.....
No. of 20 tons cars	99	.....	51	.....	.....
No. of 60 ton cars	.....	68	33	.....	.....
Total No. of cars	99	68	84	—15	+16
Total M. res.	13,464	13,464	13,464	0	0
Total grade res.	.....	.....	.....	.....	.....
Total all res.	13,464	13,464	13,464	0	0
The above trains on adjusted tonnage rating basis:					
Adjustment	67.74	67.74	67.74	.....	.....
Actual tons	1,980	4,080	3,000	+1,020	—1,080
Potential tons	6,706	4,606	5,686	—1,020	+1.080
Adjusted tons	8,686	8,686	8,686	0	0
Diff. in act. tons divided by diff in cars	.....	.....	.....	68	68

EXHIBIT "D"

Application of Adjusted Ratings to Trains Made Up of Cars of Unequal Weight. Grade 1 Per Cent—Speed 5 Miles Per Hour

Items (resist. in lb.)	Basis of adjustment: 20 ton cars	Basis of adjustment: 60 ton cars	Trains of 20 and 60 ton cars	Diff. compared to: Tr. of 20 ton cars	Diff. compared to: Tr. of 60 ton cars
M. R. per ton	6.8	3.3	6.8 & 3.3	.....	.....
Grade res. per ton	20.00	20.00	20.00	.....	.....
M. R. per car	136	198	136 & 198	.....	.....
Grade res. per car	400	1,200	400 & 1,200	.....	.....
No. of 20 ton cars	25.12	.....	5.00	.....	.....
No. of 60 ton cars	.....	9.63	7.71	.....	.....
Total No. of cars	25.12	9.63	12.71	—12.41	+3.08
Total M. res.	3,416	1,907	2,212	—1,204	+305
Total grade res.	10,048	11,557	11,252	+1,204	—305
Total all res.	13,464	13,464	13,464	0	0
The above trains on adjusted tonnage rating basis:					
Adjustment	4.87	4.87	4.87	.....	.....
Actual tons	502.4	577.9	562.6	+60.2	—15.3
Potential tons	122.3	46.8	62.1	—60.2	+15.3
Adjusted tons	624.7	624.7	624.7	0	0
Diff. in act. tons divided by diff. in cars	.....	.....	.....	4.87	4.87

Exhibits "C" and "D" give a comparison of trains made up of mixed cars. From these exhibits it will be seen that in any given adjusted rating with corresponding car weights, the total resistance of any train of that rating is constant regardless of whether the cars making up the train are light, heavy or mixed, but the adjustment by which this is done is not the same for all cases.

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* See February issue, page 85.

From the foregoing description of the adjustment the following corollaries may be deduced:

4—The basis of any adjustment is primarily the difference in mechanical resistance in pounds per ton for cars of unequal weight, but its value depends on the relation that this difference bears to the total resistance in pounds per ton of both cars.

5—In any given adjusted rating, the adjustment represents the number of tons that any train of that rating may be increased in weight for every car the train is shortened, provided the train is to some extent a mixture of cars of the same weights as were used to obtain the adjustment.

The formula for the adjustment is as follows:

$$t = W (W + w) \frac{c}{r + d} \quad \ldots\ldots\ldots\ldots \text{From [illegible]}$$

By inspection the following corollaries may be deduced from this equation:

6—The value of the adjustment depends on the weights of the cars used as a basis for the adjusted ratings.

7—The value of the adjustment depends on the values used for mechanical resistance in pounds per ton for the cars selected as a basis.

8—With given car weights and corresponding values of mechanical resistance, the adjustment decreases as the grade resistance in pounds per ton increases.

As previously explained, the sole cause of the difference in tons of any two trains of the same total resistance operated under similar conditions, is the difference in the mechanical resistance in pounds per ton for cars of unequal weight.

Grade and curve resistance in pounds per ton, however, are all independent of car weights, and therefore comparing these two trains of the same total resistance but of unequal weight, the difference in mechanical resistance in pounds per ton of the two trains, which causes the difference in the tons, decreases in relative value but not in actual value as the independent values of resistance increase an equal amount in pounds per ton for both cars or trains. As the adjustment represents the relative value of this difference in mechanical resistance in pounds per ton it follows that the adjustment will decrease as the sum of these independent units of resistance increase.

Therefore, the value of the adjustment depends on the car weights and on the values of mechanical, grade and curve resistance that are selected as a basis for the adjusted ratings. From this, then, it is clear that unless the adjustment represents in tons the relative difference in the total resistance in pounds per ton and in pounds per car, for the district to which it applies, it is safe to assume that the adjusted ratings are in error, and consequently motive power is under-loaded or over-loaded.

Table VI shows how the adjustment varies with different rates of grade, the first entry involving mechanical resistance only and the other entries involving both mechanical and grade resistance. This table is further illustrated in detail by Exhibit E at the bottom of the page.

TABLE VI

Adjustment for Various Grades

Grade	Weight per car		Difference in units of resistance				
	Lighter car	Heavier car	Mech. resist. per ton	Mech. resist per car	Grade resist per car	Total resist. per car	Adjustment
Formula	(W)	(W + w)	(c)	(r)	(d)	(r + d)	$\left(\frac{t}{c}\right)$
0.0	20	60	3.5	62	...	62	67.74
0.5	20	60	3.5	62	400	462	9.09
1.0	20	60	3.5	62	800	862	4.87

(To be continued)

Maximum Speed at Which Rated Tractive Force Can be Developed

By Edward L. Coster

In the American Engineer for February, 1913, there was a paper by the late Lewis R. Pomeroy entitled Curves of Locomotive Operation, which contained formulas and constants for the determination of the maximum speed at which both saturated and superheated steam locomotives could develop their rated tractive force, and the corresponding coal consumption for different rates of evaporation per square foot of heating surface and per pound of coal.

A recent examination of this article revealed errors which led to a recalculation of the constants and their extension to include a higher degree of superheat. The revised analysis, which follows the previous method, is here presented.

Let d = cylinder diameter in inches.
s = piston stroke in inches.
D = driving wheel diameter in inches.
P = boiler pressure in pounds per square inch.
H.S. = total evaporative heating surface in square feet.
T.F. = rated tractive force in pounds.
w = weight of a cubic foot of steam at the assumed mean effective pressure = $0.85P$.
r.p.m. = revolutions per minute of driving wheels.
V = maximum speed in miles per hour at which a locomotive can deliver its rated tractive force.

Assuming that at full cut-off the volume of steam admitted to each cylinder per stroke equals the piston displacement, then the pounds of steam consumed per revolution

$$= \frac{4 \frac{\pi}{4} d^2 s}{1728} w = 0.001818 d^2 s w$$

This is based on the assumption that at full cut-off the

EXHIBIT "E"

[illegible] Total Resistance on Various Rates of Grade—Total Mechanical and Grade Resistance 13,464 Lb. Speed 5 Miles Per Hour

Item	[illegible]	Res. in lb. per ton			Res. in lb. per car			No. of tons	No. of cars	Adjustment $\frac{t}{c}$
		Mech	Grade	Total	Mech	Grade	Total			
Straight level track	20	6.8	...	6.8	136	...	136	1,980	99	
	60	3.3	...	3.3	198	...	198	4,080	68	
Difference	40	3.5	...	3.5	62	...	62	2,100	31	67.74
Grade 0.1 per cent	20	6.8	2.0	8.8	136	40	176	1,530	76.50	
	60	3.3	2.0	5.3	198	120	318	2,540	42.33	
Difference	40	3.5	...	3.5	62	80	142	1,010	34.17	29.58
Grade 0.2 per cent	20	6.8	4.0	10.8	136	80	216	1,247	62.35	
	60	3.3	4.0	7.3	198	240	438	1,844	30.73	
Difference	40	3.5	...	3.5	62	160	222	597	31.62	18.96
Grade 0.3 per cent	20	6.8	6.0	12.8	136	120	256	1,052	52.60	
	60	3.3	6.0	9.3	198	360	558	1,448	24.13	
Difference	40	3.5	...	3.5	62	240	302	396	28.47	13.90
Grade 0.4 per cent	20	6.8	8.0	14.8	136	160	296	910	45.50	
	60	3.3	8.0	11.3	193	480	678	1,191	19.85	
Difference	40	3.5	...	3.5	62	320	382	281	25.65	11.00

weight of steam furnished by the boiler per stroke to supply that lost by clearance, cylinder condensation, piston and valve leakage, is approximately equal to the difference between the weight of a volume of steam equal to the piston displacement and the weight corresponding to the volume of steam actually admitted to the cylinder per stroke.

Since for any speed, miles per hour

$$= \frac{\pi D \times 60 \text{ r.p.m.}}{12 \times 5{,}280} = \frac{D \times \text{r.p.m.}}{336}.$$

$$\text{T.F.} \times V = \frac{0.85Pd^2s}{D} \times \frac{D \times \text{r.p.m.}}{336} = \frac{0.85Pd^2s \times \text{r.p.m.}}{336}$$

$$\text{therefore}\quad \text{r.p.m.} = \frac{336V \times \text{T.F.}}{0.85Pd^2s},$$

hence the pounds of steam consumed per hour

$$= 0.00182d^2sw \times 60\,\frac{336V \times \text{T.F.}}{0.85Pd^2s} = \frac{43.17V \times \text{T.F.} \times w}{P}.$$

If W lb. of water are evaporated per square foot the H.S. per hour,

$$\frac{43.17V \times \text{T.F.} \times w}{P} = \text{H.S.} \times W,$$

$$\text{whence}\quad V = \frac{PW \times \text{H.S.}}{43.17w \times \text{T.F.}} = c\,\frac{\text{H.S.}}{\text{T.F.}} \;\ldots\ldots\ldots\ldots\; (1)$$

$$\text{where}\quad c = \frac{PW}{43.17w} = 0.02316\,\frac{PW}{w}.$$

If P = 200 lb., m.e.p. = 0.85 × 200 = 170 lb., and according to Marks and Davis' steam tables, for saturated steam at this pressure, w = 0.4046 lb.; for 200 deg. F. of superheat, w = 0.3052 lb., and for 250 deg. F. of superheat, w = 0.2893 lb. Introducing these values in the last equation, and successively taking W = 8, 9, 10, 11 and 12 lb., we obtain the following values of c:

Evaporation of water per sq. ft. H.S.		Saturated steam.	Superheated 200 deg. F.	Superheated 250 deg. F.
8 lb.	c =	91.6	121.4	128.1
9 lb.	c =	103.0	136.6	144 1
10 lb.	c =	114.5	151.8	160.1
11 lb.	c =	125.9	167.0	176.1
12 lb.	c =	137.4	182.2	192.1

If W_1 lb. of water are evaporated per pound of coal, the maximum pounds of coal required per hour

$$= \frac{43.17V \times \text{T.F.} \times w}{PW_1} = c_1 \times \text{T.F.} \times V \;\ldots\ldots\ldots\ldots\; (2)$$

$$\text{where}\quad c_1 = 43.17\,\frac{w}{PW_1}$$

Substituting the above values of P and w in the last equation, and successively taking W_1 = 7, 8, 9 and 10 lb., we derive the following values of c_1:

Evaporation of water per lb. coal.		Saturated steam.	Superheated 200 deg. F.	Superheated 250 deg. F.
7 lb.	c_1 =	0.01248	0.00941	0.00892
8 lb.	c_1 =	0.01091	0.00823	0.00780
9 lb.	c_1 =	0.00970	0.00732	0.00694
10 lb.	c_1 =	0.00873	0.00659	0.00624

As an illustration of the practical application of these formulas, consider two similar locomotives of 60,000 lb. rated tractive force, with 200 lb. boiler pressure, each having a ratio $\frac{\text{T.F.}}{\text{H.S.}} = 8$, or $\frac{\text{H.S.}}{\text{T.F.}} = \frac{1}{8}$, one engine using saturated steam, and the other steam superheated 200 deg. F. Then taking W = 10 lb., and W_1 = 8 lb., from equations (1) and (2) and the corresponding tables, we have:

For saturated steam, maximum speed, $V = \frac{114.5}{8} = 14.3$ m.p.h.

For superheated steam, maximum speed, $V = \frac{151.8}{8} = 19.0$ m.p.h.

For saturated steam, hourly coal consumption
$= 0.01091 \times 60{,}000 \times 14.3 = 9{,}361$ lb.

For superheated steam, hourly coal consumption
$= 0.00823 \times 60{,}000 \times 19.0 = 9{,}382$ lb.

These values of V closely agree with those shown by the corresponding curves of available tractive force given on pages 20, 21 of the 1920 edition of "Locomotive Data," published by the Baldwin Locomotive Works; and taken in connection with the figures for fuel consumption, clearly indicate the value of the 200 deg. F. of superheat.

The value of V can also be determined by the following simpler method. In his Notes on the Comparison of Locomotive Dimensions,* Lawford H. Fry says: "It may be taken that at slow speeds with engines in full gear, a horsepower can be developed (at the rim of the driving wheels) from 3.0 sq. ft. of heating surface in a saturated steam locomotive and from 2.5 sq. ft. in a superheated locomotive. On this basis the maximum speed in miles per hour at which the full rated tractive effort can be developed will be $V = \frac{125}{B}$ for saturated and $V = \frac{150}{B}$ for superheated locomotives,"

where $B = \frac{\text{T.F.}}{\text{H.S.}}$

Thus for saturated steam,

$$\text{A.H.P.} = \frac{5{,}280\,\text{T.F.} \times V}{60 \times 33{,}000} = \frac{\text{T.F.} \times V}{375} = \frac{\text{H.S.}}{3}$$

$$\text{Whence}\quad V = \frac{375}{3} \times \frac{\text{H.S.}}{\text{T.F.}} = \frac{125}{\frac{\text{T.F.}}{\text{H.S.}}} = \frac{125}{B}$$

Similarly for superheated steam,

$$V = \frac{375}{2.5} \times \frac{\text{H.S.}}{\text{T.F.}} = \frac{150}{\frac{\text{T.F.}}{\text{H.S.}}} = \frac{150}{B}$$

If B = 8, then for saturated steam, $V = \frac{125}{8} = 15.6$ m. p. h.

and for superheated steam, $V = \frac{150}{8} = 18.7$ m. p. h.

which values closely agree with those previously obtained. The formulas given in this paper being primarily based upon boiler capacity, disregard the gradual decrease in rated tractive force with increase of speed up to V due to the limitations of the valve gear, and the augmented machinery friction†, as indicated by the slight downward slope of the upper portions of the Baldwin tractive force curves above referred to.

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* The *Railway Mechanical Engineer,* April, 1921, pages 211 to 215.

† See Kiesel's formula for machinery friction, given on page 57 of Wood's Locomotive Operation and Train Control, 1915.

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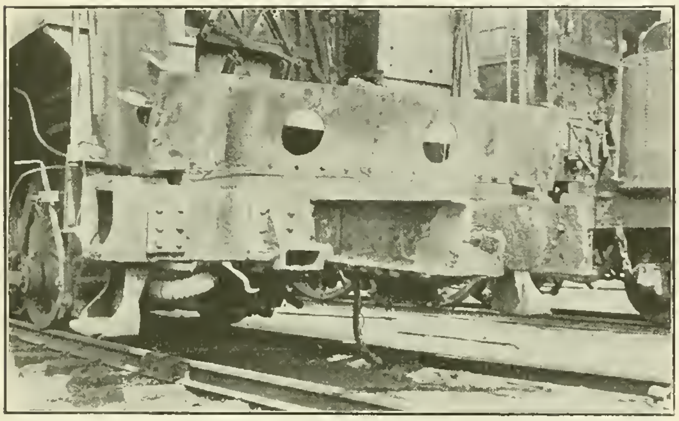
Electrified Section of Japanese Government Railways

Bureau of Locomotive Inspection Report

More Locomotives Inspected; A Smaller Number of Defects and 15 Per cent Fewer Accidents

THE eleventh annual report to the Interstate Commerce Commission of the chief inspector of the Bureau of Locomotive Inspection for the fiscal year ended June 30, 1922, shows an increasing number of locomotives inspected with a reduction in the number of defects and also a reduction in the number of accidents. A summary of the report follows:

The tables show the number of locomotives inspected, the number and percentage of those inspected found defective, and the number for which written notice for repairs was issued because of not meeting the requirements of the law, with the total number of defects found and reported. They also show the number of accidents, with number of persons killed and injured, caused by the failure of some parts or appurtenance of the locomotive and tender, including the boiler and appurtenances thereof.



Broken Sills Caused Locomotive and Tender to Separate Lost Motion Previously Reported

A summary of all accidents and casualties during the year ended June 30, 1922, as compared with the year ended June 30, 1921, shows a decrease of 15.4 per cent in the number of accidents, a decrease of 48.4 per cent in the number killed, and a decrease of 11.3 per cent in the number injured.

LOCOMOTIVES INSPECTED AND DEFECTS FOUND

	1922	1921	1920	1919	1918
Number of locomotives inspected...	64,354	60,812	49,471	59,772	41,611
Number found defective	30,978	30,207	25,529	34,557	22,196
Percentage found defective........	48	50	52	58	53
Written notice for repairs served..	3,089	3,914	3,774	4,433	2,125
Total defects found..........	101,734	104,848	95,066	135,300	78,277

During the fiscal year there were 33 boiler explosions, resulting in the death of 22 persons and the serious injury of 56 others, a substantial reduction as compared with the preceding year. Most of these explosions were caused by overheating of the crown sheet, due to low water. Proper inspection and repair of all parts and appurtenances of the locomotive, including the boiler, is essential to safe and efficient operation, especially the firebox, water feeding and indicating appliances, together with thorough boiler washing, as often as water conditions require, and the removal of scale and sediment from the interior of the boiler which cause heating surfaces to overheat, crack and weaken, and frequently cause failure with serious results.

Investigation of accidents during the year, where the fusion or autogenous welding process was involved supports the position previously taken that the process has not yet reached a state of perfection where it can be safely depended upon in boiler construction and repair where the strain to which the structure is subjected is not carried by other construction which conforms to the requirements of the law and rules, nor in firebox crown-sheet seams where over-heating and failure are liable to occur, nor its excessive use in repairing long and numerous cracks in side sheets.

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE LOCOMOTIVE AND TENDER, INCLUDING THE BOILER

	1922	1921	1920	1919	1918
Number of accidents................	622	735	843	565	641
Decrease from previous year (per cent)	15.4	12.8	[1]49.2	11.8	4.1
Number killed	33	64	66	57	46
Decrease from previous year (per cent)	48.4	3	[1]15.8	[1]23.9	25.8
Number injured	709	800	916	647	756
Decrease from previous year (per cent)	11.3	12.6	41.6	14.4	4.8

[1] Increase

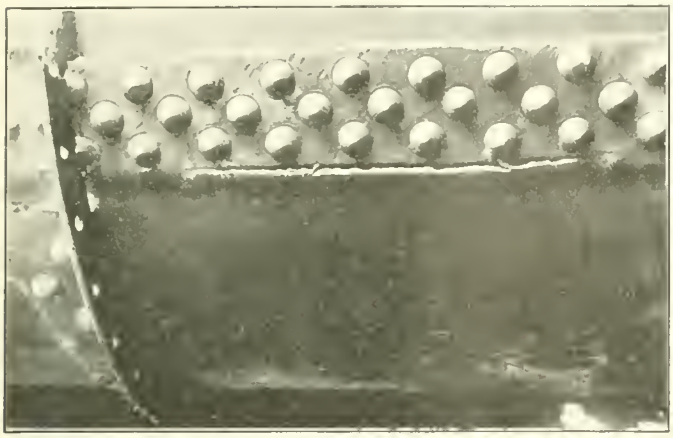
Records continue to show that approximately 80 per cent of all autogenously welded seams involved in so-called "crown-sheet failures" have failed, while 16.9 per cent of riveted seams have failed under like conditions. The fatalities where sheets tore have been seven and one-half times as great as where they did not tear. From July 1, 1916, to June 30, 1922, autogenously welded seams were involved in 22.1 per cent of the crown-sheet failures, while 44.1 per cent of the total killed in crown-sheet accidents were killed where the autogenously welded seams were involved.

Exploded Main Reservoir; All Seams Autogenously Welded Four Years Before Explosion

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE LOCOMOTIVE BOILER

	1922	1921	1915	1912
Number of accidents	273	342	424	856
Number killed	25	51	13	91
Number injured	318	379	467	1,005

A large number of accidents have been caused by defective grate-shaking apparatus, the majority due to the shaker bar not properly fitting the fulcrum lever. This condition has been brought about because of no standard design being maintained, making such parts interchangeable. It should be required, therefore, that all carriers adopt a standard whereby shaker bars can be made interchangeable on all of their locomotives with a proper fit.



Rupture of Patch Applied to the First Course Longitudinal Seam in the Boiler Barrel

PERSONS KILLED AND INJURED, CLASSIFIED ACCORDING TO OCCUPATIONS

	1922		1921		1920		1919		1918	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:										
Engineers	11	213	15	237	16	272	14	194	11	245
Firemen	10	277	25	360	20	404	22	265	19	306
Brakemen	7	66	13	64	9	77	11	82	6	62
Conductors	..	25	2	20	2	19	2	16	..	21
Switchmen	1	13	3	15	4	19	1	7	2	8
Roundhouse and shop employees:										
Boilermakers	1	10	1	7	2	9	1	9	..	11
Machinists	..	9	1	3	1	20	..	5	..	11
Foremen	..	1	1	3	..	3	..	3	1	4
Inspectors	..	2	..	5	..	1	..	6	4	4
Watchmen	..	3	..	4	4	3	..	2	..	3
Boilerwashers	..	1	..	7	..	13	..	7	1	4
Hostlers	..	10	..	8	..	13	..	6	..	8
Other roundhouse and shop employees	1	15	1	25	3	30	1	11	2	19
Other employees	2	23	2	16	4	26	3	23	..	26
Non-employees	..	41	..	26	1	7	2	11	..	24
Total	33	709	64	800	66	916	57	647	46	756

During the year 148 applications were filed for extension of time for removal of flues. Investigation disclosed that in 17 cases the condition of the locomotives was such that no extension could be properly granted. Fifteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period was allowed. Six extensions were granted after defects disclosed by the investigation had been repaired. Nine applications were withdrawn and the remaining 101 were granted.

Ordered Removed from Service on Account of Steam Leakage

There were filed 1,508 specification cards and 5,519 alteration reports necessary in determining the safe working pressure and other required data for the boilers represented. These specification cards and alteration reports have been carefully analyzed to determine whether or not the boilers covered were so constructed as to be in safe and proper condition for service, and that the stresses were within the limits required. Numerous discrepancies were found and corrective measures taken.

ACCIDENTS AND CASUALTIES RESULTING FROM FAILURES OF LOCOMOTIVES AND TENDERS AND THEIR APPURTENANCES

	Year ended June 30								
	1922			1921			1920		
Part or appurtenance which caused accident	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	3	..	3	1	..	1	2	1	2
Aprons	11	..	11	16	..	16	8	..	8
Arch tubes	4	..	5	5	..	5	9	1	15
Ash-pan blowers	7	..	7	5	..	5	6	1	5
Axles	5	..	17	5	..	6	5	..	5
Blow-off cocks	16	..	16	14	..	14	15	..	15
Boiler checks	4	..	4	7	1	7	5	..	6
Boiler explosions:									
A. Shell explosions	1	..	1	..	..	..	..	..	..
B. Crown sheet; low water; no contributory causes found	13	15	23	20	19	26	24	22	35
C. Crown sheet; low water; contributory causes or defects found	14	6	27	33	24	52	35	19	46
D. Fire box; defective stay bolts, crown stays, or sheets	5	1	5	1	2	..	2	..	2
E. Fire box; water foaming	..	..	..	..	..	..	..	..	..
Brakes and brake rigging	10	2	24	6	..	6	3	..	3
Couplers	21	..	23	11	1	13	8	..	8
Crank pins, collars, etc.	10	..	10	6	3	8	4	..	4
Crossheads and guides	4	..	4	4	1	4	5	..	3
Cylinder cocks and rigging	3	..	3	4	..	4	..	..	..
Cylinder heads and steam chests	3	..	3	6	..	6	9	..	9
Dome caps	..	..	..	..	..	..	..	..	..
Draft appliances	6	..	9	8	..	9	1	..	1
Draw gear	7	..	7	8	1	8	11	2	9
Fire doors, levers, etc.	2	..	2	8	..	..	11	..	11
Flues	28	..	32	32	1	35	45	..	52
Flue pockets	1	1	..	1	1	..	..	..	..
Footboards	11	1	10	8	3	5	23	..	23
Gauge cocks	2	..	2	..	..	..	2	..	2
Grease cups	3	..	3	7	..	7	10	..	10
Grate shakers	49	..	49	85	..	85	108	..	109
Handholds	12	1	11	19	..	20	15	1	14
Headlights and brackets	2	..	2	8	2	6	9	1	9
Injectors and connections (not including injector steam pipes)	21	..	24	15	2	13	23	..	27
Injector steam pipes	9	..	9	15	..	17	23	1	29
Lubricators and connections	9	..	9	12	..	12	14	..	15
Lubricator glasses	3	..	3	3	..	3	17	..	17
Patch bolts	..	..	..	..	..	..	..	..	..
Pistons and piston rods	6	..	6	3	..	3	3	1	3
Plugs, arch tube, and washout	12	1	19	15	..	18	28	..	40
Plugs in fire box sheets	2	..	2	2	..	2	1	..	2
Reversing gear	53	..	53	65	..	65	59	..	59
Rivets	..	..	..	4	..	5	..	..	..
Rods, main and side	23	..	27	18	..	21	16	2	20
Safety valves	..	..	..	..	..	..	..	..	..
Sanders	2	..	2	..	..	..	1	..	1
Side bearings	1	..	1	..	..	..	..	..	..
Springs and spring rigging	10	1	9	3	..	3	9	2	18
Squirt hose	54	..	54	82	..	82	82	..	82
Stay bolts	6	..	8	..	..	..	2	2	1
Steam piping and blowers	9	..	11	9	..	9	18	1	19
Steam valves	6	..	6	11	..	12	17	..	17
Studs	7	..	8	7	..	7	9	..	11
Superheater tubes	..	..	..	1	..	2	4	..	6
Throttle glands	1	..	1	..	..	..	3	..	4
Throttle leaking	3	1	2	3	..	3	1	1	..
Throttle rigging	5	..	5	1	..	1	6	..	6
Trucks, leading, trailing, or tender	11	2	25	6	..	8	1	3	1
Valve gear, eccentrics, and rods	18	..	18	10	..	10	6	..	6
Water bars	..	..	..	..	..	..	..	..	..
Water glasses	19	..	19	25	..	25	32	..	32
Water-glass fittings	6	..	6	2	..	2	4	..	4
Wheels	8	1	7	4	1	4	2	1	4
Miscellaneous	61	..	61	91	2	117	87	2	86
Total	622	33	709	735	64	800	843	66	916

No formal appeal from the decision of any inspector was filed during the year, which again demonstrates that good judgment was exercised by them in the performance of their duties.

In closing the report the following recommendations, made last year, were repeated:

That the act of February 17, 1911, be amended to provide for additional inspectors and increased compensation, and to provide for a sufficient appropriation adequately to carry out the purpose of the law.

That all locomotives not using oil for fuel have mechanically operated fire doors so constructed that they may be operated by pressure of the foot on a pedal or other suitable device located on the floor of the cab or tender at a proper distance from the fire door and convenient for the fireman.

Derailments and Accidents Due to Defects in or Failure of Some Part of the Locomotive or Tender

	1922	1921	1920	1919	1918
Number of derailments*.........	22	8	7	7	2
Number killed	5	..	7	6	..
Number injured	61	30	18	7	2

*Only derailments reported by carriers as being caused by defect in or failure of parts of the locomotives or tender were investigated or counted in this tabulation.

That power-reversing gears be applied to all locomotives and that air-operated power-reversing gears have steam connections with the operating valves conveniently located in the locomotive cab, so arranged that in case of air failure steam may be quickly used to operate the reversing gears.

That a power grate shaker be applied to all coal-burning locomotives.

That all locomotives be provided with a bell so arranged and maintained that it may be operated from the engineer's cab by hand and by power.

That cabs of all locomotives not equipped with front door or windows of such size as to permit of easy exit have a suitable stirrup or other step and a horizontal handhold on each side approximately the full length of the cab, which will enable the enginemen to go from the cab to the running board in front of it, the distance between the step and handhold to be not less than 60 in. nor more than 72 in.

That all locomotives, where there is a difference between the readings of the gage cocks and water glass of two or more inches under any condition of service, be equipped with a suitable water column, to which shall be attached three gage cocks and one water glass, with not less than 6 in., preferably 8 in., clear reading, and one water glass with not less than 6 in., preferably 8 in., clear reading on the left side or back head of the boiler.

The Next Step in Locomotive Construction*

Present Steam Locomotive Needs to Make No Apologies—Suggestions As to Future Developments

By A. F. Stuebing

Managing Editor, *Railway Mechanical Engineer*

So much has been said about the shortcomings of the steam locomotives as built at present that it is difficult to discuss the radically different types of motive power that are now being proposed without taking sides in the controversy and presenting a partisan viewpoint. From past discussion it is evident that the opinion prevails in some quarters that no determined effort is being made, or ever has been made, to improve the locomotive and that almost any radical change in the construction would be an improvement. Engineers in other fields seem to have little appreciation of the merit of the underlying principles that have made the standard type of steam locomotive for so long a time the best machine available for railroad motive power. On the other hand, men who have always been accustomed to the steam locomotive show a disposition to defend it under all conditions. I shall not try to present an argument but rather state a few of the important facts on both sides of the case and attempt to point out the relative merits of the various types from the standpoint of their economic value for passenger and freight transportation.

The locomotives used for main line service all over the world for practically 90 years embody three distinctive features—reciprocating pistons direct-connected to the driving wheels, a multi-tubular boiler of the fire-tube type and an exhaust nozzle for creating draft. It was the combination of these three features by Stephenson in 1829 that made the Rocket a success. Many people seem to consider the fact that there has been no change in these fundamental principles of locomotive construction in nearly a hundred years as evidence that the machine is out of date. I believe that further investigation would prove that it was rather a case of the survival of the fittest, for the history of the locomotive shows that there have been many attempts to improve it by radical changes in construction. The best locomotive designers in the country have always been on the alert to improve locomotive construction. Furthermore, the locomotive has a popular appeal to almost everyone and engineers in other fields have brought out many devices for application to the locomotive, some of which have been found to have real merit.

A Survival of the Fittest

To show that the present design of steam locomotive is not the result of the blind following of earlier precedents, let me cite a few examples. A great deal of attention is now being given to the substitution of a fan or blower for the exhaust nozzle as a means of creating draft. Trevethick first used the exhaust steam to increase the draft in 1807. Stephenson made a more successful application in 1829 and only six years later the first front-end fan was tried by Seguin. In 1839 Ross Winans of the Baltimore & Ohio built a locomotive with forced draft under the grate. The fan was driven by the exhaust steam which then passed to a feed-water heater. You are all familiar with later attempts to apply the same principle, the most important of which were the experiments made on the Santa Fe about 1912. Now others are working on the problem so it is evident that the possibilities of mechanical draft have not been neglected. As soon as it can show a substantial saving, the railroads will be found ready to accept it.

If we turn to the cylinders, valves and valve gears, we find the situation very similar. Consistent attention has been given to improving the efficiency of these parts. In fact, in the development of high steam pressures, which is one of the important means of decreasing fuel consumption, locomotives led the way for stationary power plants. Compounding also was given a thorough trial, but most compounds were abandoned because the increased maintenance cost and lack of reliability offset the saving of fuel. When the Corliss valve gear was introduced, reducing the steam consumption of stationary engines, attempts were made to obtain the same benefit in locomotive valve motion but they were never successful because of the mechanical difficulties. If we turn to superheating, I believe we will find the modern locomotive represents the most advanced practice in the application of high superheat to reciprocating engines. The present tendency in engines for stationary service is toward the use of uniflow cylinders. These were applied on locomotives in this country many years ago and more modern designs are now in use in Great Britain and on the continent of Europe.

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*From a paper entitled "Are We Due for a Radical Change in Locomotive Construction?" which was read at the January, 1923, meeting of the New York Railroad Club.

As long as the reciprocating steam engine was the only type of prime mover, the locomotive was always well up in the front rank of progress and it is only since the introduction of the steam turbine and the internal combustion engine that the efficiency of stationary power plants has shown any marked improvement over the locomotive. For years, engineers have studied the turbo-locomotive but until recently no one has been able to prepare a design that was suitable for railroad work. Nor has the internal combustion locomotive been neglected. Dr. Rudolph Diesel, the inventor of the Diesel engine and a very able engineer, tried to apply his internal combustion engine to a locomotive, but finally gave up because he found the problem so extremely complex and difficult. Many other examples could be cited of unsuccessful attempts to get away from the basic features of the steam locomotive but I believe those already mentioned are sufficient to indicate that the locomotive in its present form has survived because it has certain merits.

Fundamental Requirements

Perhaps the comments which I have already made sound like the conventional defense of the steam locomotive, but that is not my intention in presenting them. I merely want to give a historical background to show that some very able men have devoted their energies to designing substitutes for the steam locomotive without success. It is absolutely necessary to bear in mind that any new type of motive power, if it is to be a success, must be adapted to the existing railroad facilities. This means that it must haul a train load approximating that of the steam locomotive and make equal or greater speed. If the number of trains were to be increased to any considerable extent or the speed reduced by new motive power, the capacity of the lines would be reduced so that it would be necessary to provide additional track and larger terminals. This would involve an enormous capital expenditure which could not be justified by any conceivable increase in locomotive efficiency.

Any new type of motive power should be economical in the use of fuel, as simple and sturdy as possible, and what is perhaps most important, it must be reliable. One of the weaknesses and also one of the important advantages of the steam locomotive is the fact that there are very few defects that make it entirely inoperative. It may have leaks and pounds but it will usually bring the train in somehow. Very often this leads to neglect of maintenance which lowers the efficiency of the machine but under such conditions as existed during the strike this high degree of reliability is an invaluable asset, and it is a characteristic that is not found in other types of prime movers.

Fuel Economy and Locomotive Efficiency Not Synonymous

One of the common mistakes made by the critics of the steam locomotive is to consider that fuel economy and locomotive efficiency are synonymous. The locomotive must be considered as a transportation machine. From that viewpoint there are many factors besides fuel economy that determine whether it is economical or not. In 1921 the railroads spent $523,000,000 for locomotive fuel, but they also spent $529,000,000 for wages of engine and train crews and $448,000,000 for repairs to steam locomotives. Fixed charges on the investment in locomotives is also very important but is sometimes not given proper consideration because it is not listed in the operating expenses. These are only the major items which are directly affected by the locomotive. Many others are affected indirectly. It is evident that if a new type of motive power reduces the cost of fuel but at the same time causes a greater increase in the expenditures for crew's wages, repairs, fixed charges, etc., it is not an economical transportation machine regardless of its economy from the thermo-dynamic or mechanical standpoint.

Taking into consideration all the factors mentioned above, where can we look for a successor for the steam locomotive? Much, of course, will depend on changes in prices. If the relative cost of fuel becomes much higher, this will operate to the advantage of the types of motive power that are more efficiency from the fuel standpoint. If interest rates become very low the railroads may be justified in using equipment that involves a greater initial investment. However, in the present discussion changes in these relationships will be disregarded because it is impossible to predict how future conditions will affect them.

The Turbine Locomotive

There is no question but what we are justified in accepting the electric locomotive as a satisfactory substitute for the steam machine under certain special conditions. Universal electrification, however, seems to be a long way in the future and there is certain to be a big field for other types of motive power, namely, turbine and internal combustion locomotives, provided they can make good under railroad conditions.

Within the past three years, great progress has been made in the development of the turbine locomotive. Two fairly high-powered units have been built and a third is now under construction. It may be well to consider briefly some of the features of these turbine locomotives to see whether they conform to the requirements already laid down for an efficient transportation machine.

The first high-power turbine locomotive was that constructed by the Swiss Locomotive Works. It is a 10-wheel locomotive converted from the standard type which, of course, imposed many limitations on the design. Nevertheless, it is stated that on its trial trip the locomotive showed a fuel economy of 25 per cent as compared with a compound steam locomotive in similar service. The engine has not been free from mechanical difficulties and up to the present time the builders have not given out a complete description. It is understood, however, that the fan draft did not operate satisfactorily and certain parts of the machinery have failed.

Shortly after the Swiss turbine locomotive was built the Ljungstrom Turbine Company in Sweden finished a quite different design. The engineers of this company are recognized as among the foremost turbine designers and from the engineering and mechanical standpoint the locomotive leaves little to be desired. It has a thermal efficiency of 14.7 per cent, which would be considered a good performance for a large modern power house. In actual service on the Swedish State Railways, it saved 52 per cent of fuel compared with modern superheated reciprocating locomotives.

From the standpoint of capacity the locomotive does not show up so favorably, as it develops only 1,800 h.p. The designers state that machines with a capacity up to 6,000 h.p. could be produced, but I am inclined to doubt whether a condenser of the required size to give the proper vacuum under all temperature conditions could be built within practical limits of weight and size. The most serious handicap to the introduction of the turbine seems to be the mechanical complications which it involves. There are a great number of connections to be kept tight and the entire mechanism is much more delicate than that of the reciprocating steam engine. This would tend to increase the difficulty of maintenance and reduce the proportion of the time which the locomotive would spend in actual service. The first cost of the turbine locomotive would be about three times that of the steam locomotive of equivalent power and its useful life is indeterminate so the fixed charges would probably be heavy.

I do not want to take the position of condemning the turbine locomotive for I feel very strongly that we should make a thorough test of all promising innovations and try in every way to utilize the meritorious features. I do believe, however, that in the present state of the art the turbine locomotive is hardly a practical unit for use on American railways and if it is to take an important place in future motive power it must be made more rugged and more simple.

An interesting modification of the geared turbine locomotive is the Ramsay turbo-electric locomotive recently placed in service in Great Britain. In this locomotive the turbine is connected direct to an electric generator, which, in turn, drives the motors on the axles. The electric transmission, of course, increases the cost and weight per unit of power very greatly and would limit the maximum output that could be obtained with locomotives of a given weight. Furthermore, the transmission would probably have a lower over-all efficiency than gear transmission. On the whole, it seems doubtful whether the additional complication over a geared turbine locomotive would be justified.

Diesel Locomotives

This leads us to the consideration of the application of the Diesel engine to locomotive service. It is a very attractive proposition because the Diesel engine has the highest thermodynamic efficiency of any prime mover developed up to this time. Its fuel consumption per horsepower is about one-fourth that of a modern superheated locomotive and because of the fact that there would be practically no standby losses the Diesel locomotive should use not more than one-sixth as much fuel as a steam locomotive. It also offers attractive possibilities of eliminating water and fuel stops and ash pit expenses and reducing the cost of hauling company coal and other fuel.

The two big problems in the application of the Diesel engine to locomotives are first to obtain a reasonable weight per unit of power and second to develop a practical method of starting the train. The Diesel engine, like the gas engine, will not start itself and will not deliver high torque at slow speeds.

The Diesel engine is similar to the gasoline engine except that the fuel is not ignited by a spark. The compression in the cylinders is carried up to about 500 lb. per sq. in. and the heat generated by compression is so high that when the heavy fuel oil is sprayed in under pressure, it immediately takes fire. The engine is usually started by compressed air from storage tanks which is admitted to some of the cylinders of the engine by a special valve arrangement. The individual units as built at present, range from 20 to 3,000 h.p.

The ordinary Diesel engine is heavy, some designs weighing as much as 450 lb. per horsepower, but special types have been built which are very much lighter. For instance the six-cylinder Diesel engine for the German submarines weighed only 57 lb. per horsepower. The 1,000 horsepower unit was 9 ft. high, about 4 ft. wide and 20 ft. long. If this Diesel engine was to be applied to a locomotive it would take up practically the entire space above the frames up to the limit of the vertical clearance. It would take three such engines to develop as much power as the locomotives that haul the Twentieth Century or the Broadway Limited.

I think we can pass over the problem of reducing the weight per horsepower of the Diesel as that seems to be practically solved at the present time, although the light-weight Diesels are more highly refined than the commercial types, and their cost is considerably greater. I do not think that is a very great obstacle, however. Assuming that it does not hinder the application, we still have the problem of making the Diesel engine develop power when the train is starting or running at low speed.

There are several means by which that can be effected. One is electric transmission, another is hydraulic transmission. Then we have also the possibility of auxiliary air to keep the engine running until the train is under way, and, last, the steam auxiliary.

The electric transmission is heavy and adds greatly to the cost of the unit. The hyradulic transmission is fairly efficient—it is light, but it is expensive, and all the designs that I have seen are difficult to build in large units. The air auxiliary has limited capacity. It is the system that was used on some Diesel locomotives built in Germany. A very large air tank was provided and not only furnished the air necessary to turn the engine over when starting it, but it also furnished power until the train had obtained such a speed that the Diesel engine was within its operative speed range. The lowest running speed as a rule is about one-tenth the maximum, so that an engine rated at 450 revolutions per minute would have a minimum speed of about 45 revolutions. This means, for example, that the Diesel engine if direct-connected could operate at train speeds from 4 to 40 miles an hour.

The steam auxiliary or the so-called Still Diesel engine is the latest development. In the Still engine the heat from the water jackets which surround the cylinders, and usually the exhaust as well, is utilized to generate steam in an auxiliary boiler. It would probably be necessary in locomotive service to supply considerable fuel to the auxiliary boiler, but it would offer the advantage of making steam available to act on the lower side of the pistons, so that the engine could be started and kept running for some time from this source of power. After the train was under way, it could be thrown over to operate as an ordinary Diesel engine.

Engineers are working very hard on the application of these various systems to the Diesel locomotive and there will probably be rapid progress in the development of improved designs.

The Diesel locomotive could effect remarkable savings in fuel and could be built in large units so that it should not increase the unit cost of crew's wages. The first cost would be high but this should be offset by the elimination of delays at ash pits and water stations. It is not unlikely that within the next few years a sturdy reliable Diesel locomotive will be developed which will be a worthy competitor of the steam locomotive.

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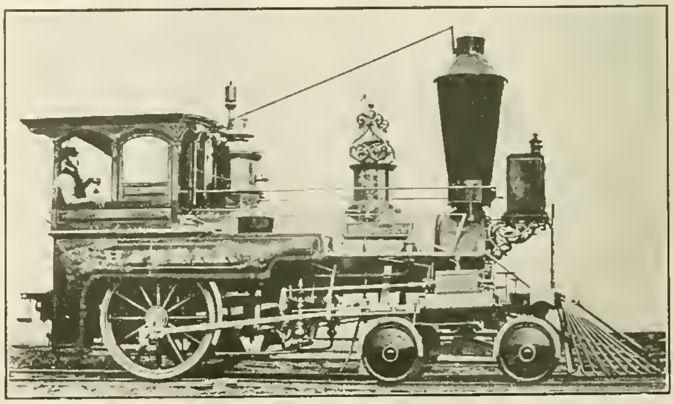
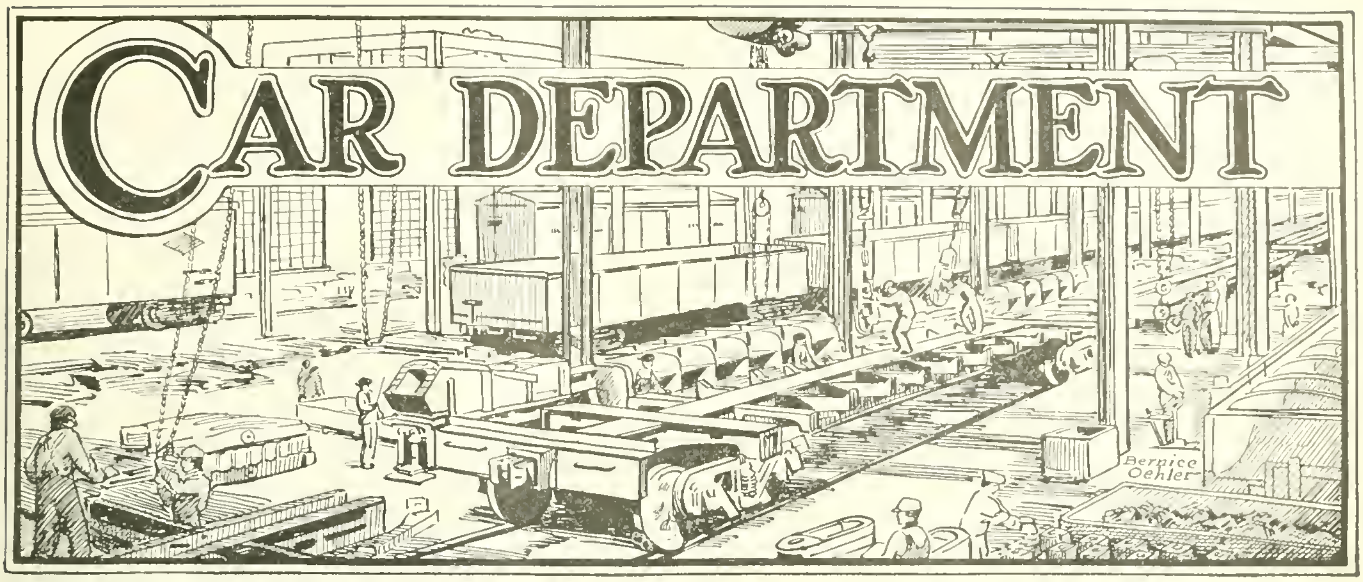


Courtesy, Railway & Locomotive Historical Society

Hackensack & New York Railroad, 1860

This road is now a part of the New Jersey & New York, operated by the Erie. Locomotive built by Rogers Locomotive Works, Paterson, N. J.



Scrapping Steel Cars by Means of the Carbon Arc

Electric Cutting Process Proves an Economical Method for Reducing Scrap to Sizes That Can Be Cut by Shears

By E. H. Dralle
Westinghouse Electric & Manufacturing Company

THE electric arc has for some time been recognized as a most potent agent for the fabrication and production of mild steel structures, and as perhaps the most economical means obtainable for the repair of worn or broken steel members, especially where they are of appreciable thickness or volume; but as a means for reducing scrap material to convenient sizes for remelting, the value of the carbon arc has been only recently appreciated.

Perhaps the railroads, always among the first to exploit new welding developments and to experiment with new suggestions involving electric arc processes, stand to profit most by the widespread use of the electric arc as a means for scrapping steel coal and coke cars. In the past, it was a common practice among many railroads to turn worn-out cars over to wrecking companies for dismantling, but the possibility of using the carbon arc advantageously for this service is resulting in the discontinuance of this practice and the adoption of a plan whereby all wrecking of cars will be done within the railroad shops. This condition will, without a doubt, result in a saving of time and expense.

Various Methods of Dismantling

Assuming that the car wrecking is done within the railroad shops, the problem demands considerable study to determine the best method of dismantling; that is, there must be a choice among:

(1) Cutting the heads off the rivets, and dismantling in the reverse order of assembling.

(2) Reducing the cars to suitable scrap sizes, entirely by cutting with the carbon arc.

(3) Reducing to sizes suitable for handling by four men, and finishing the scrapping by means of a large shear or shears, whichever is required to meet conditions.

These methods will be considered in order without regard to any peculiar local conditions existing to influence the adoption of any particular method.

Selecting the Most Economical Method

It is probable that scrapping by cutting the heads off the rivets would be found desirable where parts of the car could be salvaged for use in the repair of other cars. In fact, it is in this service where rivet cutting is most widely applied. It is doubtful, however, if this would prove a profitable scheme of scrapping cars, even though employed to a great extent by wrecking companies.

To work entirely satisfactorily, all rivets that are to be cut should be in a plane closely approaching the vertical, so as to allow the molten metal a ready means of escape. Attempting to cut the heads off rivets in a horizontal plane will result in actually welding the plates to the rivets unless means are employed to force the metal from its position as rapidly as it is melted, as for example by using a strong current of compressed air. Such a procedure would be cumbersome in manipulation, and for this reason, objectionable. However, in vertical planes, this method of dismantling would compare favorably with straight cutting.

Time Required for Cutting Rivets

On an average coal car, there are approximately 1,400 rivets above the main frame of the car. With ⅞ in. diameter rivets, and a current value of 800 amperes, it has been demonstrated that an average of 8 seconds actual cutting time is required per rivet. Obviously, then, the cutting time for a complete car would be 1,400 times 8, or slightly more than three hours. The discomfort caused by the use of these heavy current values makes it impossible for an operator to work continuously. This fact, coupled with the time consumed in moving from place to place will result in a working factor of perhaps 80 per cent, so that the cutting time is raised to 3 ÷ 0.80, or 3¾ hours.

After the cutting is completed, one man with an air hammer; or two men, one with punch and the other with a heavy hammer, must force out the stub ends of the rivets to complete the dismantling. This operation would require the greater portion of 1¼ hours, so that the time to dismantle a car down to the main framework is practically five hours.

The cost of scrapping a car by this method would be divided as follows:

Labor at 60 cents per hour—6¼ hours (5 hours for arc operator and 1¼ hours for helper to remove rivets)	$3.75
Power at 2 cents per kw. hr. (3 hours using 48 kw.-800 amp., 60 volts, from general efficiency of machine, 70 per cent)	4.20
Total cost, not including maintenance, interest on capital invested and depreciation of machine	$7.95

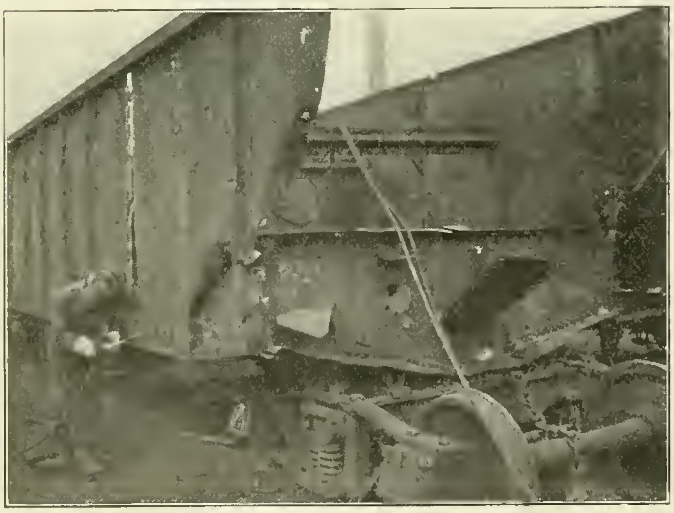
Adding to the above figure the cost for reducing the main framework of the car, would give a direct cost of about $15 for scrapping one car. The operating rates are not sufficiently fast to permit of one cutter scrapping two cars per day. To be practical, this schedule of two cars per day per cutter should be obtainable.

As pointed out, the above method is applicable where it is desired to salvage parts for rebuilding into other cars. Where cars are in such bad condition as not to warrant the saving of parts, best results are obtainable by using the straight cutting method to reduce to sizes suitable for handling by four men, especially since the cost of dismantling will be less than $10 per car as compared to $15 for the rivet cutting method.

To arrive at a figure upon which to base a cost for scrapping cars, a test, as will later be described, was conducted, and an accurate record kept of all results. The car was a standard coke car, having solid metal bottom, ends and half sides, the upper halves of the sides being of expanded metal.

Scrapping by Cutting Through Sheets and Frame

Starting at one of the four upper corners, immediately below the top supporting angle—this being left intact to make sure that the side would not fall out until the desired time—the cut was made down the corner to the floor of the car, thence along the entire length of the side, directly above the floor, and up to the other corner. The top angle-iron supports were then cut at the corners, and the side allowed to drop down. The time consumed was 51 minutes, and the distance cut was 43½ ft. The original thickness of material was ¼ in. sheet, but paint and rust in some places made the equivalent thickness in terms of clean iron sheets greater than ¼ in. On the other hand, corrosion was so effective as to reduce the equivalent thickness below ¼ in. in many places. One-fourth inch, however, can be taken as an average value for the thickness of material cut. It should be remembered that on account of the paint and scale on this iron, cutting conditions are entirely different from those experienced with cutting clean iron sheets.



Operator Cutting Through the Sides of a Car; the Cut Will Be Continued Straight Across the Bottom and Up the Opposite Side to Remove the End of the Car

As soon as the car side was dropped to the ground, it was cut up into three equal pieces by making two cuts along lines parallel to, and equidistant from the ends. Each cut was through 2½ ft. of ¼ in. solid material, requiring two minutes cutting time, and 3 ft. of expanded metal requiring 30 seconds cutting time.

A similar procedure was used on the second side of the car, which was cut into the same number of pieces as the first side.

At each end of the car the car bottom sloped at an angle of approximately 45 deg. from the frame to within 3 ft. of the top of the car. The length of this sloping sheet is approximately 6½ ft. After cutting out both sides of the car, cuts were made across the car along the line described by the intersection of the sloping bottom sheets and the bottom of the car. This cutting, too, was through material ¼ in. in thickness. The length of cut was 9 ft. on each end, and the time of cutting seven minutes.

Center Sill Cut Through After Side Sheets and Side Frame Have Been Removed

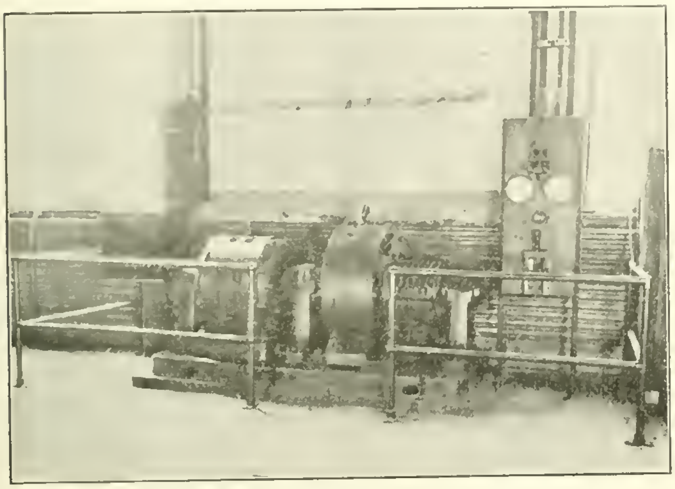
After cutting the ends as above described, it remained to cut four upright, 3 in. by 3 in. angles, and one 2 in. by 2 in. angle, all ¼ in. thick, directly above the car frame, to allow the ends to fall to the ground. The time required for this operation was seven minutes on one end, and four minutes on the other, the difference in the two times being due to the brake mechanism which had to be cut on the end requiring the greater time.

With the operations thus far, the car had been cut into eight pieces, three pieces on each side, and each end constituting one piece. To further facilitate handling, a cut was made the entire length of the car, parallel and adjacent to the center sill, and then two cuts were made across the bottom, directly back of each bolster. The lengthwise cut, 20 ft. long, required 40 minutes, and the cross cuts, each in effect being equivalent to 12 ft. of cutting, required 20 minutes each, or a total of 40 minutes. The greater portion of this time in making the crosswise cuts on the bottom was consumed in making the cuts through the center sill. The vertical members of the center sill together with the side frames, which approximated almost one foot in depth, account for the 12 ft. of cutting across the bottom of the car, which is only 9 ft. wide. In making the lengthwise cut, it was also necessary to cut through two heavy channel door supports.

With the operations as described for cutting up the main frame and bottom of the car, it will be seen that the total number of pieces into which the car was cut was 14. Of course the whole truck on each end remained intact, but the cutting was done in such a way that the framework could be entirely removed from the trucks.

The object in cutting the material to sizes suitable for handling by four men, is in keeping with the scheme to have a large shear or shears to which these larger parts will be carried by the men for cutting up into pieces suitable for remelting.

It is possible for four men to handle the side and end pieces as cut, but on account of the heavy framework and material in the bottom of the cars, additional cuts are necessitated to facilitate handling. It will be found advantageous and economical to reduce these heavy parts to suitable sizes for remelting, without transporting them to the shears. The cutting could be done completely by the carbon arc.



Motor-Generator Set of 1,000 Amperes Capacity Used for Arc Welding and Cutting

To more clearly show the cuts which were made on the car, the number of feet for each cut, and the total time for cutting, Table I has been prepared.

Table I—Details of Cutting With Carbon Arc in Scrapping Steel Car Body

Location of cut	Material cut	Length of cut, feet	Number of cuts	Time per cut, min.	Total feet cut	Total time, min.
Lengthwise—side	¼ in. sheet......	43.5	2	51	87	102
Crosswise cuts on side sheets	¼ in. sheet	2.5	4	2	10	8
	exp. metal	3	4	½	12	2
Ends at intersection of bottom and sloping bottom sheets	¼ in. sheet......	9	2	7	18	14
*Upright angles on each end	5—3 in. by 3 in. by ¼ in. angle.	½	11	1	6	11
Cross cuts on bottom....	¼ in. sheet and channels	12	2	20	24	40
Lengthwise cut on bottom.	¼ in. sheets and angles	20	1	40	20	40
Total					177	217

*For purposes of calculation, the angles on each end were taken as 3 in. by 3 in., and five counted on each end. One end had the brake mechanism mounted on it, which required practically three minutes' time to cut, making seven minutes' cutting time on one end, and four minutes on the other.

From the above table, the following costs were obtained:

Total number of feet cut (equivalent of ¼ in. sheet)..............	177 ft.
Actual cutting time in hours..............................	3.61
Kw. hours consumed (850 amp., 60 V., M. G. set eff. 80 per cent 64 kw. for 3.6 hours)................................	230
Cost of labor at 60 cents per hour.	$2.16
*Cost of power—2 cents per kw. hour.........................	4.60
Total	$6.76

*Two cents per kw. hour for power is only a basic figure. This should be much smaller if power is bought in large quantities, or if the customer generates his own power.

Assuming that the operator's time is eight hours per car instead of less than four, as shown for the actual cutting time, the cost per car will still be less than $10, because only the item of the operator's time changes, the actual cutting time being the same whether the operator spends a full day on the car or a half day. To be perfectly exact, the power bill will slightly increase, because the losses of the set go on as long as the set is running.

To have one man (cutter) completely wreck a car for cutting into sizes suitable for remelting, would result in greater expense, since a shear can reduce the smaller pieces at a more rapid rate than can be done with the arc, and the four men employed to carry material to and from the shears could be utilized by several cutters. Some few men would necessarily be employed for loading the scrap, and a few additional could be used to advantage to assist in carrying material to and from the shears.

The cost of shears, interest on investment, and depreciation of the machinery must also be considered in this connection, but unquestionably these items can be more than favorably balanced against the extra cost of operators and machines to supply them in order to do equal amounts of work per day.

Any one of the proposed methods of scrapping cars with the carbon arc will result in a great saving over the cost to do the same work with the acetylene torch. Paint, scale, and oxides which give way rapidly under the intense heat of an electric arc, are obstacles of no small importance when cutting with the acetylene. Furthermore, the cost of gas is one of the greatest items of expense, inasmuch as the torch is usually allowed to burn regardless of whether cutting is being done or not. With the electric arc, power consumption ceases when the operator fails to maintain an arc.

Aside from the cost of doing the work with gas, the inconvenience of hauling tanks, both empty and filled, to and from supply points, makes the electric arc (where power is always at the operator's command) stand out by far the more favorable of the two processes.

Equipment Required for Electric Cutting

The electric equipment required for supplying power to the carbon arc consists simply of a motor-generator set and the necessary moto-generator control and cutting panel. A desirable form of machine is shown in the illustration. The set comprises a suitable motor, either A. C. or D. C., driving a low voltage compound wound D. C. generator. The generator is controlled entirely by a panel mounting a circuit breaker, ammeter, volt meter, and knife switch, as shown.

In addition to the above equipment, there are required only a suitable mask, electrodes and holders, and a cutting resistor for each operator.

The cutting resistance is comprised of four frames of resistance mounted in an angle iron framework, having overall dimensions approximately 48 in. long, 35 in. wide, and 17 in. high. This complete unit is mounted on a trolley which allows the resistor to be moved along the car as cutting progresses. This feature eliminates a long electrode holder cable. The entire carriage can be easily moved along the trolley track by simply pulling on the properly secured electrode holder cable. On the front of the resistor unit is mounted a slate, 15 in. by 13 in. by 1 in. thick, having mounted on it two 200-ampere, single-pole, single-throw knife switches. These knife switches control resistance steps of such value that current values of 400, 600 and 800 amperes may be obtained for cutting service. The 400 ampere resistance step is permanently in the circuit, and each of the knife switches controls one 200 ampere step.

Plant layout is an important feature in the successful use of the arc process for scrapping steel cars, and while local conditions will largely determine the nature of each installation, experience has shown that best results are obtainable with a layout such as described in the following paragraphs.

It is preferable to have a separate building for this cutting service. The building should be divided into booths, accommodating one car each, and should be so designed that the motor-generator set, or sets, supplying power will be centrally located with respect to the arc cutters, power for which will be conducted along an overhead trolley. On this trolley, mounted on a carriage as described above, is the cutting control resistor with cable and electrode holder attached. The power for all operators is conducted through the trolley circuit, but each operator has his own cutting resistance, and can use any current value suitable for the work which he is doing. This arrangement of the power circuit positively insures non-interference among operators, regardless of how many are operating from the circuit. By having the resistance on a movable trolley directly above the operator, maximum cutting rates are obtained, since the movement of cables and holders to the most inaccessible positions on the car, is accomplished with minimum time and effort.

The object in having separate booths for each car is to protect operators from injurious reflected rays, and often, perhaps, direct rays from adjacent arcs. As a safety precaution, it is desirable to have only one operator per car, although with a properly outlined system of dismantling, it would be entirely possible to use two operators per car.

While the work done thus far on dismantling cars by the carbon arc process has shown that this method is decidedly superior to other methods of scrapping, it is entirely possible that a more widespread use of this process will result in new and improved means for wrecking cars, which will still further decrease the already low cost of dismantling by the arc process.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

What Constitutes Collision Under Rule 32

Nashville, Chattanooga & St Louis empty box car No. 4217 had six wood sills and several other parts broken in a Detroit, Toledo & Ironton train on May 23, 1921. The train, which was made up of about 75 cars, broke in two about 15 cars from the head end and the damage to car No. 4217 occurred when the rear end of the train ran into the head end following the automatic application of the brakes. Neither this car nor any other cars in the train at the time were derailed, cornered or side-swiped. Joint inspection disclosed that the six broken longitudinal sills were decayed, as was also the body bolster and end sill, which were broken at the same time. The handling line maintains that the damage was the direct result of the weakened condition of the car, citing case No. 1165 as parallel, and that the settlement should be handled under Rule 120. The car owner maintained that the case comes under item (d), Rule 32, which exempts from owner's responsibility damage caused by collision. Case 1179 was cited as parallel, except that in that case the car was subjected to derailment, while Nashville, Chattanooga & St. Louis car No. 4217 was involved in a collision. The owner maintained that the settlement should be made under the provisions of Rule 112.

The decision of the Arbitration Committee states that: "There is no evidence of the car having been subjected to any of the unfair conditions referred to in Rule 32. The car owner is responsible."—*Case No.* 1241, *Detroit, Toledo & Ironton vs. Nashville, Chattanooga & St. Louis.*

Break-in-Two Not Evidence of Handling Line Responsibility Under Rule 32

On December 20, 1920, Pence automobile car No. 595 was broken in two while being moved by the Chicago, St. Paul, Minneapolis & Omaha in a train consisting of 9 loaded and 45 empty cars. While the train was moving at a speed claimed to be about four miles an hour, with one engine at the head end and one engine at the rear end, a coupler knuckle slipped by on the second car from the head engine. The resulting emergency application of the brakes caused the Pence car, which was the fifth forward from the rear end, to break in two. The handling line set forth that the car was an old gondola from which the sides and ends had been removed, that it was not equipped with inverted truss rods and therefore had only the strength of the wood sills, in a generally weakened condition, to prevent breaking upward under impact. The owner was notified, as provided in Rule 43, as to the circumstances surrounding the failure, and on February 22, 1921, authorized the handling line to make repairs and render bill for the expense. After the bill was rendered the owner refused payment, claiming that the handling line was responsible under Rule 32 and protesting that the car was not worth what had been charged for repairs. This company maintained that had there been no pusher engine at the rear end of the train, the accident would not have occurred. The handling line contended that the cause of the accident was not one of those specified under Rule 32, for which the handling line is responsible, and that in making and billing for these repairs it had fully complied with the rules.

In sustaining the bill of the railroad company against the car owner, the Arbitration Committee stated: "Car was not damaged under any of the conditions enumerated in Rule 32. Rule 43 was complied with in obtaining owner's authority before repairs were made."—*Case No.* 1243, *Pence Automobile Company vs. Chicago, St. Paul, Minneapolis & Omaha.*

Do Unit Charges for Bolt Renewals in Passenger Rule 21 Include Jacking?

In rendering bills for the replacement of broken or missing draft bolts on Northern Pacific passenger cars, which required that the car be raised, the Southern Pacific charged for the actual time required to complete the operation. The Northern Pacific took exception to this practice, citing specifically Southern Pacific's bill No. 574108 for such repairs made during October, 1920. The exception was taken on the ground that item (7) of passenger Rule 21 (for bolts over six inches in length) covers this work and that the charge of 0.4 hours specified in Supplement No. 3 of the 1919 code, which was effective at the time, is ample allowance to cover all labor necessary to apply them, including jacking up the car. The Southern Pacific contended that items (6) and (7) of passenger Rule 21 do not cover renewal of any bolts which require jacking of the car but refers solely to bolts which may be applied in the ordinary course of repair work without the necessity of jacking the car or other preparation. In support of this view the Southern Pacific called attention to the fact that under the freight car rules the labor charge for jacking alone is 1.5 hours. For these reasons the Southern Pacific maintained that the note following item (26) of passenger Rule 21, Supplement No. 3, applies in this case.

The Arbitration Committee decided as follows: "The labor charges in question are not excessive. Objection of the Northern Pacific is not sustained."—*Case No.* 1242, *Northern Pacific vs. Southern Pacific.*

Present Day Tendencies in Car Construction[*]

Recent Improvements in Design; Need of Rust-Resisting Steel, Improved Insulation and Painting

By E. R. Viberg
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THE title of this paper would lead one to believe that today's tendencies in car construction differ to a great extent from construction in the past, but this is not the case. Those in charge of designing and building equipment in the early days of railroading had the same object in view as prevails today, namely, to improve and strengthen the rolling stock to meet the ever-increasing demand from the transportation department for stronger and heavier capacity cars, and at the same time having in mind a reduction in dead weight in proportion to the revenue load.

In order to form some idea regarding this important subject and the difficulties encountered, it may be interesting to first review the early history of the car-building industry.

Development of Passenger Cars

There was little difference in appearance between the early passenger car and the freight caboose. Some attempts at ornamentation were made, but these were modest, consisting simply of ornamental paintings, scenes from life more or less artistically executed, and very simple arrangements for comfort.

Candle light was provided for night travelers, and in cold weather a stove in the corner of the car furnished the heat which travelers had been accustomed to draw from each other, or in a small degree, from the straw with which the car floor had been covered.

As travel increased and the necessity for better accommodation became apparent, the car was lengthened and its height increased, ventilation was improved and sanitary conveniences added.

A great step forward was taken when provision was made for sleeping in a recumbent posture. A night car with rude sleeping berths such as used on steamboats, but not furnished with bedding, was the first form of sleeping car which surprised and delighted the public. This car was introduced on the Cumberland Valley in Pennsylvania in 1836, and in November, 1838, the Philadelphia, Wilmington and Baltimore put on a similar car.

In 1854 sleeping cars having the same general features as those now in use were introduced. These cars provided seats for about 60 passengers, and at night these seats were converted into flat berths. The inventor was Theodor T. Woodruff. The license to build and operate these cars was later acquired by Webster Wagner.

Pullman sleeping cars were introduced in 1864 and 1865. In 1867 a hotel car, the first in use, was built by him for the Great Western of Canada, which road in August, 1882, was absorbed by the Grand Trunk. In 1868 Wagner built the first two drawing-room cars ever run for pay.

For supplying heat, improvement in processes to the number of several hundred have been patented. Heating by salt water circulation once displaced the use of stoves but afterwards steam heating was substituted, and most cars constructed today are equipped with a heating system which takes steam from the locomotive.

In lighting, several forms of compressed gas have been substituted for candles and oil lamps. All cars now built are generally equipped with electric lighting.

Freight Car Development

The introduction of steel rails led to the construction of heavier freight cars, for it was soon found that such rails would bear heavier loads without danger. By increasing the dead weight of the car from say 18,000 lb. to 21,000 lb. its carrying capacity was increased from 20,000 lb. to 30,000 lb., etc. The carrying capacity can be increased faster than the dead weight of the car, and thus the paying weight constitutes a larger percentage of the total load hauled.

The construction of wooden cars of a greater capacity than 70,000 or 80,000 lb. not being practical because the increase in size and weight of parts would increase unduly the dead weight and decrease the revenue load, together with the increased cost and scarcity of suitable lumber, steel freight cars were introduced in 1897.

The following table of averages shows the relative increase since 1876 in dead weight of cars and revenue load:

Year		Dead wt. of car	Wt. of rev. load	Total wt. loaded	Wt. of car, percentage of total	Rev. load, percentage of total
1876	....	20,500 lb.	20,000 lb.	40,500 lb.	50.60	49.40
1882	....	24,000 lb.	40,000 lb.	64,000 lb.	37.50	62.50
1889	....	27,700 lb.	60,000 lb.	87,700 lb.	31.60	68.40
1895	....	36,000 lb.	80,000 lb.	116,000 lb.	31.04	68.96
1920	....	48,300 lb.	120,700 lb.	169,000 lb.	28.53	71.47
1921	....	78,900 lb.	236,100 lb.	315,000 lb.	25.04	74.96

This table is interesting, as, while it shows 285 per cent increase in dead weight of present day equipment over the earlier type, it shows also that the earning capacity has been increased by 1080 per cent over the old and small car used in the early days of railroading, illustrating the great strides made in car construction since 1876.

Improved Passenger Car Construction

In a general way today's tendencies in car construction consist mostly in improvement of present designs and may be summed up as follows:—

1st. To improve the present construction.
2nd. To eliminate parts.
3rd. To lighten equipment.
4th. To reduce friction.
5th. To use commercial run of steel.
6th. To use rust resisting material.
7th. To improve insulation.
8th. Standardization of component parts.
9th. To preserve the equipment by improved painting.

Among these I shall deal with the various branches of construction and details.

The principal efforts of builders in conjunction with various railroad officials have been to improve underframe and draft gear conditions and details in connection with protection and safety of passengers, with greater comforts for travelers. One detail, however, until recently did not receive the attention it should; this important part is the coupler. During the development of car bodies and trucks, various parts were strengthened and heavy capacity friction draft gear and buffer applied, but the coupler remained much the same, with the result that coupler failures were frequent. The 5 in. by 5 in. long shank coupler with the old type head, used for so many years for passenger cars, will soon be obsolete, however, as cars now built are all equipped with class "D" A.R.A. standard couplers, with shank of proportionate strength to the head.

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[*] From a paper presented before the Canadian Railway Club, December 12, 1922.

The adoption of this coupler, and increase of the present inadequate coupler side clearance, has made it necessary to arrange for the air, signal and steam pipes to oscillate with the coupler to prevent tearing of hose connections. This may be accomplished by a special design of combination coupler and pipe carrier, or simply a separate pipe carrier which will work with the coupler and maintain a fixed relation between coupler shank and pipe connections.

As wood body construction for passenger cars has disappeared, so also the composite wood passenger trucks have become obsolete and are being replaced by cast-steel trucks. These trucks eliminate about 50 per cent of the parts necessary for the wood trucks and afford better facilities for application of clasp brakes, the tendency now being to equip all passenger trucks, both four and six-wheel, with this type of brake rigging.

Present tendencies indicate that not only center sills and draft gear are being given due consideration, but all parts entering into construction of cars are carefully analyzed for strength consistent with dead weight. Furthermore, making all parts possible interchangeable eliminates a great number of otherwise necessary parts, and results in effective and economical construction.

Platforms have been strengthened to prevent telescoping, and the old built-up construction with its multiplicity of parts, more or less discarded for the one-piece cast-steel buffer casting, to which center sills and other members are joined. These castings are generally so designed that all attachments such as safety chains, buffer and draft gear, can be readily applied and easily detached in case of repairs.

Underframes of various types have been used, but the majority of cars now built are equipped with fish-belly type center sills. Care must be exercised in designing center sills, keeping the resultant line of force due to draft gear and buffer end shocks located on the center line of gravity of section, or below if possible, so that combined working stresses in compression and tension members will not exceed the elastic limit of the material. This can readily be accomplished with center sills of rolled channel sections; that is, center sills having a uniform depth throughout, but this type is not extensively used on account of its weight and deflection except for short cars. Fish-belly type center sills seem to be preferable for all cars of extreme length, and with this type the features mentioned above must be carefully analyzed and provided for by the proper distribution of the various sections.

The superstructure has been changed considerably in recent years. One of the most radical departures was the elimination of outside and inside gothic sashes, vestibule end windows and upper deck sashes. The elimination of gothic sashes effected economy in construction and incidentally removed numerous places for air leakage and draught, also facilitating a more sanitary construction as it was impossible to keep the art glass clean. The upper sashes were replaced by exhaust ventilators, with an improvement in ventilation and economy in construction, as well as improving the appearance of the interior of the car.

Attempts have lately been made to eliminate as many pressed steel parts as consistent with economy, and some designs have been prepared having rolled angles for side posts, instead of pressed steel shapes. This is an advantage as it overcomes to a great extent variation in the structure which it is impossible to eliminate entirely when using pressed steel parts. The angle post also affords better facilities for attaching furrings for the inside finish, if wood is used, and most cars built in this country on account of climatic conditions are so fitted.

Some years ago a law was passed compelling railroads to equip all cars for interchange with automatic couplers, this primarily to prevent accidents when coupling cars. Little progress has been made, however, towards also automatically coupling the air and steam connections. Many devices have been tried but have not given entire satisfaction; but developments are still progressing, and I believe railways would be justified in applying some devices now on the market, which, while not perfect, would be a great aid in speeding the making up of trains, and preventing accidents, and would, consequently, effect a great saving to the railroads.

Reduction of Dead Weight

Before the dead weight of cars can be reduced—having in mind present capacities, corrosions, loads and shocks—a grade of material having higher elastic limits and ultimate strength will be necessary, or an alloy steel of a lower specific gravity, of equal strength in pounds per square inch, and same elasticity, as material used at the present time. To lighten equipment by using higher fiber stresses will not result in a satisfactory solution, as stresses produced in service, based on assumed loading and buffing shocks, are as high as it is possible to employ without producing fiber stresses in excess of the elastic limit. It is evident from some cars built only a few years ago, now under repair, that material has been subjected to stresses in excess of its physical limits.

Reduction of dead weight of equipment is important from so many points that it merits exhaustive investigation. Assume the use of steel having an ultimate fiber stress of 100,000 lb. per square inch, and a factor of safety of three; this would allow a working stress of 33,000 lb. per square inch, or an increase of 100 per cent over safe fiber stress with present material. This would revolutionize designs prevailing today and effect a great saving in weight.

Roller Bearings

Journal boxes equipped with roller bearings are commencing to make their appearance in steam railroad equipment. A few years ago the Grand Trunk had a number of cars so equipped. The importance of reducing friction is now being seriously considered by many railroads and roller bearings are being tested in the States. While it may be a little premature to judge of their merits I venture to say that before long they will become standard for passenger cars.

Tests covering a number of years have proven that roller bearings will save from 10 per cent to 15 per cent in power consumption, and effect a saving in coal of 10 per cent, which is an item worth considering, particularly as the coal becomes more expensive. Roller bearings for railway equipment while new in this country have been used for a number of years in Europe for both freight and passenger equipment and have now been adopted in some countries as standard.

Commercial Steel

When steel was first introduced for passenger cars it was the general opinion that it would be necessary to make the exterior of the same appearance as the wood car, namely, to conceal the rivets by applying mouldings over the rivet heads and to obtain a perfectly flat surface expensive cold-rolled-steel sheets were employed.

The present practice, however, is to make the steel car of an appearance that will convince the public that they are traveling in a car of steel construction which will afford better protection in case of collision. Instead of high priced cold rolled steel sheets, commercial run of steel is being used in passenger car construction, and may be referred to as follows:

1. It is useless to pay excess cost for special rolled steel sheets, when in applying they are almost certain to become distorted.

2. As a general proposition it is a case of taking such a quality as the mills supply.

3. It may sometimes be advantageous to pay the extra

cost for special processes such as "patent levelling," but in this case only sheets in about 12 ft. lengths can be obtained.

Since commencing the building of steel passenger cars on a commercial basis, we have been confronted with the question of obtaining flat sheets. These could be readily obtained when using sheets of heavy gage, but cars in recent years have been built with light gage sheets in order to reduce dead weight, and this has resulted in buckles appearing in the completed structure which unquestionably is objectionable but difficult to overcome. Buckles are also caused by car framing such as side-sills, belt-rails, posts, and other members in contact with the sheets not being absolutely true and in perfect alinement, and in consequence will appear in the sheets after riveting. Also upon removal of the supporting stands used during riveting up, buckles will appear in the sheets due to the natural deflection of the car structure from its own weight, and may be explained with the following remarks:

The appearance must be as good as it is economically practical to produce, without sacrificing strength. Formerly it used to be the practice to doll up the exterior, and also the interior with gold and other decorations but today's tendency is to make the cars of a plain, sanitary, comfortable design. It has often occurred to the writer that the railroads would be justified in spending less money for their equipment, as I have observed many times during my travels, from the abuse of equipment by the public, that they either do not care, or have no idea of the expense of such equipment.

Rust Resisting Material

The steel car has undoubtedly proven superior to the all-wood car in many important respects, but here instead of decayed lumber we have another evil—corrosion, which constantly works on the structure until it is unsafe or not able to stand the loads and shocks incident to the service. Therefore, the tendency today is to specify copper bearing steel to overcome to some extent excessive deterioration, and some roads now specify all sheets and plates ⅛ in. thick and over to be of this material, and I understand that other roads specify this material for rolled shapes as well as for plates for passenger cars.

This material is also specified by many roads in the States for freight cars, and particularly for parts which come in contact with the lading. It takes an extra above standard base price of ordinary O. H. steel of similar sizes and shapes but this is negligible if final result expected can be obtained, as the extra cost of copper bearing steel would only amount to 1½ per cent of the total cost of the new car at present prices.

The majority of passenger cars built in the States, and also some built here, have been equipped with ordinary O. H. steel roofs which are now causing a great deal of worry and expense due to corrosion, and copper bearing steel is now extensively specified with the expectation that the use of this material will solve this troublesome problem.

One large car-building concern in the States that not only builds cars for railroads but also owns and operates cars, recently constructed for test a number of cars using wood roof covered with canvas, and also a number of cars using galvanized iron for roofs, but as yet they are not in a position to judge as to the final roof to adopt. The wood and canvas roof as most extensively used in this country undoubtedly has a longer life.

Insulation

Steel in passenger cars demanded improved insulation, but it is evident from some designs that this important feature has been sadly neglected or misunderstood. Some attempts have been made to make up the deficiency in insulation by increasing the heating facilities, but these have proven costly. As the benefit of better insulation is understood, and is now considered absolutely necessary, great improvements have been made and cars built today are, as a rule, insulated with material having a thermal efficiency (based on table prepared by the National Bureau of Standards for Thermal Conductivities of Materials) that will not transmit more than 2.68 B.t.u. of heat per square foot of surface in 24 hours for each degree F. difference in temperature inside and outside wall of section, and 3.62 B.t.u. for floor.

The only data available covering requirements for insulation is the Mail Service Department specification for mail cars, which specifies that cars must be insulated with sufficient material of thermal efficiency that will not transmit more than 8 B.t.u. of heat for side walls, ends and roof, and not more than 7 B.t.u. of heat for floor per square foot of surface in 24 hours for each degree F. difference in temperature.

A coach or sleeping car requires more efficient insulation to overcome increased radiation and conduction, due to larger area of glass and increased leakage of air around the numerous window openings.

Wood and canvas roofs need no insulation except between steel carline and headlining, compared with a car having a steel roof which necessitates considerable insulation to protect the passenger from conduction of cold in winter and heat in summer.

Roof construction as used by some of the roads today gives a B.t.u. transmission of heat of 6.8 per square foot per 24 hours per degree F. difference in temperature and is composed as follows: Roof canvas, 13/16 in. roof board, air space, ¼ in. Salamander, headlining. This construction gives with only a small quantity of insulation better results than the requirement for mail cars and should be satisfactory, but it cannot be denied that improved insulation even for cars with wood roofs would make it possible to heat them with less steam.

Due to vertical members in framing, insulation cannot be applied in continuous lengths, but must be confined to a length suitable for individual spaces. It is, therefore, imperative, in order to prevent conduction, to use an insulating medium between all surfaces of steel in contact, and to isolate the outside steel plates from inside framing member so as to obtain an uncombined form of construction, otherwise in cold weather a frost line will appear on inside of car.

Freight Car Standards

In the earlier stages of steel car designs, the sizes of material were more or less based on the members used in wooden construction and, consequently, many of the early designs of freight cars proved defective, but served to develop a better knowledge of the relative value of steel and wood in car construction, and the use of the elastic limit rather than the ultimate strength.

The car constructed with wood underframing and wood draft timbers attached with bolts to the center sills, and with spring draft gear of light capacity, formed a very resilient structure, but when steel was introduced into car construction, while it developed a more rigid design, it has resulted in local damage to some of the members of the car, and in damage to the lading. The center sills, together with the draft gear, have become a live issue, the center sills to form a sustaining beam of sufficient strength not only to carry the load but also to form a column to take care of direct and indirect stresses, caused by buffing, the draft gear to form a shock absorber, protecting the car structure and the lading.

Spring draft gears in steel equipment having proven inadequate and costly and not of the capacities required are now being replaced by heavy-capacity, long-travel friction-gears so applied to cars that at no time will coupler horn come in contact with buffer casting, but instead transmit the buffing shock to center sills at rear draft lugs, which incidentally reduces the length of that portion of center sills which must absorb stresses due to buffing. With the spring-gear and the final buffing shock taken by the buffer-block, the column is increased considerably and naturally makes a weaker structure.

Much has been written about the defects in early designs of steel freight cars through a lack of knowledge of the designer, but in spite of all the publicity, cars are built today which are little better than in the early days. I had occasion to analyze a recent design of car which showed combined stresses as high as 35,700 lb. per square inch in center sills. Some of these cars, no doubt, due to high stresses and rough handling in the classification yards, have landed on the repair track with failed center sills, together with many thousands of the older cars.

In 1907 an important change was introduced in box car construction when the steel-underframe, steel-superstructure box car made its appearance. This has become almost the universal car and today remains, except for minor refinements, much the same as the original design. As the steel-underframe took the place of the wood-underframe box car, so also now the steel-frame box cars are rapidly replacing the steel-underframe wood-superstructure, due to the impossibility of keeping the wood superstructure in repair on a rigid steel underframe. The posts and braces work loose, the frame and roof shift in either direction in heavy shunting, under which condition it is impossible to keep sheathing, lining and roof on the car for any length of time.

Hand brakes have been improved to meet A.R.A. requirements, and to obtain more efficient brakes, some cars have been equipped with gear brakes, and large numbers are being equipped with lever brakes, which have resulted in a great improvement over the old and inefficient hand brake wheel now in general use.

Steel has not altogether replaced wood for furrings and interior finish in passenger cars. For freight cars large quantities of lumber are, and always will be, used.

When building cars of all wood little attention was given to the moisture content, which it is so important and necessary for good construction to consider. Good dry lumber, as proven by test, becomes approximately two and one-half times stronger than the wood as it comes from the tree.

The tendency today is to construct freight cars with steel framing and wood lining and flooring, not only box cars but also types of open cars. This construction is more economical and repairs can be effected without expensive shop equipment. It is my opinion that this construction will be used in the future as the all-steel car, due to corrosion, has a short life and is expensive to repair, unless the use of copper bearing steel, now extensively specified, will overcome this deterioration.

Lumber, when used in freight cars with steel framing, serves only to retain the lading or form supports, and as lumber is classified by grade, it would lead to advantage and economy if more consideration was given to this subject when preparing specifications; that is, use a good grade of lumber for flooring and lining for box cars, and a lower grade for roofing, particularly as cars today are mostly equipped with outside metal roofs. The same principle also applies to coal and refrigerator cars.

Regarding the proper moisture content, it is comparatively simple to dry all lumber in a reasonably short time with the modern dry kiln, except oak, which requires a long time to dry. It will take from four to ten months to dry oak framing of sizes specified for car equipment.

Trucks and Springs

Freight car trucks have received due consideration; wheels have been redesigned and increased in weight, rating of axle carrying capacity increased for some capacity cars, and arch-bar trucks, which have been used for so many years, are being replaced by those with cast-steel frames. Today in the States 90 per cent of all freight cars built are equipped with cast-steel truck side frames.

By the use of this class of truck many parts are eliminated, as will be noted from the following table:

Type of trucks	Capacity	No. of parts	Weight two trucks	Parts saved	Weight saved	Reduction in parts, per cent	Reduction in weight, per cent
Arch bar...	40-ton	268	14,400 lb.	...	......	..	..
Cast steel...	40-ton	128	14,000 lb.	140	400 lb.	52	3
Arch bar....	50-ton	304	17,000 lb.	...	......	..	..
Cast steel...	50-ton	144	16,123 lb.	160	877 lb.	53	5

This comparison shows a reduction in parts of over 50 per cent in favor of the cast-steel truck and a reduction in weight, which, although small, is sufficient to receive consideration. The elimination of so many parts also minimizes delays caused by failures of arch-bar trucks which depend on bolts for securing the parts. These bolts after a short time become loose and the truck and car land on the repair tracks instead of being in service and earning revenue.

Attention has also turned towards obtaining better brake rigging, and there is a tendency to equip freight car trucks with clasp brakes. Some heavy capacity cars have already been so equipped, and I venture to state that all trucks for cars of 50-ton capacity and over will eventually be specified to include clasp brakes.

Truck spring failures have become serious of late, due partly to the recent increase in loading and partly to the change in method of stenciling the capacity on axle carrying capacity and increased rating without alteration in classification of truck springs. Failures have become so alarming that the A.R.A. recommended in 1921 the use of alloy steel and a change in method of manufacture, which, if adopted, would make the springs much more expensive, and would not solve the problem. These failures can be reduced, and possibly eliminated altogether, if the present standard of springs was reclassified, using class "D" for 80,000 lb. capacity cars, and class "H" for 100,000 lb. and 120,000 lb. capacity cars, as this would reduce the working stress to about 50 per cent of the ultimate allowable stress.

TABLE SHOWING EXISTING CONDITIONS

Class	For cap. cars A.R.A.	Cap. of spring at 80,000 lb. per sq. in. fiber stress	Total load on each nest	Total deflection of spring at 80,000 lb. fiber stress	Percentage of total deflection due to load and car body	Percentage of total allowable fiber stress	Fiber stress due to load and car body at static. Lb. per sq. in.
A	60,000 lb.	40,412 lb.	23,125 lb.	1⅞ in.	57	57	45,600
C	80,000 lb.	56,320 lb.	29,875 lb.	1 11/16 in.	53	53	42,500
D	100,000 lb.	63,148 lb.	38,475 lb.	1 11/16 in.	61	61	48,900
H	*	79,145 lb.	38,475 lb.	1 11/16 in.	49	49	39,200

*Shows conditions that would exist if A.R.A. class "H" spring was used for cars with 5½ in. by 10 in. axles.

Conditions under old loading rules for 50-ton capacity cars were as follows:

Average dead weight car body and truck............	42,000 lb.
Deduct weight of two trucks....	17,000 lb.
	25,000 lb.
Add for two truck bolsters.................	1,800 lb.
Dead weight on bolster springs......................	26,800 lb.
Load plus 10 per cent for overload..............	110,000 lb.
Total load on springs..........................	136,800 lb.
Load on each nest of truck springs..................	34,200 lb.

Figures in the table showing existing conditions for the same capacity car give an increased load of 4,275 lb. on each nest or a total increased loading on the four nests of 17,100 lb. or 12.5 per cent. This increased load, while not large, must have some relation between past and present spring failures, as it is the general practice to design helical springs so that the static load will not exceed 50 per cent of the maximum load at 80,000 lb. per square inch.

Stresses dut to static loads only, however, while a factor in causing spring failures are not the most serious. Other forces which create additional stresses must be added to the static load to obtain final results.

As stated in the M.C.B. proceedings, volume 30, if the center of gravity of the car is 72 in. above the rail 40 per cent of the static load acting horizontally will almost entirely relieve the weight on one rail—which also acts on the springs—and to this must be added 26 per cent of the static load for vertical oscillation to obtain the combined load on each spring.

For example, a 60-ton capacity box car, maximum axle load 169,000 lb., as shown on the diagram, produces a static load on each nest of springs of 38,495 lb.

The resultant of a horizontal force, 40 per cent of load, equals 21,997 lb. which must be added to the static load on one set of springs and deducted from the static load on the other set of springs. To these figures the load due to vertical oscillation must be added, which makes a total load of 76,218 lb. on one set of springs, and 20,787 lb. on the other side of the truck.

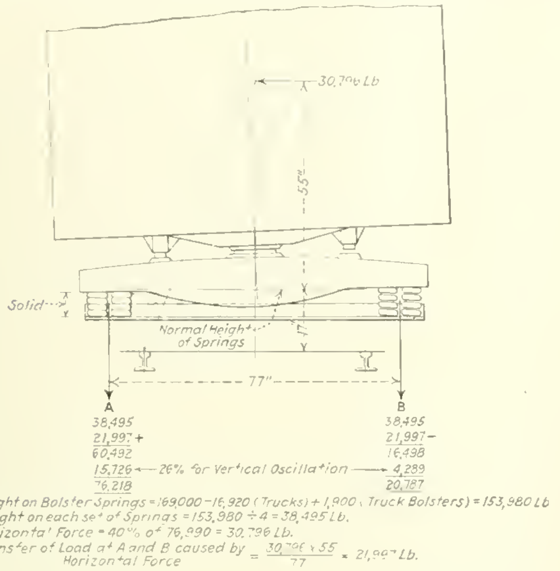

30,796 Lb
55"
17"
Solid
Normal Height of Springs
77"
A
B
38,495
21,997 +
60,492
15,726
76,218
38,495
21,997 −
16,498
4,289
20,787
26% for Vertical Oscillation
Weight on Bolster Springs = 169,000 − 16,920 (Trucks) + 1,900 (Truck Bolsters) = 153,980 Lb
Weight on each set of Springs = 153,980 ÷ 4 = 38,495 Lb.
Horizontal Force = 40% of 76,990 = 30,796 Lb.
Transfer of Load at A and B caused by Horizontal Force = 30,796 × 55 / 77 = 21,997 Lb.

Diagram Showing Effect of Oscillation on Bolster Springs

Under these conditions one set of springs are solid as the weight upon them exceeds the capacity of class "D" springs by 12,218 lb. and as the springs are subjected to these conditions time and again, but one result can be expected, which can be remedied only by introducing springs having greater capacity and more suitable for the conditions imposed.

Refrigerator Cars

Refrigerator cars transport the most valuable and expensive commodity handled by the railroads, and incidentally must carry cooling elements—ice—which is a dead loss in two ways, namely, the initial cost, and the weight carried without revenue. Although railroads have been faced with these losses for years, few attempts have been made to improve conditions until recently, no doubt for the reason that no data has been available to check losses of radiation and conduction, and select the proper insulating material and amount required.

It has been made possible, however, due to recent investigations, to calculate rather than conjecture what insulation and amount to use, and it is apparent that great improvement has been made in recent designs. Some cars lately built have been insulated with sufficient material of thermal efficiency to transmit no more than 2.6 B.t.u. of heat for wall, floor and roof sections per square foot of surface in 24 hours for each degree F. difference in temperature, but this is not sufficient, and greater improvement must be made in insulation of refrigerator cars. The extra cost of insulation would be insignificant compared with the saving, as I am sure that the present ice consumption can be reduced 50 per cent with better insulated cars.

In modern refrigerator cars the side insulation is required to run in one piece from door post to door post, and to be of sufficient width to run from side sill to side plate, which construction is ideal, but the old method of applying insulation in floor and roof is still maintained, namely, to apply insulation material between wood sills and carlines, which design invites poor construction on account of the numerous joints and furrings which may be fairly tight when new, but after a few months are bound to become loose and defeat the purpose intended.

I would therefore suggest that floor and roof insulation be applied in the same manner as used for sides, namely, in one piece covering the entire area, securely attached all around to eliminate all leakage possible. This will make the insulation more effective as well as reduce cost of application.

Most refrigerator cars today are constructed with steel underframe of a rigid design, with wood frame superstructure. Why not go further and apply steel framing for this class of equipment as well as for box cars? The steel superstructure will form a rigid support for sheathing, insulation and lining, and will hold them securely together and prevent radiation and conduction on account of the inadequate wood framing.

Painting

One of the most important, but from observation the most neglected requirement for preservation of equipment, is painting. It has been customary to paint the exposed surfaces only, and the unexposed surfaces, which are almost impossible to inspect for deterioration, left entirely unprotected, which practice has resulted in a premature failure and costly replacement.

The tendency now is to give the painting of cars the attention warranted, and equipment built of late has been painted with the utmost care. While the initial cost of good painting will amount to a few additional dollars per car, the cost is, after all, comparatively small when compared with the total cost of the car and is money well spent, as undoubtedly their life can be increased several years.

To obtain good results, however, it is necessary to clean by sand blast all steel parts before painting is attempted.

Replacement of Old Equipment

While this paper primarily was intended to deal with present tendencies in car construction, it may be interesting to refer to the program by the railways for replacing existing old wood cars. The replacement of passenger wood equipment with steel has been quite rapid in Canada, and the percentage of such replacement has exceeded that of the United States roads by a considerable margin.

From the report by the Interstate Commerce Commission for December, 1919, which is the only record available, the increase in steel passenger cars in the United States for three years has only been at the rate of about 3.2 per cent whereas in Canada during the same period the increase amounts to about 9 per cent of total cars owned and operated. However, out of about 7,040 passenger cars in Canada, only 17 per cent are yet of steel construction.

Similar conditions prevail regarding freight cars. The last report from the Interstate Commerce Commission shows a total of about 2,300,000 cars in the United States, of which 1,505,717 are all-steel or steel underframe construction, a total percentage of 65.5 per cent.

Canada's position in this regard is not so good, as out of 219,168 cars 47 per cent are all-steel or steel underframe construction. Fully 50 per cent of the wood construction cars have reached, and some exceeded, the normal expectancy of life, and should be replaced by modern equipment.

In the United States the annual retirement is about 72,000 cars or a percentage of .031 per cent of the total, and it may be assumed that the same percentage should prevail in Canada. At this rate Canadian roads should add about 7,000 cars per annum to maintain their present number of cars, which figure does not allow for any increase to take care of the normal growth of business.

Properties of Chilled-Iron Car Wheels

Investigation by University of Illinois of Stresses Due to Mounting, Static Load and Flange Pressure; Advantages from Increased Flange Thickness

An investigation covering some of the properties of chilled-iron car wheels has been conducted at the University of Illinois, the work having been carried out under the direction of J. M. Snodgrass, professor of railway mechanical engineering, and F. H. Guldner, special investigator, and with the co-operation of the Association of Manufacturers of Chilled Car Wheels.

The results of that portion of the investigation dealing with the strains caused by forcing the wheel upon its axle and thereafter applying a static load were covered by Bulletin No. 129 of the Engineering Experimental Station. Abstracts from this bulletin were given in the *Railway Mechanical Engineer*, October, 1922. A continuation of the report is contained in a newly issued Bulletin No. 134 which deals with subsequent tests.

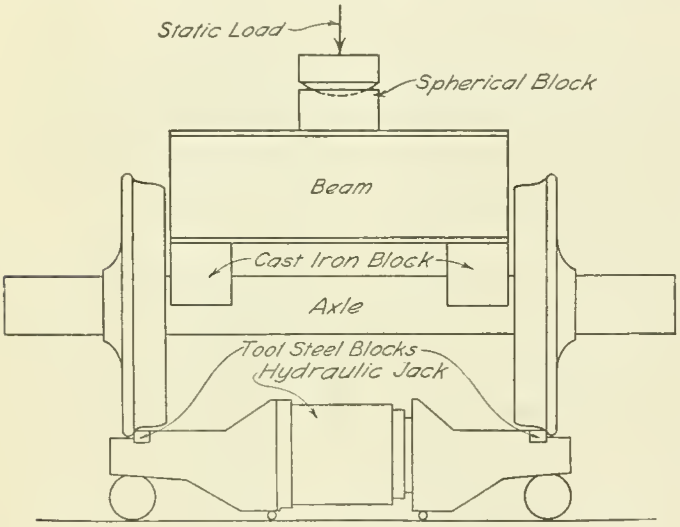


Fig. 1—Method of Applying Static Load and Flange Pressure

The first part of Bulletin No. 134 discusses the strains existing in a 33-in. 840-lb. wheel of the arch-plate type when subjected to the effect of mounting, static load and side thrust pressures, taken both individually and collectively. The remainder of the bulletin deals with a series of tests made to determine the ultimate strength of car wheel flanges, both new and worn.

Combined Effect of Mounting, Static Load and Flange Pressure

The equipment used to apply the loads for experimentally determining the combined effect of wheel fit, static load and flange pressure is shown in Fig. 1. It consisted of a 200-ton hydraulic jack supported on rolls which in turn were supported on the bed of a 600,000-lb. testing machine. Specially made castings fastened to each end of the jack had hardened tool steel blocks inserted near their ends, the upper sides of these blocks having contours similar to the head of a rail. A pair of wheels previously mounted on an axle rested on these steel blocks. By means of a block with a spherical seat, a beam, and two cast iron blocks resting on the axle, the static load was transmitted to the axle, thence through the wheels and on down to the bed of the testing machine. After a static load of the desired magnitude had been applied, a flange pressure of the desired amount was obtained by means of the hydraulic jack. The strains due to the various combinations of load were determined by means of a Berry strain-gage.

The strains were measured on a series of 2-in. gage lines, both radial and tangential, extending from the hub to near the rim on both inside and outside faces of the wheel tested. The static loads employed were 13,050 lb. and 25,450 lb. After the stresses due to these loads had been ascertained and while the static load of 25,450 lb. was still maintained, a side thrust or flange pressure of 8,000 lb. was added by means of the hydraulic jack. Additional readings were taken and the flange load then increased to 16,000 lb. and afterwards to 32,000 lb. The last condition, namely, 25,450 lb. static load and 32,000 lb. flange thrust, was considered to be representative of the normal maximum loading that might occur in service.

The compressive stresses found for the various load conditions were relatively unimportant. The maximum corresponding simple tensile stress—18,400 lb. per sq. in.—was due to mounting and was found at the gage-lines nearest the hub on the inner face. The application of static load and flange pressure did not materially affect this stress. Stresses of such magnitude occurring in the hub regions are generally less dangerous than stresses of lesser value at other positions in the wheel. This is due to the fact that the stress in the hub region is a steady one, that is, the material is not subjected to repeated stress. The combined effect of mounting and the application of a maximum static load and a flange pressure probably in excess of that encountered in normal wheel service was found to produce tension—with a few minor exceptions—in both radial and tangential directions on the outer face of the 840-lb. arch-plate wheel. On the inner face over the region investigated, this combination of loading was found to produce tension at the tangential and compression at the radial gage-lines. The tensile stresses on the outer face near the junction of the inner and outer plates resulting from the application of maximum static load and flange pressure are subject to repetition and at some points to complete reversal. The number of such reversals of stress that would occur in the normal life of a wheel, due to the occurrence of a sufficiently high flange pressure caused by traversing curves of small enough radius at high enough speed, is relatively small compared with the millions of reversals found necessary to cause failure under similar conditions in investigations of repeated stress. Hence, the question of severity of stress due to the combined effect of mounting, static load, and flange pressure may be considered from the static viewpoint alone. It does not appear that the stresses due to this combination of loading are severe in themselves, but if these stresses are increased by abuse of the wheel, through prolonged brake application, they might become large enough to cause incipient cracks leading to wheel failure.

Strength of Chilled-Iron Car Wheel Flanges

The apparatus used in making tests of the ultimate strength of the flanges consisted essentially of a steel beam built up of channels and plates as shown in Fig. 2. This beam was placed on the weighing table of a 600,000-lb. testing machine, and the wheel to be tested was supported thereon at opposite points on a diameter, at one side by a piece of tool steel pressing against the flange, and at the other by a semi-circular piece of steel supporting the tread. The location of the point of application of the load on the flange could be varied by means of a block and wedge applied to the tread at a point diametrically opposite. This block and wedge further acted to take the horizontal pressure component due to the angularity of the flange at the point of load application The load was applied to the wheel, through a block with a spherical seat. For this series of tests 33 wheels were used and from three to six tests to fracture were made on each wheel.

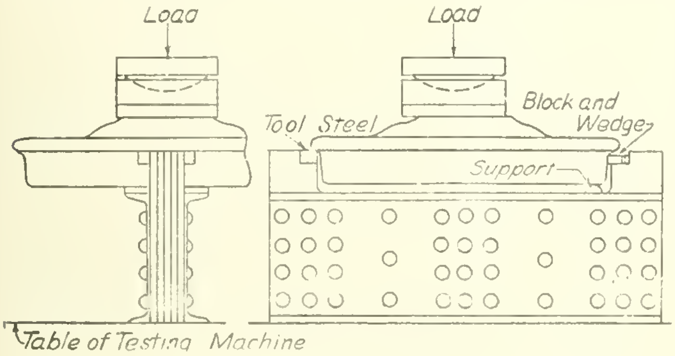
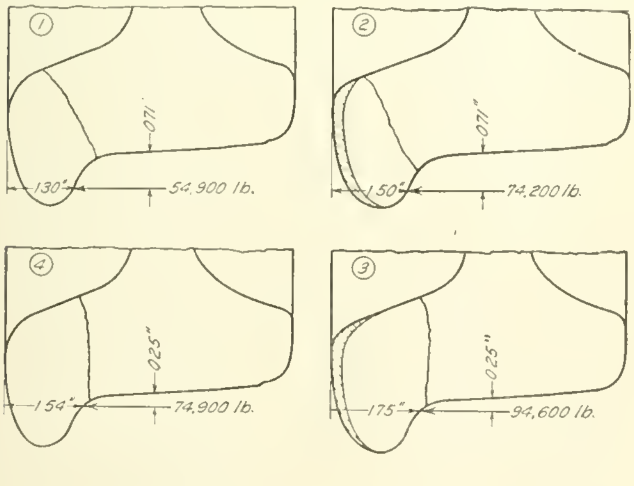


Fig. 2—Apparatus Used to Determine Strength of Flanges

The flanges were of various shapes and include specimens representative of both new and worn wheels. Among them were wheels with the standard contour recommended by the Master Car Builders' Association, and others with the reinforced flange suggested by the Association of Manufacturers of Chilled Car Wheels to replace the present M.C.B. standard flange. In addition, there were tests made on wheels with flanges ground to represent various stages of wear, and also on two wheels which were worn out in service.

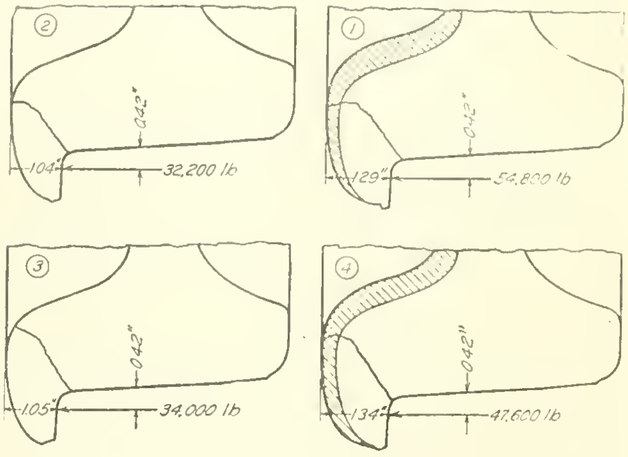
In the case of a number of the wheels tested the flanges were ground to represent various stages of wear, so that the ultimate strengths determined in these cases furnish data as to the safety of wheels similarly worn in service. The location of the point at which the pressure was applied to the flange was also varied, and thus data were secured applicable to the case of wheels operating on improperly maintained track, on which the flanges may strike frogs, switches, etc. Irregularities occurred, however, in the results of these tests which preclude correct deductions concerning the effect of flange thickness. The irregularities in the results were caused by differences in the various wheels with respect to depth of chill, chemical composition, physical properties of the metal, etc.



MCB Flange as cast AMCCW Flange as cast

Fig. 3—Typical Results of Flange Tests on Special Wheel with Standard and Reinforced Flange

In order to obtain information of value regarding the effect of additional metal in the flange region, an attempt was made to eliminate these differences by using wheels cast from special patterns, in which one-half of the circumference had the standard M.C.B. flange and the other half had additional metal on the inner face. Three types of wheels were thus cast and from these the effects in both new and worn wheels of, first, increasing the thickness of the flange, second, increasing the thickness of the tread, and, third, increasing the thickness of both flange and tread simultaneously, were determined. To make the comparisons still more direct the loads were in every case applied to the flanges of these specially prepared wheels on a radius midway between the points where two adjacent brackets entered the tread, thus eliminating as far as possible the complex effect of the support of the brackets. In addition, the flange pressures were in each case applied at identical distances below the tread, thereby removing the effect of difference in the moment of the load. Because of these precautions it is felt that the results obtained from these wheels cast from specially prepared patterns are truly representative.



MCB Flange with ground Throat Modified Flange with ground Throat

Fig. 4—Typical Test Results on Special Wheel with Standard Flange and with Reinforcement on Flange and Tread; Throat Ground to Represent Worn Flange

Conclusion in Regard to Wheel Flanges

The conclusions to be drawn from the tests made to determine the ultimate strength of the wheel flange may, within the limits of these tests, be summarized as follows:

(1) When the flange pressure is applied to wheels with badly worn flanges on a radius midway between the points where two adjacent brackets enter the tread, the ultimate strength of the flange is an inverse function of the distance of the point of pressure application from the tread, that is, the greater the distance the smaller the ultimate strength.

(2) This inverse relation does not hold in the case of new or slightly worn flanges, neither does it hold in the case of either new or worn flanges if the point of pressure application is on the same radius as that on which a bracket enters the tread. In this case it was found in some of the tests that the bracket apparently strengthened the flange, while in others a weakening of the flange was observed, these conditions indicating a complex supporting effect due to the bracket.

(3) The addition of 3/16 in. of metal to the back of the present standard flange, as proposed by the Association of Manufacturers of Chilled Car Wheels, increases the ability of the flange to withstand side thrusts. This increased

strength was plainly shown in the tests of five specially prepared wheels, in which one-half of the circumference had the present standard M. C. B. flange and the other half the proposed additional flange thickness. These wheels showed an increased flange strength due to the additional metal of from 10 to 90 per cent in the case of badly worn flanges and from 26 to 49 per cent in the case of slightly worn or new flanges.

(4) In the case of the wheel having one-half of the circumference cast with the standard M. C. B. tread and the other half with the 3/16 in. of additional metal on the inner and under side of the tread, the results were negative, inasmuch as the half with the additional metal showed decreased ability to withstand side thrust. Although tests on one wheel cannot be taken as conclusive, if further tests confirm these results, the indication would be that it is possible to add metal in such a way that not only no increased flange strength results but a decreased flange strength may actually be caused. If this be taken as proved, then there probably exists a relation or ratio between flange and tread thickness which will result in a maximum flange strength for a particular thickness of either flange or tread. In that case if a wheel be cast with the ideal ratio of tread to flange thickness for, say, a given thickness of flange, the addition of metal to or the subtraction of metal from the tread will not only not increase the flange strength but may even decrease it.

(5) The simultaneous addition of 3/16 in. of metal to both flange and tread was not found to alter the ability of the flange to withstand side thrust. As the addition of 3/16 in. to the flange alone gave added strength, this result would tend to confirm the conclusion reached in (4). The simultaneous additions of 3/16 in. of metal to the flange and 3/8 in. to the tread was found to result in an appreciable increase in the ultimate strength of the flange. The weight of metal added was about 37 lbs. or 5.1 per cent of a 725-lb. wheel, whereas the increase in flange strength resulting therefrom ranged from 40 to 70 per cent. An important feature of this case is that the advantage of the additional metal apparently does not disappear as the wheel approaches the condemning limit on account of flange wear.

(6) The general conclusion to be drawn from the results of these tests is that the flange strength of the chilled iron wheel can be increased to keep pace with probable future service requirements by a proper placing of additional metal in the tread and flange.

Interchange Car Inspectors' and Car Foremen's Convention Proceedings

Papers on Scheduling Cars Through Repair Shops and on the Loading of Steel Products Discussed

The program of the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America held at Hotel Sherman, Chicago, November 9 and 10, 1922, was a long one. A discussion of the rules of interchange was given in the December issue of the *Railway Mechanical Engineer*. The January issue contained the papers and discussions on Tank Car Repairs, Carding and Handling Explosives and Apprenticeship System for the Car Department, while the February issue contained the papers on Successful Lubrication of Journal Boxes. The present issue contains additional interesting papers and an address by C. M. Dillon, representing the Association of Railway Executives.

Safe and Economical Loading of Steel Products

By W. R. Rogers
Chief Joint Inspector, Youngstown, Ohio

The Loading Rules Committee has encouraged the manufacturers, railway clubs and individuals to offer suggestions for changes in the method of bracing and blocking the various ladings; and when we see the Committee's numerous revisions, from year to year, it appears that the field is broad for such activities. These revisions are made necessary on account of the ever changing conditions which require additions and modifications in the rules, and it is apparent that such suggestions should adhere to methods of securing loads in a practical, simple and, as far as possible, inexpensive manner.

The shippers fully appreciate that a dissatisfied customer often means loss of business, and that one sure way of losing the customer is to have his shipments delayed in transit or found at destination scattered over the car floor and in a damaged condition. It is, therefore, to the interest of the shipper to adhere to the rules, which provide substantial methods in bracing and securing the lading, and they are anxious and willing to co-operate with the carriers to that end.

The carriers' representatives with a full knowledge of the requirements of the rules, should visit the industries and explain to the shippers, in a business like manner, the various requirements of the rules, and assist the shipper in every possible manner. No opportunity, developing locally, should ever be lost to show the shipper, in the proper spirit, the results of improper loading. He will appreciate an opportunity to accompany you to inspect any such shipments received from his plant, that have given trouble on account of shifting, or for some other reason that was due to improper loading. There are many little courtesies that you can extend to the shippers in the way of suggestions as to how they can overcome some of the conditions developing in the loading of the various commodities which will be very beneficial to both the shippers and the carriers.

In territories where the industries are served by more than one railroad it has been found that if visits are made periodically, in company with representatives of the industry, much good will result in the way of adherence to the rules. We have safety first committees, loss and damage committees and fire prevention committees, each performing indispensable service. Why not industrial committees, representing the mechanical department, to cover such territories and perform a service to the common interest of the shippers and carriers?

The achievements of the Loading Rule Committees have not at all times been fully appreciated, and it is not the intent or purpose of this paper to criticise the committee. In the opinion of the writer, however, the rules governing the loading of metal sheets and plates in box cars, the rules or absence of rules to cover the loading of long flexible concrete bars, and the rule covering super-imposed loads of plates on sides of gondola cars, are not impossible of improvement.

Loading Metal Sheets and Plates in Box Cars

I know of no other commodity loaded in box cars that is more destructive to the ends of the cars than sheets or plates, when not substantially secured to prevent shifting; and the cost to the railroads from this one source of damage to equipment, including the damage claims which are the result thereof, must amount to thousands of dollars annually. Under the rules in effect prior to January 1, 1922, there was no specified manner shown as to just how the bracing at the ends of piles towards the center of the car was to be secured, other than that it was to be well spiked to floor and car sides. In many cases the bracing was cut in the mill to the shippers' own standard lengths to save the cost of hand sawing, and quite frequently the bracing was nailed to the inside lining boards and possibly to but one post, with the result that such bracing was not sufficient to keep the lading from shifting.

Rule 265, as now written, and the figures as shown in Supplement No. 1 to the 1920 code, is far superior to any previous method of bracing and securing this commodity, but in making it so, the resultant increased cost has brought about some strong objections against adherence to the rule. Some shippers maintain that some of the sheets and plates are not so difficult to keep from shifting as others, and that the lengths of a large percentage of such shipments are such that they afford an opportunity to nail the bracing to a number of side posts and side braces, which the longer lengths do not. They contend that the rule should be modified to give them the benefit of any saving that the various conditions warrant. To meet this contention it is recommended that the rule be modified to the following extent:

For all sheets or plates, except oiled sheets, when piles do not exceed 36 in. in height, and for oiled sheets not exceeding 30 in. in height, where the length of sheets or plates will not permit securing of the longitudinal bracing, as shown in Fig. 90, to three posts or braces, the bracing must extend to the doorways and two additional pieces of 2-in. by 4-in, one piece at the top and one piece at the bottom, must extend across the doorways and be properly wedged against the bracing in the opposite end of the car. Where the longitudinal bracing can be secured to at least three posts or braces, the bracing need not extend to doorways and across doorways as now required.

For all sheets or plates in piles exceeding 36 in. in height, place in each of the above cases additional longitudinal bracing in the center between the top and bottom longitudinal bracing.

The piles, except oiled sheets, to be securely wedged apart by braces consisting of not less than two pieces of 2-in. by 4-in. uprights against each pile, these uprights to have 2-in. by 4-in. by 12-in. cleats nailed to them and the floor of the car, and to be securely wedged apart near the top by one 2-in. by 4-in. piece for piles not exceeding 18 in. in height and two pieces of 2-in. by 4-in., one near the bottom and one near the top, for loads exceeding 18 in. in height.

For oiled sheets, the piles should be wedged apart in the manner now prescribed in the rules, and as shown in Fig. 90, except that the bottom ends of the upright pieces should have 2-in. by 4-in. by 12-in. cleats nailed to them and to the floor of car, instead of cleats nailed to the floor on either side of the uprights as now required.

Forty-penny nails to be used in securing all end bracing to posts or braces, and not less than twenty-penny nails used to secure all other bracing.

Permit the use of 2-in. by 4-in. pieces, instead of the 2-in. by 8-in. against the car side at the ends of the piles. This one detail alone makes it necessary for the shipper to carry the 2-in. by 8-in. lumber in stock.

The advisability of the use of strips between the lading and sides of the car, when the sides will permit a uniform bearing surface, is also questioned. Cars are usually selected with reference to their fitness for this particular loading. The sides on such cars, as a general rule, will permit a uniform bearing surface, making the use of the strips unnecessary except as may be required to facilitate unloading, and it would appear that the bearing surface on the sides of the cars, when the lading is properly wedged against the sides, offers a much greater resistance to shifting of the lading than when the strips are used. It is the contention that their use be left optional with the shippers except when the sides are of uneven surface.

As an alternate method of loading flat galvanized or plain sheets not oiled, permit the loading of sheets 84 in. or longer in accordance with the present rule for bundle sheets, Fig. 92, provided that at least two 4-in. by 6-in. by 12-in. wedges are nailed to the car floor underneath each end of the pile, in order to secure the necessary concave on top of the pile.

The above modifications to the present rule would provide a means for some saving in the present cost of bracing such shipments, and would still be consistent with substantial bracing for this commodity.

Single Overhanging Loads of Concrete Bars

In loading single overhanging loads of long flexible concrete bars, it is the practice to follow the detailed instructions of the rules governing single over-hanging loads, using but one bearing timber on the floor of the carrying car, the other end of the material resting on the car floor. The overhang is taken care of by means of a sliding timber placed on the floor of the idler car between the body bolster and the end sill.

Rule 23, effective January 1. 1922 (see Supplement No. 1), now permits the loading of 58-ft. material on a 46-ft. car. This has greatly simplified the loading of concrete bars in lengths up to 58 ft., because heretofore it was necessary to load that length material as a twin load, requiring four sliding timbers in addition to the two bearing timbers.

From time to time the question has been raised as to the allowable weight permissible when such material is loaded as single overhanging loads, and we have been governed to a great extent by Rule 23, which shows the permissible weight for single overhanging loads, as shown in Fig. 52, 54 and 55. But there is some question as to whether a shipment of this long flexible material is not a somewhat different load than those shown in the above sketches and objections have been made because a greater weight than shown in that rule is not permitted.

The present rules permit the loading of a twin shipment of long flexible material to but one-half the capacity of the cars. But a great many shipments of this 60-ft. material have been loaded as single overhanging loads to the capacity of the carrying car, or 110,000 lb. on a 100,000-lb. capacity car, with a similar shipment loaded in reverse order, so that the one idler car takes care of the overhanging ends of both loads. When so loaded it required but three cars to carry 220,000 lb., whereas it would have required four cars and approximately 65 per cent additional labor and lumber to have loaded the shipments as twin loads.

If such materials as bridge girders loaded as single overhanging loads, as in Fig. 52, can be loaded on a 46-ft. car to a maximum weight of 85,000 lb. on a 100,000-lb. capacity car (see Rule 23), with no part of that weight carried on the idler car, why would it not be feasible to increase that weight when the material is so flexible that the overhang rests on a sliding timber placed on the floor of the idler car, according to Rule 220? It is suggested that the rules show a drawing of a single overhanging load of flexible concrete bars with one bearing timber on the floor of the carrying car and a sliding timber on the floor of the idler car, and that they increase the allowable weight for such a shipment over that as shown in the table under Rule 23.

Twin Loads of Long Flexible Concrete Bars

A twin shipment of this material weighing 150,000 lb., in 60-ft. lengths, contains approximately 460 pieces of the 1¼-in. material and from 6,000 to 7,000 pieces of the ¼-in. and ⅜-in. material. The flexibility of the smaller size bars is such that four sliding timbers are required in addition to the bearing timbers, and it is simply a matter of building up the load and tying it together, so that the necessary clearance may be maintained between the floor and lading, at the same time providing for the proper functioning of the load on curves.

The bars are loaded in "lifts" weighing from three to four tons. The smaller size bars are usually tied in bundles, and some of the shippers, in order to facilitate removal of hooks and chains used in loading and unloading, place 4-in. by 4-in. timbers the full width of the load between the intermediate tiers. In the absence of rules to cover the loading of this particular material, the general rules covering twin shipments and the rules covering the loading of long flexible material are followed.

However, the flexibility of the smaller size bars is so great that there is some question as to whether or not the present rules covering the loading of long flexible material, such as plates, etc., should be adhered to in loading long concrete bars. The bars are corrugated or ribbed so that they will adhere to concrete construction and the ribs very often run at right angles to the bars. As the sliding timbers carry considerable weight, these ribs catch on the sliding irons, making it necessary that the sliding timbers, as well as the sliding irons, be very substantially secured to prevent their displacement. Some of the shippers of this material appreciate that condition and bolt the sliding irons and sliding timbers to the car floor, notwithstanding the fact that the rule covering the loading of twin shipments does not specify the manner in which the sliding timbers are to be secured.

We have experienced no trouble of any consequence with twin loads of this material when the bars were ⅞ in. or more in thickness, but the smaller size bars have given us considerable trouble. The rules covering the spacing of bearing timbers permit a variation from .6 to .8 of the total length of lading. By placing the bearing timbers .8 of the total length of lading, and thereby shortening up the length of the overhang, the use of sliding timbers to take care of the overhanging ends was eliminated on the less flexible or heavier bars. But this increases the swing of the load between the bearing timbers when moving over curves, and with the flexibility of the material the load did not at all times swing back in line with the track, making a dangerous condition. This is eliminated by shortening up the distance between the bearing timbers and spacing them .6 of total length of lading. This also relieves the sliding timbers between the bearing timbers of some of the weight that they would otherwise carry.

The drop end gondola cars of the fishbelly type of side and center sills are very desirable for such shipments, and fortunately they are the most available cars in the mill district. However, the thickness of the end gates on some of these cars is such that it is difficult to maintain the 4-in. clearance between the lading and the car floor, or rather between lading and dropped end gate. After using twelve 12-in. by 12-in. bearing timbers and 8-in. by 8-in. sliding timbers, it has been necessary in some cases to place three 6-in. blocks underneath the timbers in order to maintain that clearance, because of the deflection of the bars between the sliding timbers. A great many shipments of this material have been loaded with the sliding timbers placed between the car body bolster and the end sill, and when that practice is permitted it is not necessary, in many cases, to use any blocks under the timbers.

The present rules do not permit the placing of sliding timbers on twin shipments between the car body bolster and the end sill, but as there have been no apparent bad results when so placed, it would appear that this should be permitted. It is suggested that the rules show a drawing of a twin shipment of long flexible concrete bars, loaded on flat or drop end gondola cars, with the bearing timbers spaced preferably .6 of the total length of lading when the bars are ¾ in. in diameter or less, and not more than .7 of the total length of lading for bars of a greater diameter. Show the sliding timbers placed between the car body bolster and the end sill not more than 18 in. from the center line of the body bolster toward end sill on cars of all-steel or steel underframe construction, and require that they be secured to the car floor by ¾-in. bolts with a cleat underneath the floor, to prevent their displacement. Show sliding timbers to take care of the overhanging ends of the material when the flexibility of the overhang is such that their use is required, specifying that their thickness should not be greater than is required to keep the lading four inches clear of the floor, securing them in a substantial manner by the use of cleats on either side to prevent displacement. Show the use of 4-in. by 4-in. timbers the full width of the load between the intermediate tiers, their use to be optional with the shippers, but where used require that they be not placed within 24 in. of the vertical tie rods, in order to prevent the bending of the rods by the outer ends of the timbers when the lading shifts.

It is understood that the general rules covering twin shipments are to be followed with the above exceptions.

Special Plates on Top of the Sides of Gondola Cars

Rule 203 permits the loading of plates on top of the sides of gondola cars by two different methods, as shown in Figs. 45 and 45-A. If the method as outlined in Fig. 45 is followed and the plates are not all of the same uniform length, the shorter plates shift longitudinally against the end blocking, breaking and displacing it. If the method as outlined in Fig. 45-A is followed that condition is eliminated. It is suggested that the rule be so worded that the method as outlined in Fig. 45-A must be followed when the plates are not all of the same uniform length.

Discussion

C. M. Hitch (B. & O.): Those who have to do with the class of lading to which Mr. Rogers' paper refers will appreciate it sincerely. In some cases sheet steel is being loaded by the various shippers in a very careless manner. In order to improve these conditions and to obtain better results, we should have the mechanical representatives visit the loading points with our agents and traffic representatives, and encourage the shipper in loading such commodities in accordance with the rules. I heartily agree with Mr. Rogers.

Mr. Rogers: A copy of those proposed changes will be furnished to the Loading Rules Committee, and I also understand that the Loading Rules Committee is going into the question thoroughly, because of the fact that there has been so much agitation on account of the present rules requiring what appears to be excessive use of labor and material. There is no distinction between oil sheets or galvanized sheets or roof sheets. Almost anyone knows that it takes more bracing, better secured, to hold a ton of oil sheets than it does a ton of galvanized or corrugated roof sheets.

Mr. Hitch: We have a great many claims from shippers of sheet steel, and I do not believe that the loading rules that are in effect today go far enough to protect oil sheet steel.

T. J. O'Donnell (Buffalo, N. Y.): We receive, through our gateway, about 150 cars of steel almost every day, and with all the care they exercise in the Pittsburgh-Youngstown district, we have to cut in about one out of every ten. No matter how carefully you work out the loading rules on steel and its commodities, they will shift, more or less in ordinary handling.

Now, the Pittsburgh committee has done wonderful work in the last ten years. I think the chairman is Samuel Lynn, master car builder of the Pittsburgh & Lake Erie, and whenever you meet him he always makes it a point to ask if there is anything they can do to improve the loading of these commodities.

If they have cut down the necessity for the double load, they have certainly accomplished a great deal, because we are all looking for cars.

T. S. Cheadle (Richmond, Va.): You all realize that we have trouble with that class of material, and what a hard proposition it is to understand it, even with the valuable information contained in that paper. As a rule, the majority of us present do not deal directly with the shippers in loading these commodities. It is put up to the car inspector, who is on the job, and you can appreciate how hard it is for him to understand this rule. If anything can be done to get the shipper to co-operate with the railroad, it will mean a lot to the railroad and to the inspector, because most of the information that is gotten by the inspector is by observing the manner in which the other fellow does his work.

The information that we get at these conventions ordinarily does not get into the hands of the average inspector, and most of us do not have time to go out and give out the information we have. If anything can be done to get these things in such shape that they can be given out to the car inspector, who is going to handle a good deal of this work, we are going to effect a good deal of improvement.

T. J. O'Donnell (Buffalo, N. Y.): Our general chairman wanted me to bring to your attention a transcript of the minutes of one of our recent meetings, which deals with the attention that should be given to loading equipment.

[After the text of the Consolidated Classification rule requiring the shipper to furnish at his own expense the material required to properly secure the loading, and general rules 33 and 34 of the loading rules had been read, the chairman asked approval of the following letter from the Niagara Frontier Car Inspection Association addressed jointly to the secretaries of the Transportation, Mechanical and Freight Claims divisions of the American Railway Association. The text of the letter follows.—Editor.]

On behalf of the Niagara Frontier Car Inspection Association, we feel it our duty to call your attention to conditions existing at this frontier:

1. There is a very great hardship imposed upon the receiving line due to cars under load being received with old defects, when such defects are of a character which should have been noted and corrected, or the car not loaded, resulting frequently in transfer having to be made, causing not only heavy expense, but delay to equipment and to the freight.

2. Some railroads, if not all of them, apparently disregard American Railway Association Loading Rules and Rule 30 of Consolidated Classification No. 2, causing cars to be delayed for adjustment, because of no doorway protection being furnished at the loading point.

This is not only expensive, but delays the freight and equipment, where, if the rules were complied with, the doorway protection would have been furnished by the shippers and would have avoided the delay and expense, and also, in many cases, avoid damage to freight because of the protection securing the shipment in transit, preventing the freight from crowding the doors out and falling to the ground, becoming exposed to the elements and the possible chance, especially so on double track, of freight and swinging doors fouling trains on adjoining track, thereby endangering life and property.

It is, no doubt, true that for the first 100 miles, perhaps more, that the car travels, doorways are not in distress, but the lading is undergoing the process of creeping and sliding into the doorway, and shortly, due to service shocks or bumps in ordinary handling, the doorway is in distress and it is necessary to stop the car, placing it on shop track for adjustment. It is true that [illegible] ment [illegible] tly operation and [illegible] danger [illegible] point to see that cars are [illegible] to carry the [illegible] doorway protection is applied.

We most respectfully [illegible] that our association [illegible] tion, take under consideration the advisability of assessing the originating line for the cost of transfer and adjustments, where it [illegible] that the defects causing the transfer were present at the time the car was loaded, and also that originating road failed to see that proper doorway protection was furnished at the time of loading.

Another matter that we should like to call attention to is the practice of permitting cars to be loaded in excess of the clearances published in the Railway Line Clearance Guide. To illustrate:

A railroad west of Chicago recently loaded a car of dump cars for a point on the New York, New Haven & Hartford. When delivered to connecting line at Buffalo it was found to be too high and wide, not only for the connection out of this frontier, but the final line as well, resulting in crane having to be used, also a second car to reduce the load, at an expense of about $58.

The responsibility, apparently, is with the originating line, who, we feel, should be penalized for non-observance of the published clearances.

We have been following these things closely for some time past, and from personal observation, know that a large sum of money could be saved yearly for the railroads of the country if a penalty were imposed upon the originating carrier for violation of rules governing the three matters referred to, i. e.:

1. Loading defective equipment.
2. Failure to furnish proper doorway protection.
3. Failure to see that cars are loaded so that dimensions do not exceed the published clearances of lines over which shipments are to move.

In the matter of defective condition of cars for loading, there may be a number of reasons, which are: Non-observance of the inspectors' markings; non-inspection of cars prior to loading, or the re-loading of a defective car after load has been discharged.

It may be that you now have all of these matters under consideration, but we desire to assure you we shall be glad to collect and tabulate the information for any period you may desire, up to a year, bearing upon the subjects mentioned, in this district.

All railroads, we believe, are carrying on strenuous freight claim prevention campaigns, and in this connection we do not know of anything that is more important than the different matters referred to, in accomplishing such reduction.

Let us speak frankly. There is no use evading the facts. These violations are going on right along and can and should be reduced to a minimum, which, if done, will not only save the large amount of money wasted—approximately $75,000 per year at this frontier—but will increase car mileage materially, as well as avoid delay and damage to freight, besides eliminating complaints from shippers.

In the case of doorway protection not being furnished, causing adjustment of several hundred cars per month, if it is not the intention of railroads to compel shippers to do this, as provided for, then the originating lines should do so at their own expense, and their failure to do so should compel them to pay the entire expense, including the per diem at the junction point where adjustment is made, same to apply on cars loaded too high or wide for clearances of roads over which routed, and also on cars transferred where known they were in defective condition when loaded, the expense to be billed direct against the road originating the load.

Yours respectfully (Signed) L. J. Ferritor,
General Chairman.

Mr. Ferritor, our general chairman, is superintendent of the Wabash. He is very zealous in his effort to reduce these expenses, and he wanted this brought here for discussion.

Mr. Rogers: Let us go home and clean our own doorstep first—make our own agents use door protection where it is needed.

Mr. O'Donnell (Buffalo, N. Y.): We are doing that in our district. Our inspectors go in with the industrial managers and inspectors and see that they do it.

Mr. Rogers: I refer to our own freight agents, not our shippers.

Mr. O'Donnell: They heartily co-operate.

Mr. Cheadle: It seems to me that the only way these conditions can be overcome is by applying a penalty. I venture to say a good many of us did not know what our agents were doing until we began to get billed for that work. The car man has done all he could do.

Mr. O'Donnell: The commodities that give us trouble are first of all, baled hay; next barrel goods; next bags; then again, we have automobile parts, boxed up, that get into the doorway and become distressed. Any of those commodities should have three strips at the opening on each side. When you do not do that, you are going to damage your lading and sometimes cause loss of life on a double track line. The roads that take freight out of Buffalo are double track; the roads bringing it into Buffalo are single track.

We have a rate of $4 for adjustment of lading, $11 for transfer. Take one thousand cars a month adjusted and you have $4,000 against the roads that bring it in. Most of it is on eastbound tonnage; the west bound takes care of itself.

Address By Charles M. Dillon*

Representing Association of Railway Executives

At no period in the history of this country has there been so much misrepresentation of railroads as in this last campaign, and it is leading people, particularly farmers, to believe that while they are undergoing great hardships, the railroads are profiting and piling up great earnings. The politicians in the West say to the farmers, "The railroads, in 1922, are going to have a net of $900,000,000." That is a tremendous sum of money to mention to anybody who is broke, with his notes due at the bank, and the prices of his crops declining. But these astute politicians do not tell the farmer that even if the railroads got the $900,000,000 net, they would be $186,750,000 short of making 5¾ per cent on the investment, which the Interstate Commerce Commission says it will recognize as a fair return.

One politician just elected to the Senate, in Nebraska, said in my hearing, "True, the guarantee to the railroads expires March 3, 1923, but after that date the Interstate Commerce Commission, under the Transportation Act, fixes the rate of guarantee and has fixed it at 5¾ per cent." That has a bad effect on the public and the farmers particularly, because they actually believe that the government guarantees a certain income to the railroads, and if the railroads do not earn it, the government pays it. The farmer has nothing guaranteed him and he does not like the idea.

These politicians in whom the farmer believes, are going to Washington now and it is going to affect every one of you and all your associates in the next three or four years. They are going there with a definite program with respect to railroads. One of the first items on that program are a number of amendments to the Transportation Act, and some of them are even going to try to repeal it.

In 1873 the railroads of this country had been overdeveloped. They had been developed so far ahead of industry that there was not enough traffic to provide a fair return on their investment. As a result many railroads went bankrupt and we had what is known as the railroad panic of 1873. Millions of dollars were lost to investors in that period, and that curse has been handed up from one generation to another until today, supplemented by labor disturbances and politicians, we have created a national state of mind which concerns itself mostly with cursing anything that runs on two rails.

Today business has so far outstripped the railroads that they cannot keep up with it, and we have the biggest car shortage that has ever been known.

How does this affect business? If these railroads are not to be permitted more freedom, if they are not to be assured a fair net return, which will attract investors, investors are not going to put their money in the railroads; and if they do not put their money in the railroads, we cannot extend them, we cannot buy new equipment and we cannot improve present facilities.

How can we help the situation? By doing everything we can to discourage further increases in the regulation of railroads, either by the states or by the federal government. You can have a very great influence, working among your friends and among the politicians, in discouraging any further regulation. There are 99 bodies regulating the railroads in this country. In Congress there is always somebody who has an idea about the railroads and you may be sure that in the state legislatures there are two or three or four or maybe two dozen who have some new ideas about controlling the railroads. It is now almost impossible to do anything without permission from somebody. The public is amply protected, and so are the employees, so that no harm could come to either, if we had a less restrictive form of regulation.

There has lately appeared to be among employees an increasingly friendly interest in the railroads, and some of them have been sending to our office for pamphlets. Now, we could not get away with falsehoods about the railroads if we tried to, because the facts are matters of public record, and we could immediately be called to account. So you may feel safe in sending for any information about the railroads you need.

Scheduling Cars Through Repair Shops*

By E. H. Hall

Supt. Shops, Pere Marquette

SCHEDULING means two things to those who are responsible for shop operation. The first is output and the other is efficiency. These are attained by catching shop delays when they happen and not at the time you are expecting the car to leave the shop.

An important factor in scheduling equipment out of repair shops is first to establish a master schedule, and when a car arrives at the shop, to schedule or route that particular unit through the shop so that you know on the day it comes in what day it is going to leave there. The master schedule insures that you haven't all of your men on the one car at one time.

Having the master schedule, the first thing to be done is to make a thorough inspection of the car on the receiving track and determine what class of repairs it is to receive so that everybody in all the shops will know just when they are going to start on that car and when they are going to get off of it.

This tends to create rivalry between different departments.

One department is often the cause of another department not being able to get its work out. Now, with a schedule, everybody in each department knows that he has to be off that car at a certain time because another gang from another department is due at that time. If the carpenter work and the finishing and trimming is not completed, the painters will be held up. The schedule uncovers the delay when it happens.

Each night you can go through the shop and make a summary of delays, and you can go out and investigate them right then. You can probably make up the time lost where one department blocks the other, and it is to each department foreman's interest to keep out of the way of the other fellow

You cannot make the form of the schedule board uniform for all shops. Each shop should prepare it in accordance with their classification of repairs and with their master schedules.

If any of you have gone through the Angus shops of the Canadian Pacific at Montreal, Que., you would readily realize what the schedule means, because I believe that shop has accomplished more through scheduling equipment than any other shop in this country. In my opinion, shop scheduling is far superior plan to the piecework schedule, because you have each fellow timed in a way that is not a dollar and cents proposition to him. You are figuring on output and you can revise the master schedules and pinch the time in one department if you think they are being allowed too much time, and are crowding another department. The result is that you will increase your output and the work will be more uniform, because each department is trying to keep out of the way of the other fellow.

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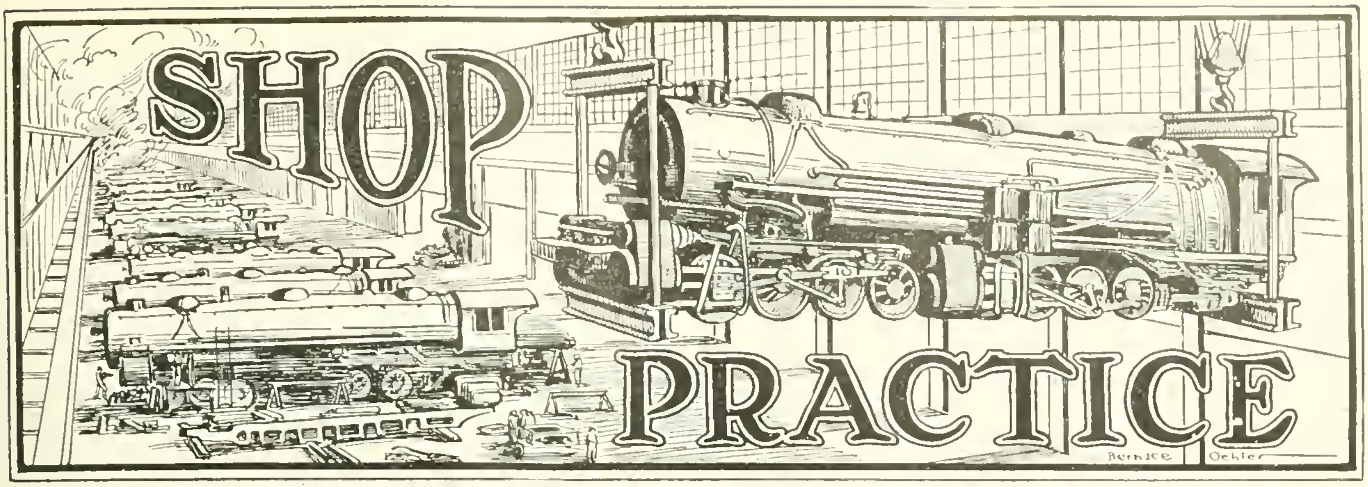
*To the convention of the Chief Interchange Car Inspectors and Car Foremen, Chicago, November, 1922.

*Paper presented at the convention of the Chief Car Inspectors and Car Foremen, Chicago, November, 1922.



Motion Work Bushing Press

A QUICK-ACTING press for applying and removing motion work bushings is illustrated in Fig. 1, the general arrangement of the press, piping and driving pulley being shown in Fig. 2. This hydraulic press is driven by a belt through tight and loose pulleys. It has the advantages of being compact and quick acting and gives pressures up to 35 tons. When located in the machine shop convenient to the motion work job, a large amount of time and effort, formerly spent trucking motion work to the driving box press, will be saved, besides relieving the congestion at the larger press.

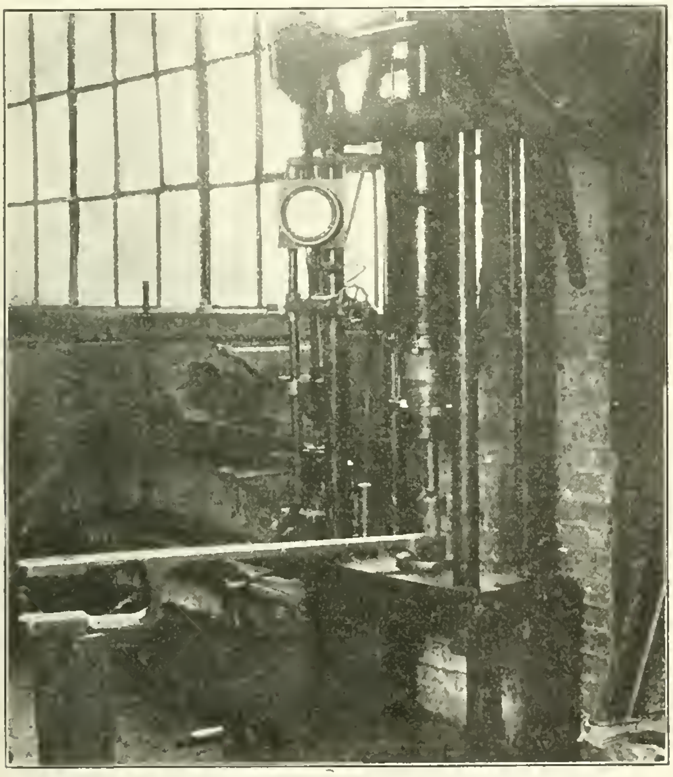


Fig. 1—Quick-Action 35-Ton Bushing Press in Operation

Referring to Fig. 2, the construction of the motion work bushing press will be obvious. The operating cylinder is supported between two substantial plates, rigidly distanced by four 3-in. round bars and nuts. The ram is operated by hydraulic pressure from the double eccentric plunger pump, a pressure gage and safety valve being provided as shown. The line of hydraulic pressure is indicated in Fig. 2, together with the position of the operating valve, supply, overflow and discharge pipes. The ram is returned, or raised, after each stroke by means of pneumatic pressure in the small cylinder at the top. This cylinder is made of 4-in. extra heavy pipe bored to a smooth surface internally and fitted with an air-tight piston. A suitable three-way valve controls the supply of air through a ½-in. pipe to this cylinder.

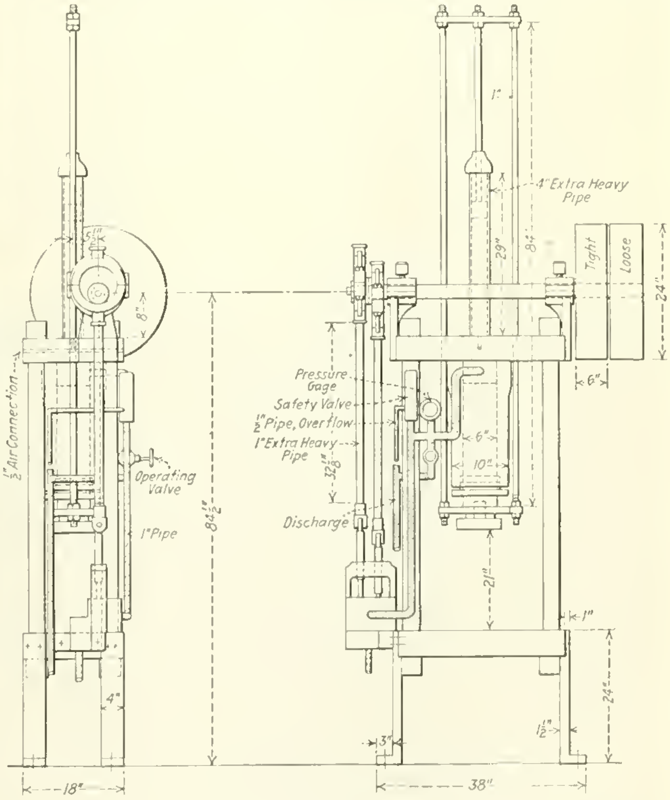


Fig. 2—General Arrangement and Dimensions of Hydraulic Bushing Press

After a motion work bushing has been pressed out or in, as the case may be, the belt is thrown to the loose pulley, stopping the pump. The main operating valve is opened wide, releasing pressure on the top of the ram and allowing free passage of the water to the discharge pipe, as pneumatic pressure in the small upper cylinder lifts the small piston, connecting rods and main ram. The upward movement of the ram is rapid but it can be stopped at any point in its stroke, being immediately available for further use at whatever elevation it is stopped.

Fig. 1 shows this hydraulic press applying a bushing to the foot of a lap and lead lever used in a Walschaert valve gear. The location of the press close to the wall and the small amount of space taken is plainly shown in the illustration. Presses of this type are a material factor in speeding up the repair of locomotive motion work, besides leaving the heavier presses free for other work.

Hammers for Testing Stay Bolts

By C. W. Carter, Jr.

Olean, N. Y.

SEVERAL kinds of hammers are used for testing staybolts, but the hammers shown in the accompanying sketch have been adopted as standard by one of the largest railroads in the United States. There are two different hammers, the 1-lb. and the 1½-lb. The 1½-lb. hammer is used to detect broken or cracked flexible staybolts or bolts in the crown sheet. The 1-lb. hammer is used to detect cracked or broken bolts of the solid type located in the door and side sheets. The handle used in the hammer, as shown by the sketch, has a very thin cross section located about three inches from the head. These hammers give satisfactory results, but different methods should be used in order to detect the defective bolts in different types of boilers.

As a matter of fact, the hammer is not the only requirement in order to obtain good results, for a great deal depends upon the person doing the inspecting. If one is not adapted to the position of boiler inspector, it is useless for him to try to become an expert as such.

In my opinion, in going over a boiler on a staybolt test, the inspector cannot get all the broken and cracked bolts. I have witnessed inspectors undergoing examination who were classed as good, but the results they obtained varied, some locating only one defective bolt while others located as many as 12 or 14. Some bolts which they marked as broken or cracked were of the flexible type and were merely unseated.

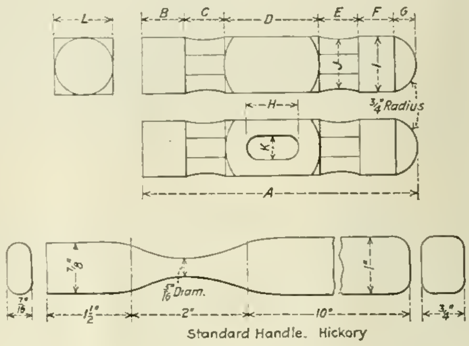
In our larger type of boilers, we apply a 100-lb. cold water test as soon as it enters the shop for repairs. In this manner we are able to get very good results in locating defective bolts, especially in the crown sheet.

Testing Flexible Bolts

To test flexible bolts, we remove all caps and strike the head of the bolt two or three good smart blows so as to finish the break if possible; then we take a round nose tool and strike the head first on one side then on the other, twisting it so that in case it is fractured it will break loose. I have seen several tell-tale holes leaking on hydrostatic tests, but have very seldom seen an inspector locate them while testing the bolts from the firebox side of the boiler.

DIMENSION SIZE

	1 Lb Hammer	1½ Lb Hammer
A	4 3/8"	4 7/16"
B	3/4"	15/16"
C	11/16"	11/16"
D	1 5/8"	1 9/16"
E	11/16"	11/16"
F	5/8"	9/16"
G	3/8"	3/8"
H	7/8"	7/8"
I	15/16"	1 1/4"
J	7/8"	15/16"
K	7/16"	3/8"
L	1"	1 1/4"



Details of Staybolt Testing Hammers

In striking a staybolt, if the hammer gives a quick rebound, the bolt is all right, but if it does not rebound and apparently sticks to the bolt it is cracked or broken. One must not depend altogether on the rebound, but upon the sense of hearing as well; a fractured bolt gives off a dead sound and is very often easily detected by one standing close to the inspector at the time.

The federal government requires that staybolts tested with water in the boiler must have at least 50 pounds pressure, otherwise the water must be drained and the test made, in which case the vibration of the sheet will indicate any unsoundness; the latter test is preferable.

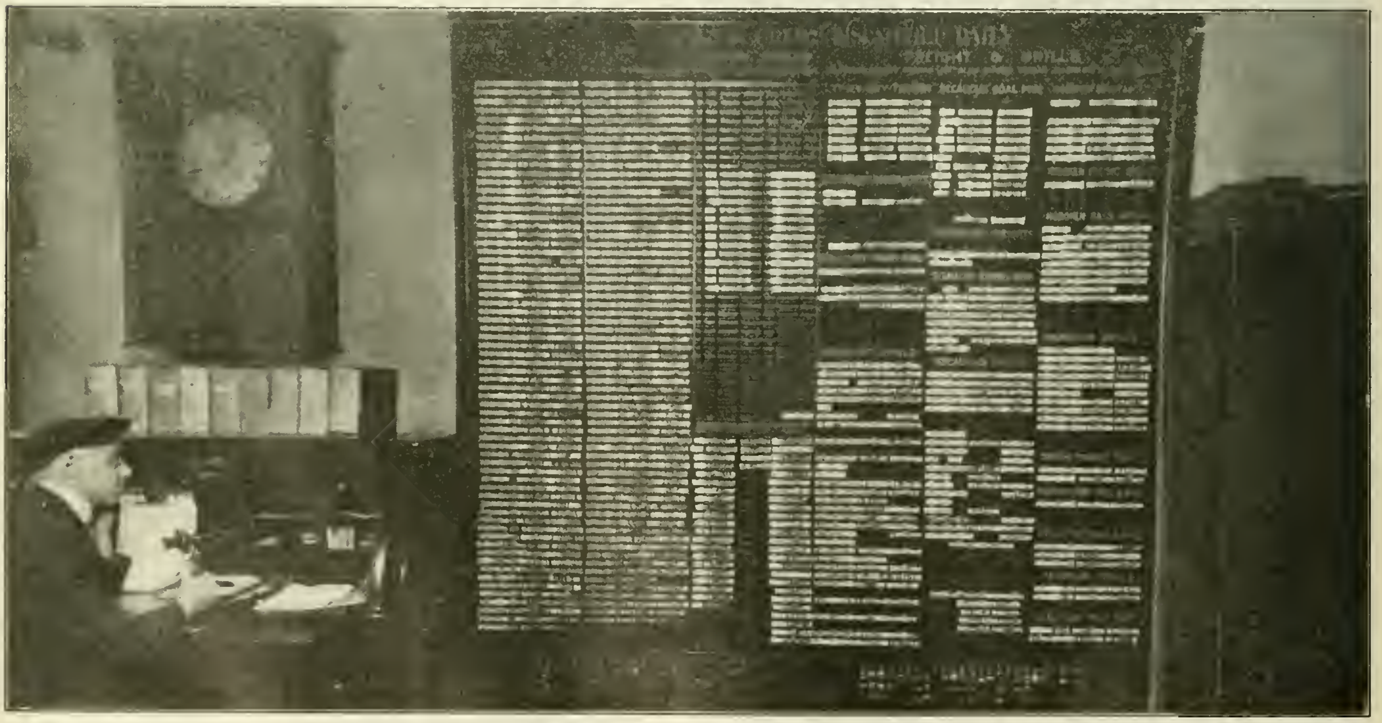
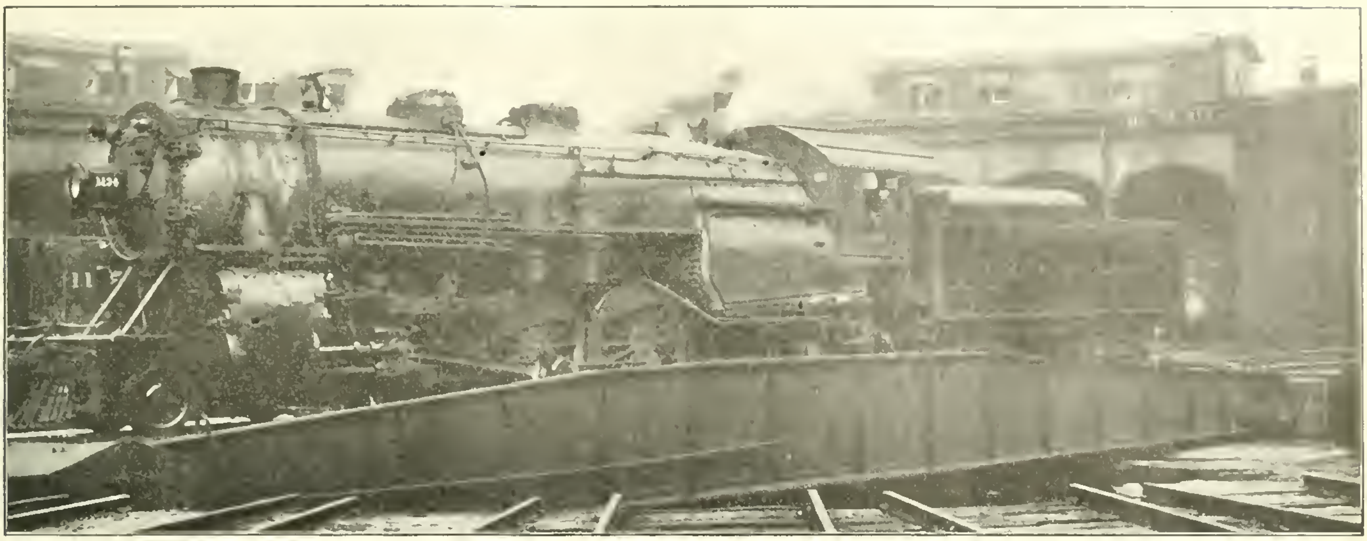


Fig. 1—Every Job and Every Man on the Roster of the Morris and Essex Division of the D., L. & W. is Shown on this Despatch Board



Locomotive 1134 Crossing the Turntable at Hoboken to take D. L. & W. Train No. 5 to Buffalo.

Despatch Board Gives Effective Control of Locomotives and Crews

SIMPLICITY and effective control of locomotives and crews are secured at the Hoboken enginehouse of the Delaware, Lackawanna & Western by means of the despatch board illustrated. This despatch board was designed by T. F. Barton, master mechanic, and put in operation about three years ago. When first installed, it was looked on with considerable skepticism and disfavor, but the fact that it is still in use after three years' trial proves its value for the purpose intended.

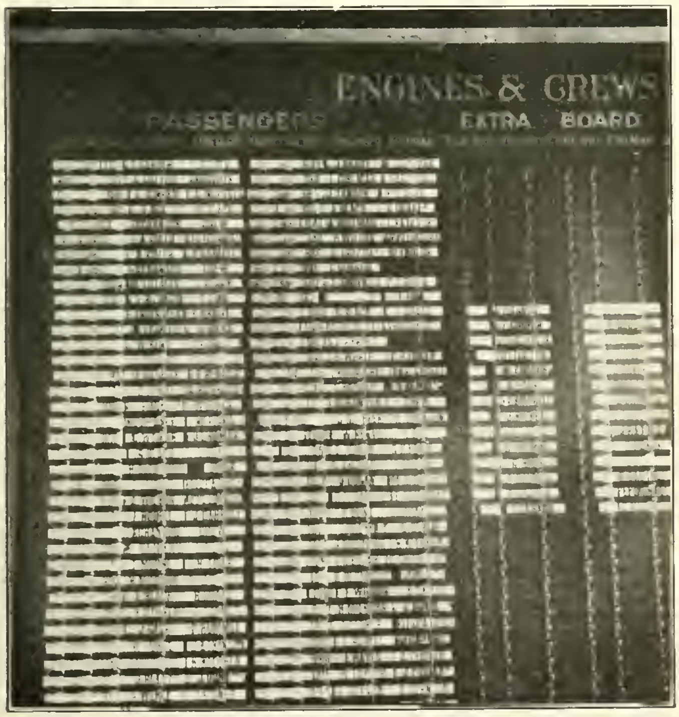


Fig. 2—Close-up of Corner of Despatch Board Showing Regular Passenger Runs and Extra Board

This board is of great assistance in handling the work of the despatcher's office at Hoboken for three reasons. It enables the despatcher to give information promptly and accurately; it gives him a check on his work; and it saves answering numberless questions which the crews can answer for themselves by simply looking at the board.

Every job and every man on the roster of the Morris & Essex division of the Lackawanna is shown on the board in Fig. 1 (see opposite page). These jobs are handled out of Hoboken terminal and 11 outside points where locomotives tie up and lay over. A log book is kept for a permanent record of messages received and moves made, but, by means of this despatch board, the despatcher has constantly in front of him the number of the locomotive to be used on each job, the time the job is called, the crew, and the present status of all crews, whether they are working, on the extra board, or laying off. The despatcher can therefore give any desired information promptly without the trouble and possibility of error involved in leafing through a voluminous log book.

The fact that all jobs and crews on the division are listed in a prominent place before the despatcher's eyes decreases the possibility of oversight in calling crews, or providing locomotives as needed. The location of the despatch board on the back wall of the despatcher's office where it can be readily seen through several windows from the engineman's room enables the crews also to examine the board and know who is assigned to each job. This saves the despatcher from answering many questions, and the men can exercise their seniority rights in the selection of desirable runs.

Description of Board

The despatch board is made of wood, about seven feet square, with headings painted at the top as indicated in Fig. 1. The names, train numbers, dates, etc., are printed on white cards which can be inserted and changed about in grooved card panels as desired. These card panels are removable, being held only by friction between the ends and the narrow vertical strips. Heading panels, such as "Harrison Drills," "Secaucus Tunnel Runs," etc., are twice as wide as card panels and are also removable for purposes of adjustment. If the number of Harrison switching jobs, for example, increases beyond the space allotted on the board, the heading "Harrison Drills" can be moved up one or more spaces, thus making room for additional cards. Compartments are provided at the bottom of the board containing extra cards, including those of enginemen and firemen who may have more than one run in 24 hours.

It will be noted that the despatch board is divided into six main vertical columns, the first two at the left being devoted to passenger runs, the third column to the "Extra Board" at the top and the "Laying Off Board" at the bottom, and the next three columns to extra freight, drill and roustabout jobs. Under the heading "Special Service," shown rather indistinctly at the bottom of the fifth column, are included the locomotives and crews assigned to extra jobs such as second sections, inspection trips, etc.

The two columns of regular passenger runs (shown in Fig. 2) indicate in each case the train number, time, locomotive number, enginemen and firemen, respectively. The "Extra Board" contains the name of each extra engineman and fireman together with the date and time of his last run. This affords a valuable check against calling him again inside of eight hours. The "Extra Board" also establishes the order in which men are to be called to substitute on regular jobs and thereby helps the despatcher. Another feature of importance is that a small red slip is inserted in front of the name of every man on the "Extra Board," and this slip is transferred with the name when the man is assigned to a job. In this way every extra man, whether on duty or not, can be instantly located on the board.

The "Laying Off Board" shows the name of each engineman and fireman who for any reason is off duty, and the date when leave of absence was granted. By showing the dates opposite each name, the despatcher is enabled to note and look up those who have been out unduly long without a satisfactory excuse.

Board Helps Locate "Missing Men"

As previously explained every man on the roster of the Morris & Essex division is shown on this despatch board. If he is not on the regular or "Laying Off Board" he must show on the "Extra Board." If not on the "Extra Board," the despatcher knows at a glance that he is missing and can endeavor to locate him. This is a very important feature, giving the despatcher a check on the men. Sometimes a job at one of the outlying points will be taken off the board and the despatcher not notified for 24 hours or possibly longer. If it were not for the board the crew might fail to report, laying off two or three extra days, possibly when most needed.

Holidays are usually busy times for the railroad and as is natural, many of the crews want permission to lay off. If they cannot get it, they use every possible subterfuge within their power. Sometimes they go on the "Laying Off Board" two or three days before a holiday in order to make sure that they get the day off. The despatcher has a check on this by means of the date, and then the fact that a man is known to be on the "Laying Off Board" has a tendency to prevent his staying off longer than necessary, especially if other men are trying to get permission to be off and cannot.

The operation of this despatch board may be made perhaps more clear by an illustration. If an engineman on a regular run is sick or has permission to be off duty, his card is simply taken from its regular place, leaving a vacancy, and put on the "Laying Off Board." The vacancy is a reminder to the despatcher that another engineer must be called two hours before the job starts to work. The despatcher then takes the card of the leading engineman from the "Extra Board" and puts it in the vacant place, calling the extra man two hours before the time the job is scheduled. The chances of oversight are thereby greatly reduced. When a regular man comes back he goes to work on his regular job and his card displaces that of the extra man who was taking his place. This extra man's card then goes back on the extra board with the date and time indicated, the man being available for call eight hours from that time. If an extra man lays off, when he returns to service his card is put on the "Extra Board" again.

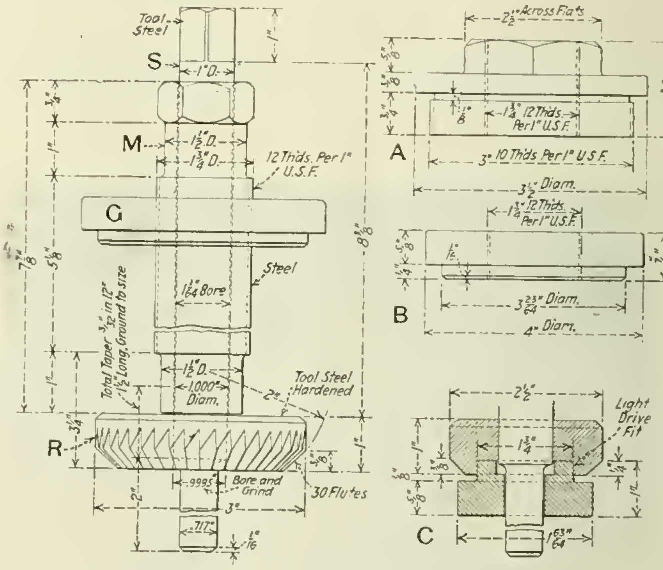
This despatch board is extremely flexible, comprehensive and readily understood. It is an invaluable aid to the Hoboken despatcher in controlling locomotives and crews on the Morris & Essex division of the Lackawanna.

Boiler Check Valve Seat Reamer

By E. A. Miller

OWING to excessive wear in service, boiler check valve seats frequently require a great deal of grinding. If the worn places on the valve seats are removed entirely by grinding with powdered emery or some other abrasive the operation takes a long time, and experience has shown that it is best to true up the seat with some form of reamer, the final grinding operation then being only a short one.

A special reamer with two guide caps designed for this purpose is shown in the illustration, the reamer *R* being a taper drive fit on spindle *S* which is a sliding fit in sleeve *M*. The lower end of the spindle serves as a pilot pin and the upper end is squared, providing a means of turning. Guide cap *G* is provided for application in the body of the valve, serving as a guide for sleeve *M* and spindle *S*. It will be noted that spindle *M* is threaded externally for longitudinal adjustment in guide cap *G*, being turned by means of the hexagon head at the top.



Much Laborious Hand Grinding Is Saved by This Boiler Check Valve Seat Reamer

In operation, this device is inserted in the boiler check valve with the end of the spindle and the guide cap accurately positioning the reamer. Sleeve *M* is then turned down until the reamer bears with a slight pressure against the valve seat. Turning the spindle *S* with a wrench will then true the valve seat, sleeve *M* being tightened from time to time until all worn spots on the valve seat are removed.

Two kinds and several different sizes of guide caps are required, the cap illustrated at *A* being used for small check valves and threaded into the valve body. For larger valves the guide cap shown at *B* is used, having no thread and being kept in place in the valve by means of an outside plate.

For 3-in. valves and larger the type of reamer illustrated, giving a ball seat, is used. Smaller valves require an additional guide bushing as shown at *C* and have a 45-degree bevel. In certain cases the valve seat is flat.

Determination of Boiler Operating Factors

Part 1

Two-Part Article Showing Methods of Checking Boiler-Room Efficiency—Test Results Given

By D. C. Hess

Stoker Engineer, Westinghouse Electric & Manufacturing Co., Philadelphia, Pa.

Recently there has been a radical change in the method of operating boiler plants equipped with underfeed stokers. There were times when it appeared to be common practice to drive all the boiler units in service at their maximum rating without regard for operating economy or maintenance costs. There are times in the average boiler plant when the sudden demand for steam requires that the boiler be operated at high ratings over the peak load periods. However, continued operation at high ratings for long periods has generally been recognized as not good engineering practice because of consequent low operating efficiency, lack of economy, and increased expense of maintenance.

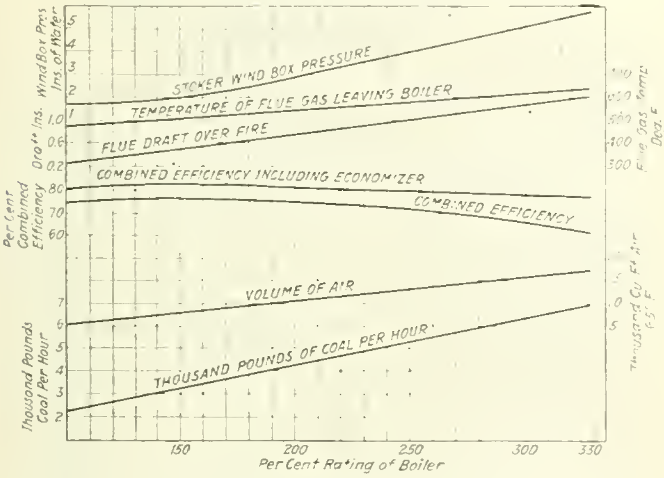


Fig. 1 Performance Curves of a Six-Retort Westinghouse Underfeed Stoker and 558 Hp. Boiler

Combustion Rates and Efficiencies

There is a certain combustion rate at which the stoker and boiler operate at their highest efficiency. This can be determined by running a series of short tests at varying rates of combustion, and, thereafter, an effort should be made to run as near this point as possible. However, usually this cannot be done because in case of a new plant the designing engineers have to consider various elements such as first cost, labor, etc. In the case of old installations, it will often be found that the load demand upon the station has outgrown the station, with resultant high overloads. In this discussion it should be considered that the plant will operate at the highest efficiency point, for if the plant operates at any other point, the same discussion holds good, but in a lesser degree.

Fig. 1 shows the result of a series of tests using Illinois coal in a six-retort Westinghouse underfeed stoker and a 558-hp. boiler. The grate area was 105.66 sq. ft. A rating of 328 per cent was obtained. The unit operated most efficiently at 160 per cent of normal boiler rating, when burning approximately 3,300 lb. of coal per hour. 550 lb. per retort, or 31.2 lb. per sq. ft. of grate surface.

Fig. 2 shows the results of a series of tests run with Pittsburgh district coal. Each 650-hp. boiler had a grate area of 123.27 sq. ft., which was supplied with fuel by a seven-retort Westinghouse underfeed stoker. The best efficiency was obtained at 185 per cent of normal boiler rating. It is also interesting to note the similarity between the combined efficiency and CO_2 curves of this test. There was a gradual rise in the flue gas temperature as the boiler rating was increased.

Operating Deductions

The results brought out by these tests show the essential conditions which are necessary to maintain the best operation of the stoker equipment. The point of highest combined efficiency for the first installation is 160 per cent of rating, while with the second equipment the best efficiency was obtained between 170 and 185 per cent of the rating.

The operating force in this plant has found that it can force this equipment to 328 per cent of rating if necessary. The condition of the furnace after a high rating test will determine the effects of the high temperature on the furnace walls and stoker parts.

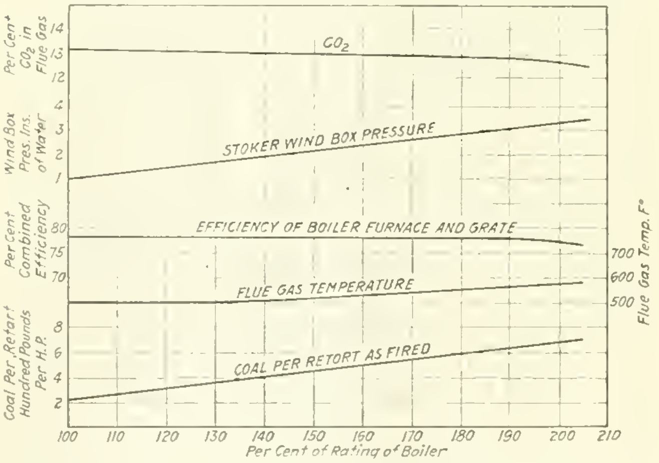


Fig. 2 Performance Curves of a Seven-Retort Underfeed Stoker Firing a 650 Hp. Boiler. Average B. t. u. of Coal As Fired 12,358

The type of stoker and fan driving equipment should be determined by the heat balance of the entire plant. If additional exhaust steam is required for feed water, engine- or turbine-drive will be preferable from an economy standpoint. On the other hand, if plenty of exhaust steam is available, it might be preferable to use motor drive.

Prevention of Clinker Formation

Clinker trouble is usually not so pronounced in most underfeed stoker installations until high ratings are reached, and high furnace temperatures are being maintained. If the coal being used contains a low fusing ash, it is evident that clinker trouble will be encountered. Clinker in the fuel bed is hard to avoid, and in cases where they do not move to the rear with the movement of the fuel bed, a hook or slice bar has to be used. Recent changes in the design of boiler bridge walls tend to decrease furnace temperature and with it to some extent the formation of clinkers. This is accomplished by sloping the front surface of the bridge wall backward so that the rays of heat impinged upon it reflect directly into the boiler tubes and not back into the fuel bed. Also, the latest engineering practice is to expose all tube surface possible to the fire, thereby decreasing the furnace temperature.

In some plants side wall and bridge wall clinker troubles are avoided by the use of steam jets. On the other hand, many plants are using side wall tuyeres (Fig. 3) in connection with underfeed stokers. These side wall tuyeres are cast iron air boxes which extend above the side retorts and down along the side walls. They are rectangular in shape and fit closely together, but allow room for expansion and contraction. A large cored central space feeds air to the holes in the surface. The air issues at right angles to the wall or tuyere face. At plants where these side wall tuyeres are in use the side wall clinker trouble has been entirely eliminated, also the life of the boiler walls has been considerably increased. While the maintenance of the tuyeres is low, due to air cooling the metal, stokers equipped with these tuyeres burn high-ash western coals and low-ash eastern coals equally well. Several furnaces have been in operation over three years with very satisfactory results. The air admitted through these side wall tuyeres has little or no effect on the CO_2 as the air is admitted below the surface of the fuel bed and serves as an aid to complete combustion.

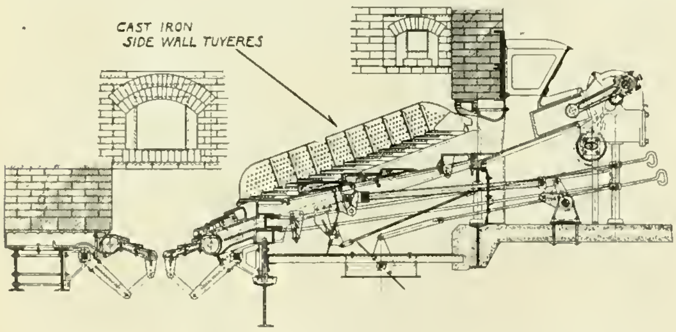


Fig. 3—Double Dump Moving Grate 17 Tuyere Underfeed Stoker with Side Wall Tuyeres

Instruments Aid Efficient Operation

Central station engineers are fully aware of the necessity for supplementing an expensive boiler plant with a few reliable instruments that are absolutely necessary for efficient and successful stoker operation. This does not mean that an elaborate set of instruments is necessary, but every boiler plant unit should be equipped with draft gages for measuring the pressure of the air in the windbox, in the combustion chamber and in the last pass or in front of the stack damper. A recording or indicating CO_2 apparatus is also desirable for close combustion regulation.

Steam flow meters are extremely valuable boiler appliances. The use of such equipment gives a good check on the combined efficiency of the boiler and stoker.

The ability of the coal to ignite and burn readily in the grates is quickly determined by such actual operating tests. Moreover, such tests have repeatedly proved that very good results can be obtained from cheap coal. The proper ratio between the rate of coal feed and approximate air pressure for various grades of coal will be quite evident after a series of such tests, at different ratings.

Pyrometers are valuable for determining the flue gas temperature. A high stack temperature means that a relatively small amount of heat is being absorbed by the tubes. This is caused in most cases by defective baffling and dirty tube surfaces. Also a balanced draft in the combustion chamber decreases the infiltration of air through the setting, and thus is conducive to higher efficiency. Power plant engineers have taken time to study the theoretical side of combustion from its economy standpoint and have saved thousands of dollars each year in the fuel alone. They understand just what a two or three per cent increase in CO_2 means, also the greater evaporation per pound of coal by keeping the flue gas temperature at its lowest possible point. The result in dollars and cents has been most gratifying.

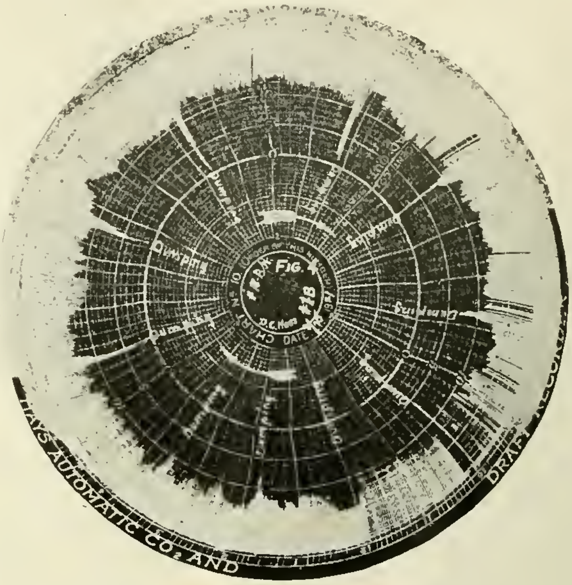


Fig. 4—A 24 Hr. CO_2 Chart Taken at a Western Pennsylvania Steel Plant. Average Value of CO_2, 12.5 Per Cent

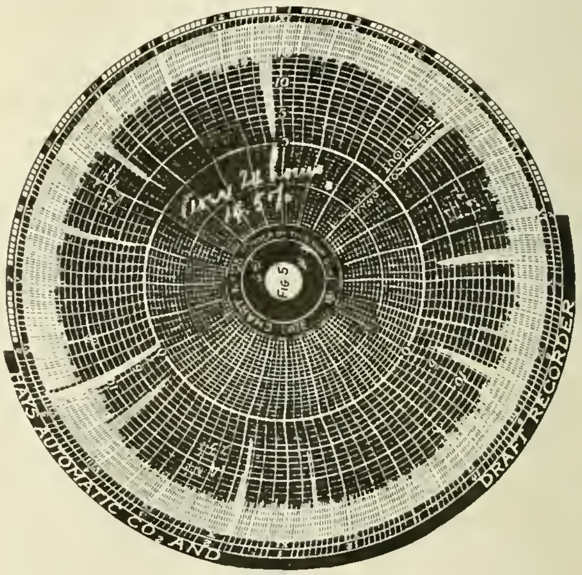


Fig. 5.—A 24 Hr. CO_2 Chart Taken at a Western Pennsylvania Steel Plant. Average Value of CO_2 on the Same Unit, 14.5 Per Cent

Fig. 4 shows a CO_2 record for 24 hours' operation, the average value being about 12.5 per cent. Fig. 5 shows a chart with an average CO_2 content of 14.5 per cent on the same unit. These CO_2 charts were made at a western Pennsylvania steel plant. They certainly tell the story to the management as to which is the best fireman and which unit is getting the best results. Note the CO_2 drop at each fuel bed cleaning period, which is caused by excess air being admitted through the side doors and dump grate openings. This emphasizes the advantage of the mechanical steam dump which aids the operator in cleaning the fires quickly. Dampers are provided on the dump grates of the stokers under consideration, to prevent an excess of air from being admitted up through the dump grates at cleaning periods. These dampers are opened to burn excess fuel on the dump grates, thereby increasing the combustion rate and reducing the carbon content in the refuse. In comparing the two CO_2 charts it will be noted that there is a two per cent difference between the average of Figs. 4 and 5. This is approximately a two per cent fuel loss in the operation of the stoker from which Fig. 4 was taken. This fact emphasizes the importance of the boiler test for setting the operating pace.

(To be continued)

Shop Improvements Under Way at Richmond Hill

Important Improvements at Long Island Locomotive Shops Well Under Way—Some New Machines Already Working

PRACTICALLY all of the work involved in the repair and maintenance of Long Island locomotives is done at the general repair shops located at Richmond Hill, Long Island. These shops were operated for years with only minor improvements and in an endeavor to bring the shops up to date so that locomotive repairs can be carried on more effectively, the railroad has instituted an extensive improvement program under the direction of G. C. Bishop, superintendent of motive power.

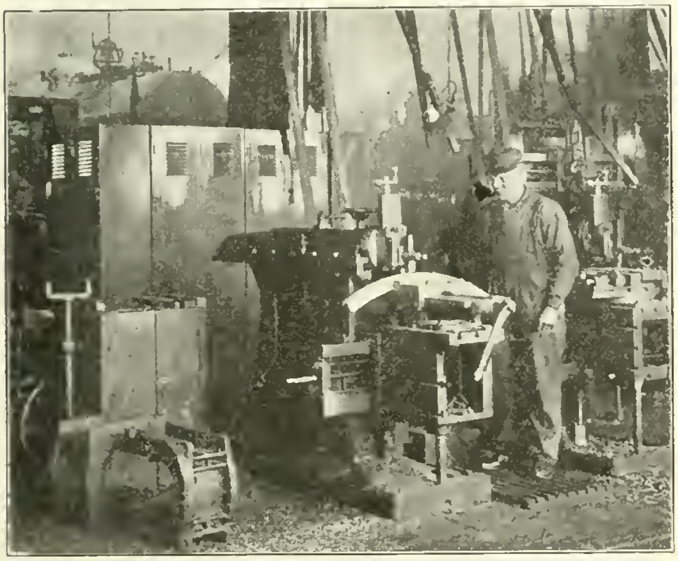


Fig. 1—Shaping a Reverse Lever Quadrant—New Steel Lockers in Background

This improvement program involves among other things the provision of additional crane facilities, with a 150-ton crane for handling locomotives. Considerable new machinery has been purchased, including a special car wheel boring machine and a double-acting wheel press. This machinery and the entire wheel job will be taken out of the main shop and segregated in an adjoining building, thus relieving the congestion in the main shop to a considerable extent and greatly facilitating the trucking of material back and forth through the shop. Every effort will be made to provide good working conditions and a step in this direction has been taken by the installation of new steel lockers in which the men can hang their clothing and personal effects. These lockers are distributed at convenient points throughout the shop, a series of 12 lockers being shown in the background of Fig. 1. These steel lockers replace old wooden lockers and boxes and, in addition to being considered very desirable by the men, greatly reduce the fire hazard. A master key is provided for the foremen, who, thereby, have access to the lockers for purposes of inspection or in case keys become lost. The possession of the master keys avoids the necessity of breaking into the lockers and in addition facilitates the periodical inspection of all lockers. Experience has shown that such inspections are necessary since the shopmen will otherwise succumb to their well-known weakness of accumulating large numbers of tools (many of which they can never use) in their private boxes or lockers.

New Machines Already Installed

Some of the new machines recently purchased have already been set up in the machine shop and are producing good work. One of the most productive of these machines is the vertical turret lathe illustrated in Fig. 2. This type of machine is of great value in railroad shops owing to the variety of locomotive parts which can be rapidly machined on it. The provision of the turret boring head in combination with the side head effects an important increase in the number

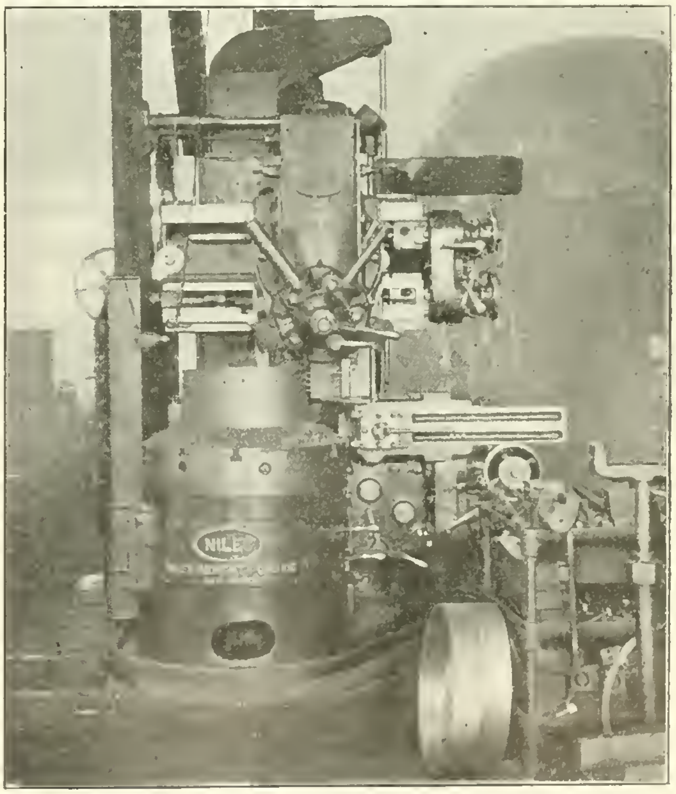


Fig. 2—The Vertical Turret Lathe—A Production Tool

of operations which can be performed at one setting of the work. Speed and feed changes are quickly made and the convenient location of operating levers permits a big output to be secured from the machine.

The vertical turret lathe is used as in other shops for miscellaneous boring, turning and cutting-off operations on piston rings, piston heads, valve rings, valve chamber bushings, eccentric cams, eccentric strap liners, etc. The speeds and feeds used in making the piston rings illustrated in Fig. 2 may be of interest. These rings are 20½ in. in outside diameter, being 13/16 in. wide and ⅝ in. thick. There are 16 rings in a packing pot and it takes about 4½ hr. to set up the pot and machine the full set of rings. The inside and outside diameters are machined at the same time, using the boring and side heads with a feed of .037 in. per revolution. The speed of the packing pot is 13 r. p. m. The inside and outside diameters are then finished using the same feed but speeding up the packing pot to 18 r. p. m. The packing rings are cut off four at a time by means of the multiple cutter illustrated, using a feed of .004 in. per revolution and a speed of 9.3 r. p. m. Piston heads for the 20-in. cylinders are machined in about 1½ hr. Piston bull rings are bored, turned and faced in 3 hr. Piston spiders are bored and faced in 1½ hr.

One of the new machines which has proved adaptable to a wide variety of work is the 15-in. heavy duty slotter illustrated in Figs. 3 and 4. This machine is driven by a two-speed countershaft providing eight speeds from 8 to 48 strokes per minute. The available feed variation is from 0 to ⅜ in. per stroke. After increased power and rigidity, the most important advantage of this new machine over the old slotter used at Richmond Hill is largely due to the single pulley drive with gear box enabling the speed changes to be made quickly. The clutch and brake are both on the same pulley at the rear of the machine, operation of the shifter in one direction applying the clutch and in the other direction the brake. By this arrangement the slotter can be stopped with the tool bar in any desired position. The gear-shifting mechanism is provided with an interlocking device which prevents any possibility of shifting the gears until the slotter is stopped. This makes the machine practically fool proof and prevents the possibility of stripping gears.

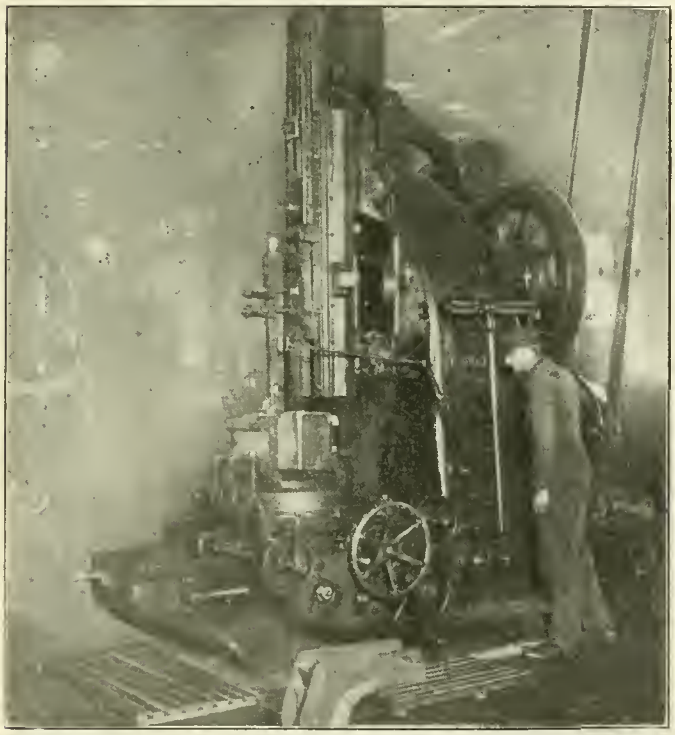


Fig. 3—New Slotter Proves an Efficient and Versatile Machine

An important feature of this slotter is the arrangement of the tool bar with a home-made device for relieving pressure on the cutting tool on the return stroke. The cutting tool, best shown in Fig. 4, is held in a pivoted block arranged with a spring so that on the down stroke the block is held rigidly against the bar, but on the up stroke the block pivots, allowing the cutting tool to swing back and drag lightly on the work. In this way the cutting tool is relieved of heavy pressure on the return stroke, thereby greatly increasing the cutter life.

Slotting steel driving boxes for the crown brass and cellar fits is one operation efficiently performed on this machine. The work is accurately and rapidly done and, on the 12-in. driving box shown in the illustration, takes approximately 2½ hr. A roughing and a finishing cut, using 3/32 in. feed in each case, are taken. For roughing, about 22 strokes per minute are made and for finishing, the slotter is speeded up to 28 strokes per minute. Keyways in driving wheels are slotted in 30 min. and in eccentric cams in about 20 min. respectively. The journal brass fits in cast-iron truck boxes are slotted in 1½ hr., including the time of set-up, using a feed of 3/32 in. and 37 strokes per minute. These truck boxes are used on the electrical equipment on the Long Island.

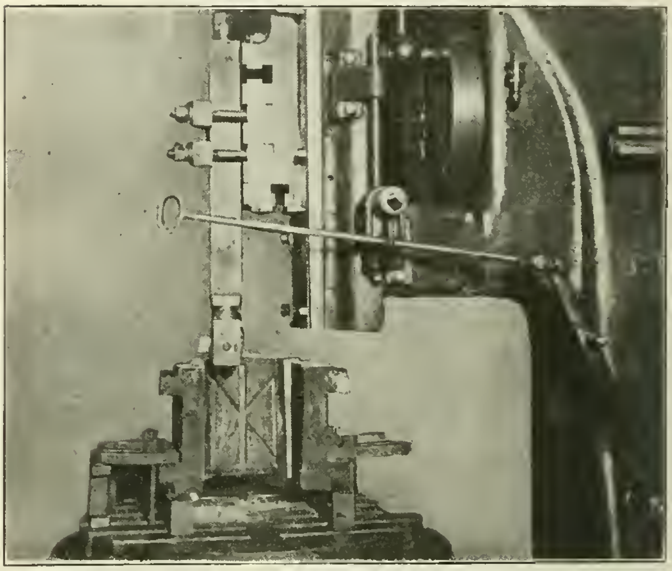


Fig. 4—Close-up of Slotter Ready to Machine Crown Brass

Another job which is peculiarly a slotter job is the machining of underhung steel spring stirrups. These stirrups are first planed on two sides but owing to their proportions, it would not be difficult to finish them on the planer. Each stirrup has to be machined where it fits up into the driving box and also where the spring has its bearing, as shown by the dotted lines in Fig. 5. As in all slotting jobs the time required will depend to a considerable extent on how much material must be removed. On the average, it takes two hours to rough and finish a spring stirrup using a 3/32-in. feed and 22 strokes per minute for the roughing cut. The same feed and 28 strokes per minute are used for the finishing cut. This machine is also used for general slotting operations as they come up in the shops.

Conveniently-Operated Hydraulic Press

The hydraulic press illustrated in Fig. 6 has been put in operation recently at Richmond Hill and may be accurately described as a labor-saving tool. It provides pressures up to 60 tons with a ram stroke of 30 in. for the application of driving box crown brasses and rod bushings. When the press is not busy on this work, it is sometimes used for applying motion work bushings. The press applies crown brasses or rod bushings quickly by simply moving the lever shown in the operator's hand in Fig. 6. The gage above the operator's head registers the pressure, which must be held within certain definite limits. By means of a quick return stroke there is practically no lost time in getting ready for the application of the next driving box crown brass or rod bushing.

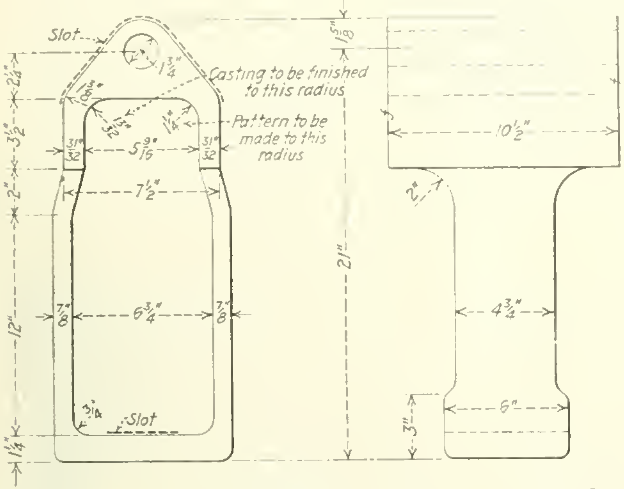


Fig. 5—Dotted Lines Indicate Slotting Operations on Steel Spring Stirrup

A convenient feature of this machine is the pneumatic auxiliary hoist shown at the left, arranged on a swinging arm along which it can move by means of the double roller carriage indicated. A rear view of the press is shown in order to make clear the arrangement of the cast-iron platform *P* arranged at the same height as the bed of the press. The driving box can be easily hoisted to this platform, slid along to the press and the brass applied by one man without the expenditure of a great amount of energy. Should a large number of driving boxes accumulate the provision of a helper to line up the boxes on the platform will materially speed up the operation.

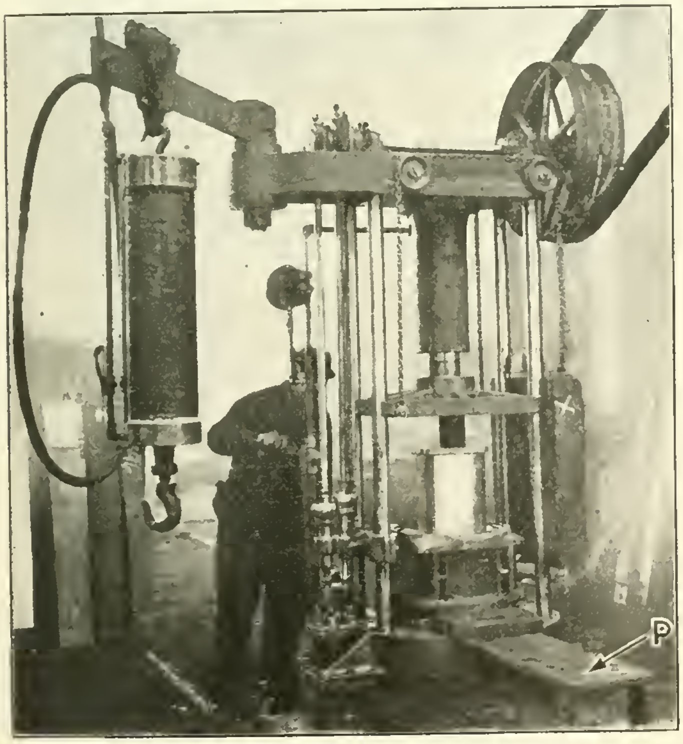


Fig. 6 A Reliable, Easily-Operated Press is Essential for Applying Crown Brasses

The turret lathe illustrated in Fig. 7 is shown not because it is strictly speaking a new machine but because of the unusually large work being done on it. The cast-iron tankwell, shown in the illustration, is 14 in. in outside diameter and while primarily not a turret lathe job, this illustrates the capacity of the machine to handle large work in emergency.

Plain Milling Machine a Valuable Shop Tool

Another of the modern machines installed at Richmond Hill which is giving satisfactory performance is a large No. 5 plain knee-type milling machine. This machine is used with suitable milling cutters for machining motor car axle bearing brasses in gangs of three at a time, removing 1/4 in. of metal with a table feed of 30 in. per min. and a spindle speed of 95 r. p. m. An unusual feature of this job was the discovery that cutters made of billet steel, case hardened, stood up better than high-speed steel cutters and showed a greater resistance to heating due to sand in the castings. It was not always possible to get good quality brass castings and after several experiments, case hardened cutters made of billet steel at the local shop were found to give the best service.

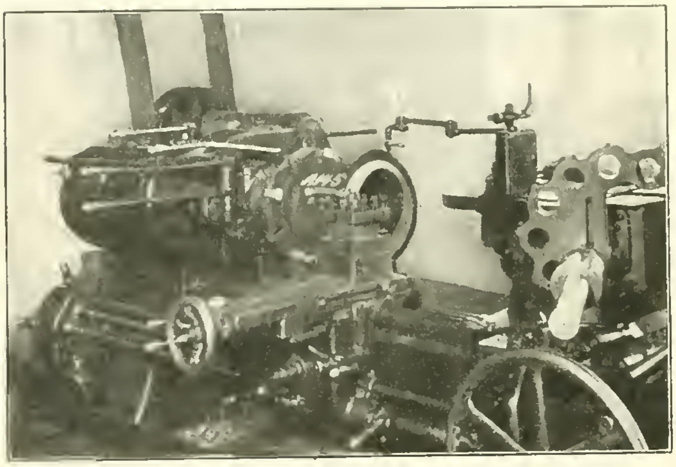


Fig. 7 Heavy Duty Turret Lathe with Chucking Equipment Machining Tankwell Casting

Both main and side rods are milled on this machine to advantage, the main rods being machined at the front end for the brass fit. It takes about 2½ hr., including the time of set-up, to mill the front end brass fit, the fit of the steel key block taking practically as much longer owing to the fact that an end mill must be used to machine for the shoulder. The fork ends of side rods are also machined on this miller in about ¾ hr. A spiral milling cutter supported at the outboard end is used, the cutter running at 24 r. p. m. and the feed being 5 in. per min. One roughing cut is taken through the center of the fork end leaving about 1/32 in. to be removed in the finish operation on either side.

Contrasting this operation with machining the side rod fork end on a slotter will be of interest. In the first place, several 2-in. holes, probably not less than four, would have to be drilled, taking in the neighborhood of three hours. Four hours would then be required to finish the fork end by slotting, the total time by this method being 7 hr., or a considerable increase over the time required to do the job on the milling machine. In addition to this work piston rod keyways, driving axle keyways, and many other small milling operations are performed to advantage on the plain knee-type miller.

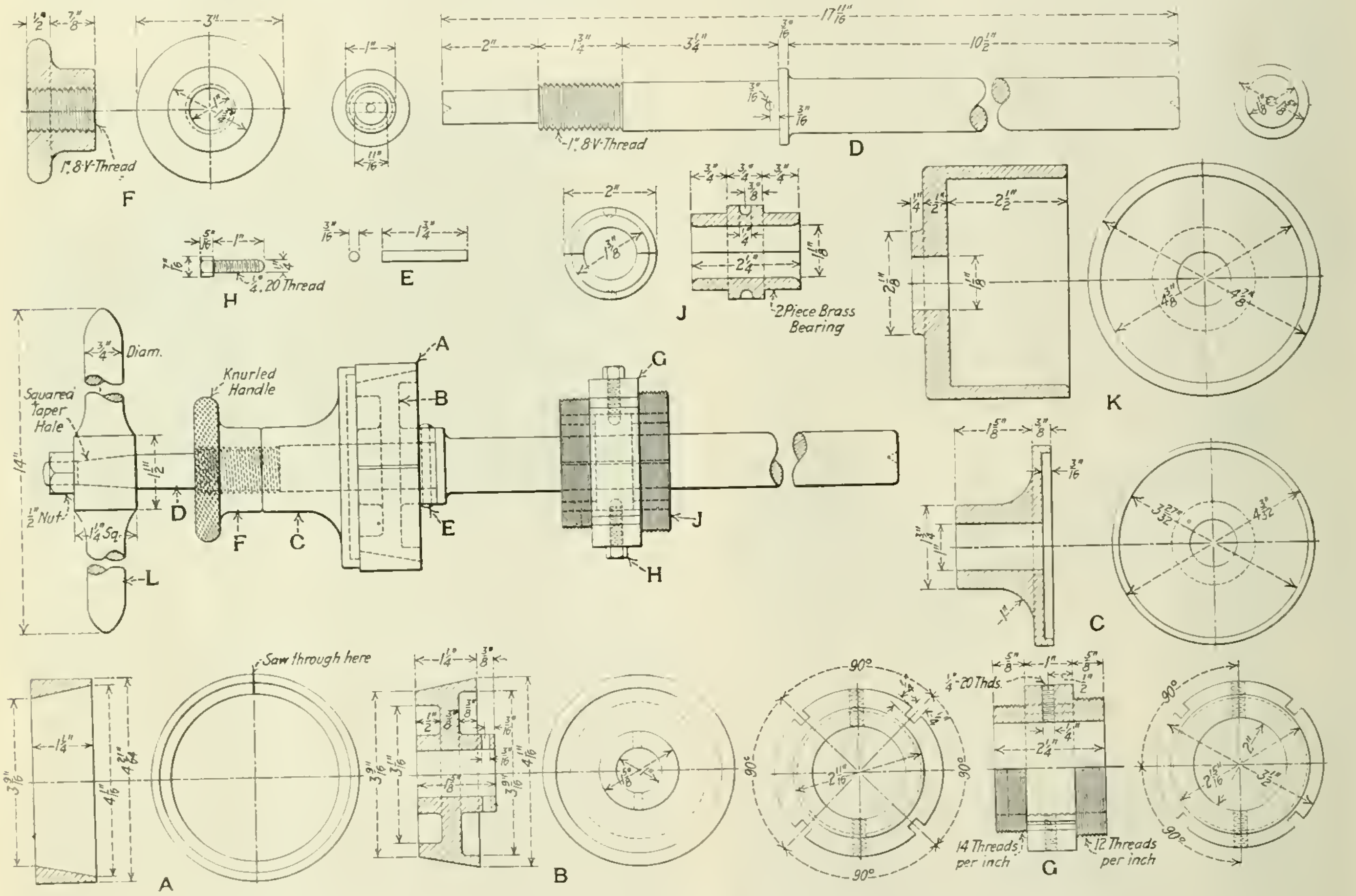
Further details of the improvements at Richmond Hill will be described in the *Railway Mechanical Engineer* as soon as the work has been completed.

Control Valve and Distributing Valve Cylinder Grinder

By J. D. Flinner

Supervsior of Air Brakes, Monongahela, Brownsville, Pa.

WHEN the cylinders of P. C. air brake control valves or E. T. distributing valves become worn and out of true, it is usually necessary to send them away to the factory for the application of new bushings, or the old cylinders must be trued on an internal grinding machine. This will enable new piston rings to be fitted accurately so that the valve will stand the test on a standard test rack. It costs money and takes time to ship valves away for the application of new bushings, and in many shops internal grinding machines are not available for truing the worn cylinders. Another way of overcoming the difficulty is by means of the tool, illustrated, which can be operated by hand and used to regrind and true worn control valve cylinders. (A similar tool could be readily devised for E. T. distributing valves or triple valves.) This tool is designed to true the cylinders of equalizing portions, one tool serving for both the equalizing and release cylinders, since they are both of the same diameter.



Assembled View and Details of a Simple, Effective Device for Truing Worn Control Valve Cylinders

In general, the tool consists of an expanding ring *A*, on the outer surface of which is glued a piece of 00 Aloxite cloth which contains the abrasive and performs the grinding. Ring *A* is made to expand by longitudinal movement on taper part *B*, which revolves with arbor *D* through the action of pin *E*. Revolution of the knurled handle *F* to the right with the arbor *D* stationary, obviously expands ring *A*. The arbor is guided by part *G* provided with a suitable bushing and arranged with threads on either end, to suit the respective chucking threads of the valve. Revolution of arbor *D* and expanding ring *A* with the abrasive cloth are secured by means of handle *L* provided with a squared taper hole for application to the end of arbor *D*. A one-half inch nut holds this handle in place. Part *K* is a protection for the grinder when not in use and is also used when applying new Aloxite cloth to ring *A*.

The 00 Aloxite cloth, which forms the abrasive in this case, comes in rolls 1½ in. wide and 50 yd. long and is not expensive. It is easily applied, using any good glue as follows: First cut a piece of Aloxite cloth that will go around ring *A*, coat it with glue, put it around the ring, insert the grinder head in part *K* and expand the head. Allow the head and Aloxite cloth to remain in part *K* until the glue has become well set; then with a sharp knife trim off the edges extending over rings *A*, and the grinder is ready for use

In operation this grinder should not be inserted in the control valve cylinder until all oil or grease has been carefully removed. Then insert part *G* and apply the grinder in the cylinder with arbor *D* through the guide bushing. Holding handle *L* still, the knurled handle *F* is turned until ring *A* expands and fills the cylinder. Revolution of handle *L* will then perform the function of a grinding wheel and take a light cut from the cylinder.

Inasmuch as the outer surface of expanding ring *A* is an accurate cylinder, the tendency is to remove high spots in the control valve cylinder and true it. The ring *A* should not be expanded so that it turns with great difficulty. Better results are obtained when the grinder turns easily, taking light cuts. The grinder should be pushed forward and back the full length of the cylinder while turning, thus giving a lapping effect which tends to keep the cylinder true as well as the grinder. A short time only is necessary to true cylinders with this device and as many as 40 have been ground with one piece of Aloxite cloth before renewal. It is highly essential that the cylinders be free from oil and grease.

Conveniently Located Lye Vat

It is quite common to find railroad shop cleaning tanks or lye vats located in a small outbuilding at some distance from the main shop. In such a case the additional labor involved in trucking locomotive parts to and from the lye vat is considerable, to say nothing of the time lost in getting these parts to the departments where they are to be repaired. In addition, the building is frequently unheated, and the resulting formation of steam in cold weather not only delays the cleaning operations, but creates an undesirable hazard. To overcome these difficulties, a rectangular sheet iron lye vat has been placed next to the stripping pit in the transverse erecting shop of the Pittsburgh & Lake Erie at McKees Rocks, Pa. It was originally intended to place this lye vat in a vacant pit, but subsequently a special pit was dug between adjacent tracks and the lye vat inserted in one end as shown in Fig. 1. Construction details, given in the drawing (Fig. 2), are published by courtesy of Karl Berg, shop superintendent at McKees Rocks, who states that the lye vat has been a material help in speeding up cleaning operations.

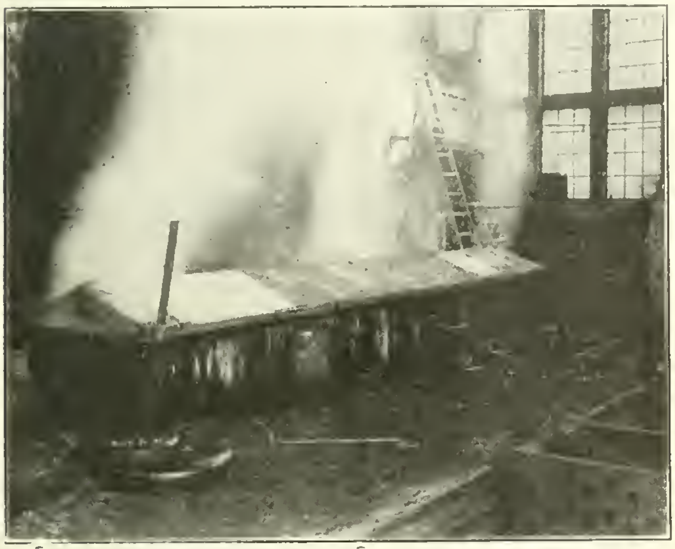


Fig. 1—Locomotive Parts Are Quickly Cleaned in this Lye Vat Located in the Erecting Shop Next to the Stripping Pit

This lye vat is large enough to take practically any locomotive part, with the exception of the driving wheels, and, being adjacent to the pit on which locomotives are stripped, brake rigging, spring rigging, binders, driving boxes, shoes and wedges, motion work, etc., can be quickly cleaned without undue trucking. Relatively small parts are placed in square baskets, one of which is shown in the lower right corner of Fig. 1. This basket is 3 ft. by 3 ft. by 4 ft. in size, being built of scrap boiler plates riveted to an angle iron frame work and having alternate square sections of the sides burned out as indicated, so that water can flow quickly in and out. This basket is arranged with a hinged bottom which may be tripped. Substantial ears on the sides enable it to be hoisted by a crane and suitable chains.

As the baskets are filled with locomotive parts needing cleaning, they are lowered in the lye vat and allowed to remain half an hour or whatever time may be necessary, depending on the amount of grease to be removed. At the end of that time the hinged safety covers on the lye vat are swung back and the baskets hoisted out, being moved one at a time to the other end of the pit where the parts are thoroughly rinsed off and cleaned with water from a hose. A close examination of Fig. 1 will show the guard rails which prevent any one from accidentally slipping and falling into the pit while performing this washing operation. The baskets are then hoisted out of the pit and the hinged bottoms tripped, allowing the parts to fall out on the floor where they are inspected, sorted and trucked to the proper shop departments.

Owing to the temperature of the parts, they dry quickly after being washed off and, as a result, clean, dry locomotive parts are sent to the various departments. This greatly increases the output and contentment of the men, as will be readily realized by anyone who has ever attempted to handle or repair locomotive parts only partially cleaned of dirt and grease.

Referring to Fig. 2, a plan and two elevations of the lye vat are shown, together with important details. The tank is practically 20 ft. long by 4 ft. wide by 5 ft. deep. It is built of ¼-in. boiler plate, angles, channels and Z-bars. It is supported on either side by plates under the pit rails and on the bottom by ten cross piers. The tank is grouted in place on these piers. A set of 1½-in. heater coils is provided in each side of the tank, being amply protected by

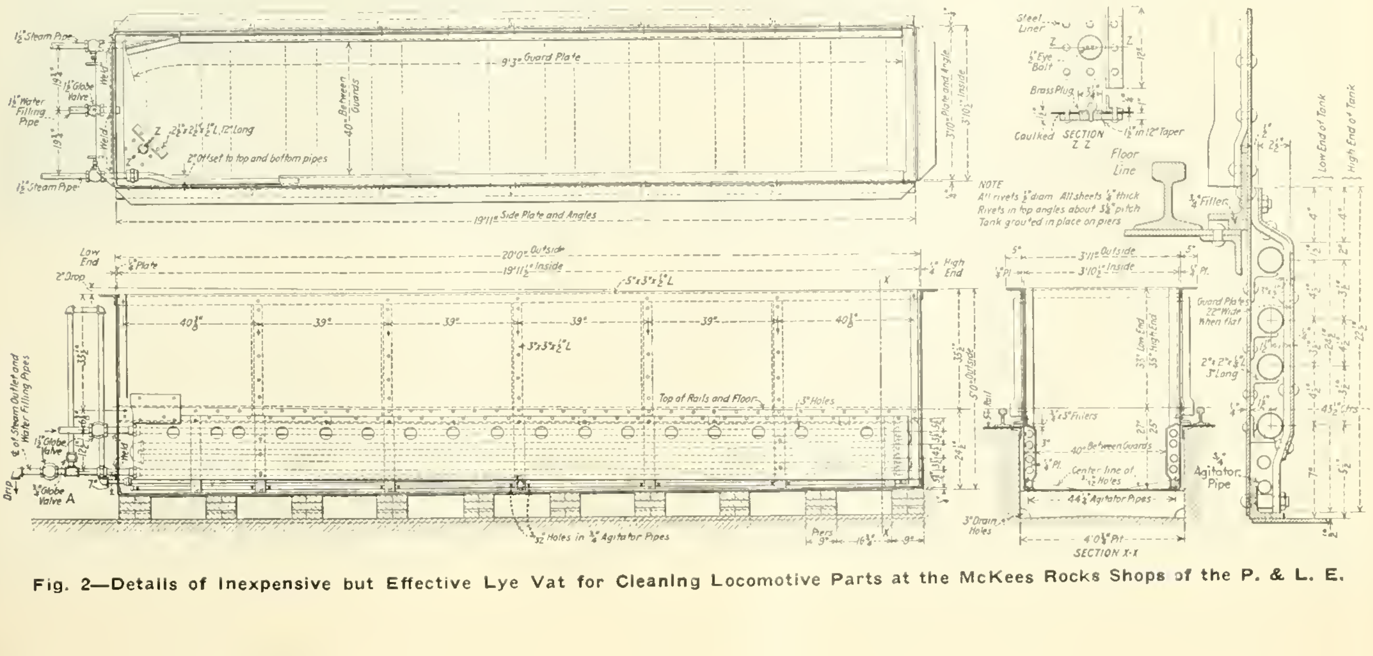


Fig. 2—Details of Inexpensive but Effective Lye Vat for Cleaning Locomotive Parts at the McKees Rocks Shops of the P. & L. E.

suitable guards. (It will be noted that the heater pipes are inclined so that no pocket is formed and the condensation drains out readily.) Globe valves control both the steam and the drip. A 1½-in. water-filling pipe is connected to the tank as indicated, also a brass plug in the bottom near the left end for cleaning purposes. From the detailed sketch it will be noted that the cleaning plug can be removed by means of an eye bolt, even though the tank be full of water.

A feature of this lye vat is the provision of an agitator pipe near the bottom of each side, drilled with 3/32-in. holes, so arranged that steam jets play on the bottom of the tank as shown in cross-section X-X (Fig. 2). This is an important feature, as it keeps the water in circulation, retards the formation of sludge on the bottom and hastens the cleaning of the parts. It will be noted that the steam inlet pipe to each agitator pipe is carried above the water level, this arrangement being necessary to prevent water from the tanks entering the 3/32-in. holes and backing up into the heater coil. Valve *A* controls the admission of steam to the agitator pipe.

Several interesting points developed when this lye vat was put in operation, one of them being that the parts to be cleaned must not be allowed to rest directly on the bottom. A false bottom was, therefore, constructed in four sections and made of channel irons placed crosswise, with longitudinal flattened boiler tubes riveted to them. By this arrangement the lye vat can be operated until the sludge in the bottom reaches the level of the boiler tubes. The tank is then emptied of water by means of the washout plug; the false bottom is lifted out, a section at a time; and the tank is cleaned in the ordinary manner by shoveling out the sludge. The false bottom is cleaned and reapplied, the tank then being filled with clean water and a new charge of alkali put in.

The temperature of the water in this lye vat can be readily maintained at the proper point by careful manipulation of the two inlet, two drip and two agitator pipe valves. With the drip valves closed, it is obvious that most of the steam admitted to the heating coils passes through to the agitator pipes, and this is usually sufficient to keep the water at the required temperature. Should it not be quite enough, the temperature can be raised by opening both steam inlet and drip valves a slightly greater amount. In general, it is desirable to keep the temperature of the water just below the boiling point so as not to waste steam, and yet get the maximum cleaning effect.

Forged Motion Work Bushings

ONE of the interesting jobs done in the Michigan Central blacksmith shop at Jackson, Mich., is shown in the illustrations and consists of making motion work bushings from solid round bar stock in a forging machine. Each bushing is made in one heat and with two or sometimes three strokes of the forging machine ram. The plungers and dies are of simple design and different sizes provide for all bushings commonly used in locomotive valve gear parts.

A pile of finished bushings 3⅝ in. in diameter by 4¼ in. long with an inside diameter of 2½ in. is shown in Fig. 1. Fig. 2 is a close-up view of the dies for these bushings set up in a 5-in. forging machine. The stock in this case consists of 2½-in. solid round bars, several bars being heated at the same time in a furnace adjacent to the forging machine. When one of these bars has reached a white heat for about six or eight inches on the end, it is inserted in recess *M* of the die. The left half of the die block (not shown in the illustration) then moves to the right, grips the stock, and the operation of plunger *A* compresses the end of the 2½-in. bar into a cylinder 4¼ in. long with an outside diameter of 3⅝ in. Before this cylinder has time to cool it is placed in the proper position in recess *N*, when 2½-in. plunger *B* presses the center out of the bushing leaving the center on the end of the original 2½-in. bar.

It will be noticed that this method is extremely economical, there being no waste of metal save for a few inches on the end of the 2½-in. bar. Bushings of the size shown can be made at the rate of about 25 an hour so that the labor cost is also small. Regarding the quality of the bushings, the result secured is entirely satisfactory. While it is probable that in tensile strength these bushings may not equal those machined from well-made tubing of good quality, it should be remembered that practically all of these bushings are pressed into various parts of the locomotive motion work or valve gear and are therefore subject to no bursting stress.

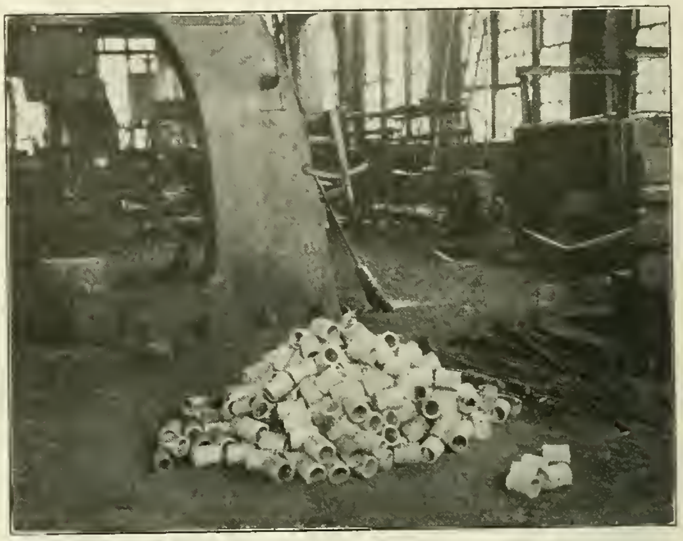


Fig. 1—Bushings Forged from 2½-In. Solid Round Bar Stock

Another important advantage results from the fact that it is not always possible to get tubing of the right size just when needed, and by making these bushings in the local blacksmith shop, the right size is always available or can be made up on short notice. The shop work is never held up waiting for motion work bushings. In addition, forging motion work bushings makes a good fill-in job for the forging machine which may not always be busy on heavy work. The forging machine represents a considerable investment and the manufacture of motion work bushings provides another job to assist in keeping the forging machine working to capacity.

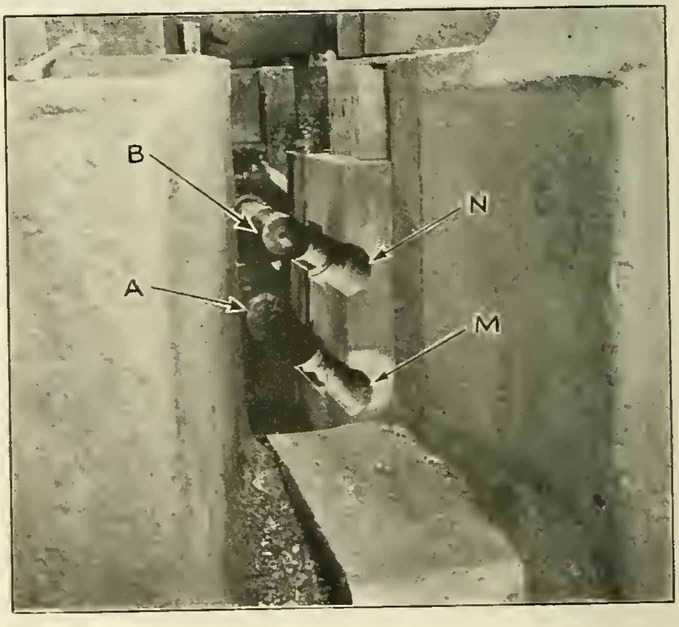
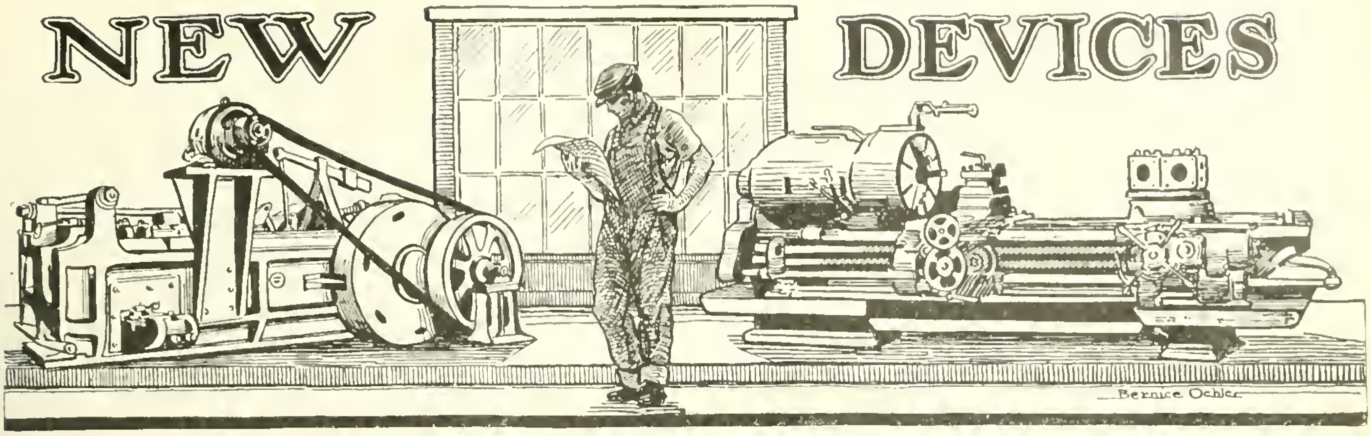
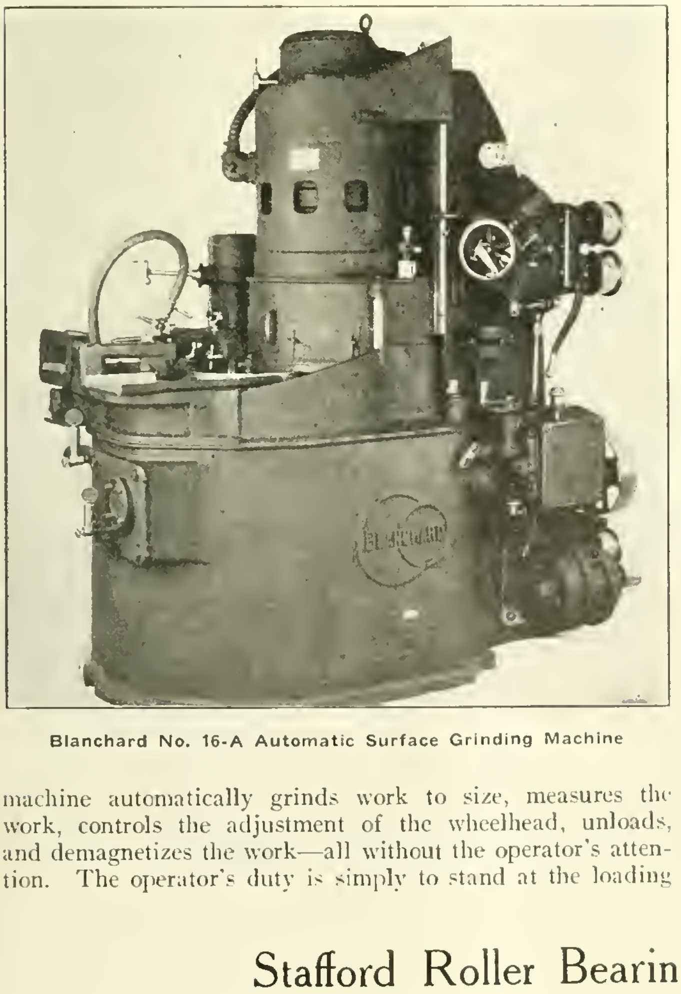


Fig. 2—Dies Adjusted in Forging Machine Ready for Operation



Automatic Surface Grinding Machine

THE No. 16-A automatic surface grinder, recently brought out by the Blanchard Machine Co., Cambridge, Mass., bears the same relation to former types of surface grinders that the automatic screw machine bears to the engine lathe. The machine is not simply one with automatic features: it is entirely automatic in its operation. The machine automatically grinds work to size, measures the work, controls the adjustment of the wheelhead, unloads, and demagnetizes the work—all without the operator's attention. The operator's duty is simply to stand at the loading station and lay the work continuously on the revolving chuck.



Blanchard No. 16-A Automatic Surface Grinding Machine

It will help in understanding the operation of the machine to follow for one grinding operation the course of a piece through the machine. At the loading position, where the piece is first laid on the rotating magnetic chuck, there is no magnetism and the piece starts around with the chuck, held in place by its own weight. Just before the piece reaches the water-guards it is held magnetically and, passing through an opening in the guards, is carried under the wheel, which has been accurately adjusted to height by the preceding pieces.

In passing under the wheel the piece is ground to size and it then passes out through the water-guards and under the wheel control caliper which automatically sets the wheel head to compensate for any wheel-wear which has just occurred. After the piece has passed the caliper the chuck becomes non-magnetic and the piece leaves the chuck, passes through a demagnetizer and thence down a chute to the holding receptacles. After the piece is removed, the chuck surface is washed with water, and then cleaned, so that it reaches the loading position, clean and dry.

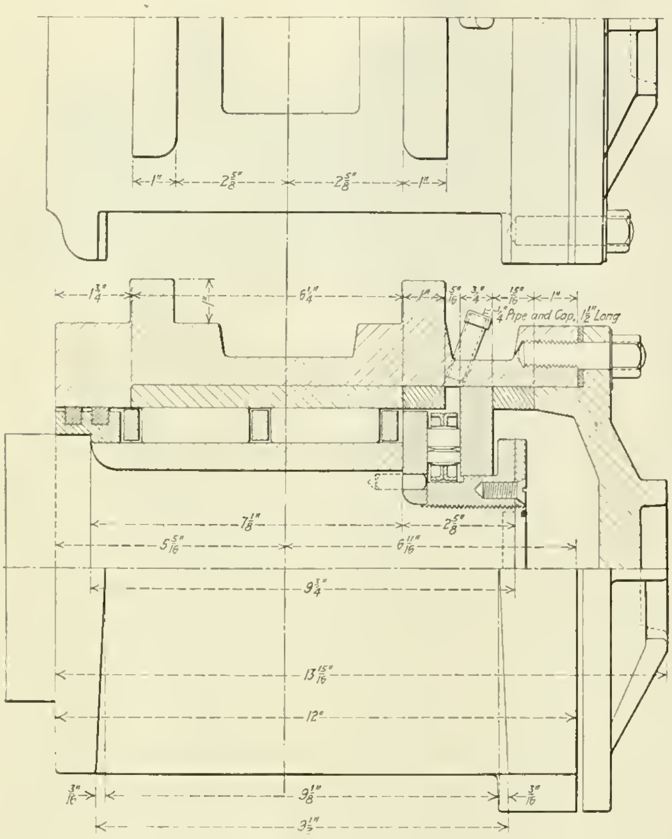
The rotating magnetic chuck is of one-piece steel construction and like other Blanchard magnetic chucks, is designed to be absolutely waterproof. As mentioned above, the chuck is only magnetic under the wheel and caliper; this is accomplished simply and without the use of sliding or moving contacts of any kind. The wheel control caliper is also of simple, sturdy construction so as not to get out of order or give trouble. The demagnetizer is connected to the motor circuit, starts and stops with the motors, and is of simple construction.

All controls are conveniently placed within easy reach of the operator. All important bearings and gears are lubricated by oil baths. Water-guards prevent splash and spray of coolant. The base forms a tank for 180 gallons of coolant and also acts as a settling pan from which the chips may be removed with the machine in operation. In the large railroad shops where many small parts requiring a ground finish can be made at one time this machine should prove a valuable time- and labor-saver.

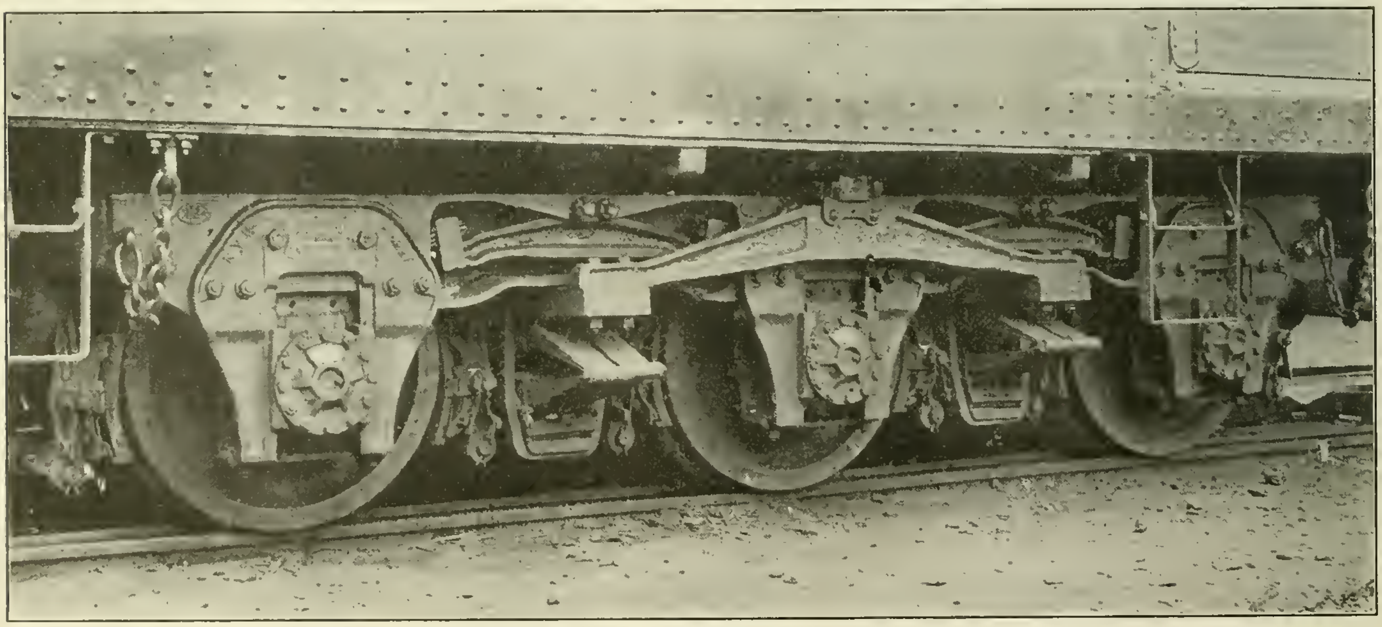
Stafford Roller Bearings for Pedestal Trucks

EARLY in January, 1923, the trucks of Michigan Central baggage car No. 1142 were equipped with Stafford roller bearings to replace standard 5-in. by 9-in. M. C. B. axles. These bearings are similar in design to those which have been in service on one set of Michigan Central freight car trucks since December, 1920. A number of detailed improvements, however, have been incorporated in the recent design of the bearings which differ considerably from those incorporated in the original design briefly described in the Railway Age, daily edition, of June 16, 1922, page 1460.

As originally designed the journal box consisted of three parts: the housing, a front cover and a back cover. To maintain a dust proof joint around the axle the inside vertical face of the back cover was provided with two circular grooves into which fitted corresponding projections on an oil- and dust-proof ring, which in effect formed an extension of the inside end of the journal bushing. This cover was bolted to the housing and in order to remove the housing and bearing it was necessary to get at the nuts on the housing studs in the limited space between the back cover and the wheel. In order to remove the back cover and the dust-proof ring it was formerly necessary to remove the bushing from the journal.



Sectional View of Stafford Roller Bearing and Journal Box



Stafford Roller Bearings with Pedestal Type Boxes

In the new design, with the exception of the front cover, in which no important change has been made, the housing is in one piece and the entire housing, with all contained parts, may be removed without difficulty and without disturbing the bushing on the journal. By referring to the sectional drawing of the bearing it will be seen that the inner end of the housing is closed by a ring which slips over the journal bushing and extends over the shoulder at the inner end of the journal. Grooves cut on the outer circumference of this ring receive two snap packing rings which maintain a tight joint against the inner circumference of the housing.

In applying these journals worn axles may be used. If the journal can be turned up to receive the bushing, without going below the standard wear limit, it may be continued in use indefinitely as the axle itself is subjected to no further wear. In the case of new axles the safe carrying capacity of the car may be increased, since no reduction in size takes place in service.

The main rollers and bushings and the thrust plates and rollers are of hardened chrome steel. The bushings are pressed into the cast steel housing with a pressure of 24,000 lb. and on the journal with a pressure of 8,000 lb.

Kind and Method of Lubrication

The approved lubricant for these bearings is a cylinder stock free from acids, alkalis and animal fats, semi-fluid in consistency. Instead of applying this through the opening shown in the drawing at the top of the box, a filling plug has been placed on the center line of the front cover. This prevents overfilling the box, the effect of which is not only to waste lubricant but to increase resistance in the bearing as well.

At various times during a period of service which now exceeds 25,000 miles, the bearings on a pair of Michigan Central freight car trucks have been examined to note their condition. Micrometer measurements have failed to reveal any evidence of wear, either on the rollers or the bushings. During this period, no repairs or other attention has been required by the bearings and the experience so far obtained indicates that one filling of the housings with the approved lubricant should run for two to three years. Starting resistance on straight, level track for a freight car of 122,600 lb. gross weight has been found to be four pounds per ton. For the baggage car, which has six-wheel trucks, the starting resistance, for the light weight of the car, is six pounds per ton.

Semi-Hot Bolt Header with Automatic Feed

A NEW and radical design of one-inch, semi-hot bolt and rivet heater with automatic feed has been developed by the engineers of the National Machinery Company, Tiffin, Ohio, and recently placed on the market. The bed frame in the new design, illustrated in Fig. 1, is only half as long as in previous models, and spring is practically eliminated, making it unnecessary to batter the heading tool against the gripping dies to properly fill out the head of the work. Some idea of the great strength and stiffness of the design is indicated by the fact that while the machine weighs 31,500 lb., it is only 51¾ in. from the center of the main shaft to the face plate, and the main shaft at the crank is 11½ in. in diameter.

The hard service and consequent wear on earlier automatic feed headers has been met by greatly increasing the size of all bearings and working surfaces, and adopting such features as the "suspended type" heading and gripping slides with bearings above the path of scale and water. All of the gripping toggles have been increased in size and are located horizontally to insure proper lubrication. The ultimate pressure that can be thrown upon the toggles and gripping mechanism is limited by a new type of automatic relief, making destructive pressures impossible. Last but not least, a fully automatic oiling system which oils every bearing of the machine automatically every ten minutes is provided, supplying a predetermined amount of oil for each bearing, proportionate to its service requirements. In a three-year test period, several machines of the new type have required no repairs or realinement, and working parts show practically no appreciable wear.

The previous trouble in die setting, resulting from the lack of a horizontal adjustment for the heading tool, has been overcome by mounting the heading tool in a bolster plate on the front of the heading slide, which, being screw-controlled in all directions, provides for quick and accurate adjustment of the heading tool with the gripping dies. This construction is outlined in Fig. 2. Where hours were previously required in alining the dies with the header, it is only a matter of minutes with this new construction. In fact, it is stated that users find it profitable to set up the machine for runs as low as 1,000 bolts or rivets. Three lengths of bolster plates are provided, so that on long, medium, or short work, the heading tool is always rigidly supported, and does not "overhang." This feature is one of great importance.

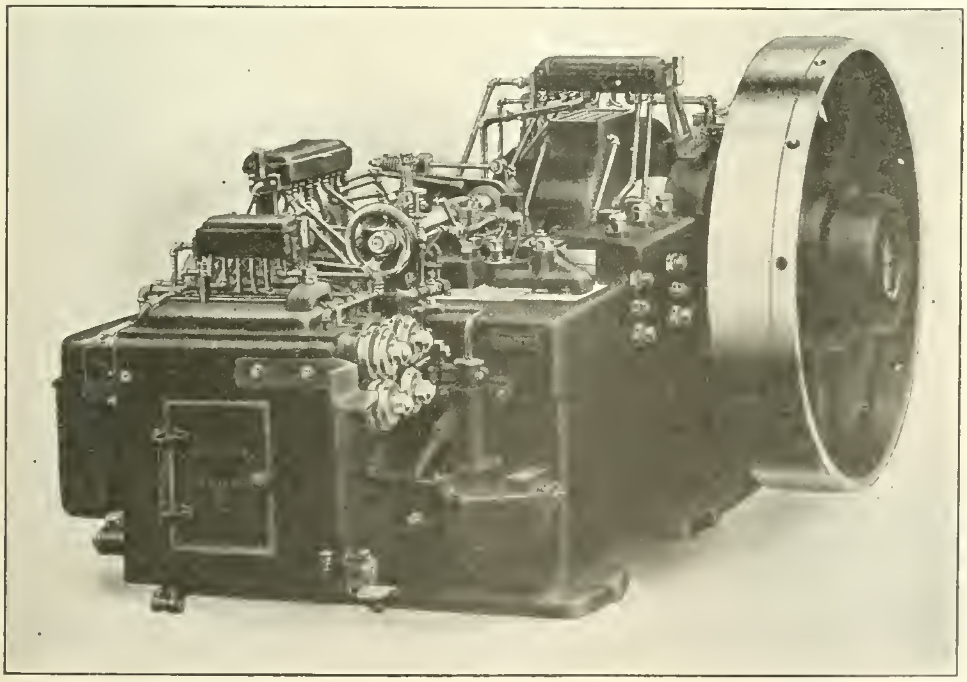


Fig. 1—National Semi-Hot Bolt and Rivet Header with Automatic Feed

The lack of control of the gripping or holding time in the old machines has been corrected by providing an adjustment in the gripping toggles. Consequently, on work requiring minimum gather or hold, such as rivets, it is possible to reduce the holding time to the exact requirement. On work such as 1-in. U. S. square head bolts, or any work requiring a large amount of gather, the gather is obtainable by means of this adjustment. The practical result of limiting the contact with the heated stock is a reduction in heating effect on the dies, with a consequent lengthening of die life.

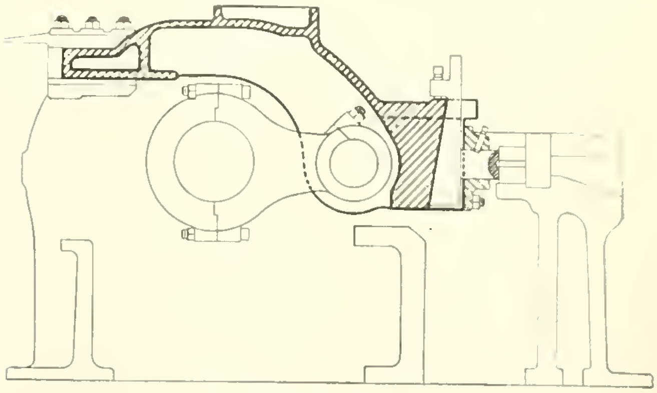


Fig. 2—Diagram Showing Heading Slide and Bolster Plate Construction

One of the difficulties of the old type of machine was an inherent defect in the design of the shearing mechanism, which tended to badly distort the end of the sheared bar, making it difficult to center the next head. This condition has been corrected in the new design by building the feed mechanism at an angle to the machine proper. This gives an angling shear, illustrated in Fig. 3, which, by compensating for the distortion, results in central heads, and makes it possible to upset and fill out an increased length of stock for large, or other special heads. To assist in the control of the stock for large-head work, a bender or straightening device is regularly supplied. This is adjustable without stopping the machine and gives complete control over the centering of the stock, or the flash.

In attempting to make bolts requiring a large amount of stock, any misalinement of the heading slide causes the stock to buckle and form a defective or unfilled head. Hence, to secure better alinement in the new design, suspended heading and gripping slides of unusual length were adopted. To secure a long heading slide without the necessity of a long bed frame, the slide, which is 60 in. long, is extended up and over the crankshaft, having two separate sets of bearings, with the location of the main shaft between (Fig. 2). This heading slide, being provided with screw adjustments for side alinement, and the heading tool or "domino" being rigidly held in the bolster plate, with a small amount of overhang, enables large heads to be made with a minimum of buckling, increasing the range of the machine. It is now possible to make U. S. square head bolts, large heads carriage bolts, New York Central square neck track bolts, Pennsylvania standard oval head track bolts, oval neck track bolts (without trimming), and a variety of large head special work heretofore considered impossible on automatic feed headers.

The powerful shearing and gripping mechanism, combined with the great strength and stiffness of the machine, enables work to be made at unusually low temperatures, resulting in a great improvement in the finish of the product, a material fuel saving, and a marked increase in die life. It is for this reason that the machine is known as a "Semi-Hot" header. Rivets are made at 1,000 to 1,100 deg. F., and bolts at 1,200 to 1,500 deg. F. Records in big bolt plants show that the life of heading tools has been doubled and of gripping dies tripled.

Consideration has also been given to every feature which would simplify the operation of the machine, reduce delays, or assist in quick changes. The bender or straightening device is adjustable without stopping the machine and the stock gage is correspondingly arranged, with a screw of such pitch that one full turn of the hand wheel gives ⅛ in. adjustment of the stock. To save delay if work is accidentally caught ahead of the dies, a wedge back of the heading tool can be relieved to get the machine "off center" easily. An automatic tripping device is also provided on the feed rod so that in case a bolt or rivet sticks in the gripping dies, the rolls are automatically raised, thus preventing the stock from continuing to feed and pile up in the dies, as frequently happened in the old type of machine before the development of the automatic tripping device.

A novel shear and face plate construction has been adopted, which, combined with the horizontal adjustment of the heading tool bolster, enables the shearing travel or "carry-over" to be adjusted. To increase the life of the shear, the water jacketing in the face plate supplies cooling water to the back of the shear, but not on the cutting edge. In order to keep the water off the bar until it reaches the shear, the feed roll spindles are made hollow and the feed rolls are water-jacketed, eliminating the necessity of running water over them and on the bar, as heretofore. Experience shows that running water on the hot bar materially increases the scaling, and results in premature deterioration of the shear and dies.

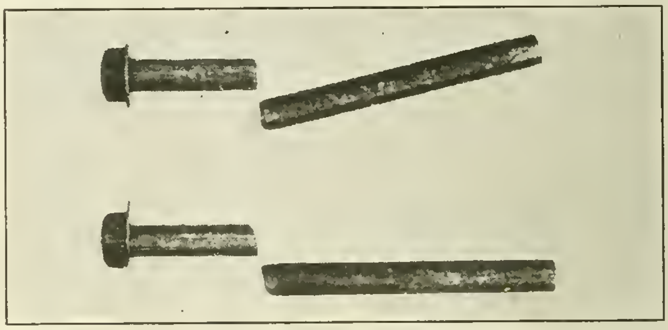
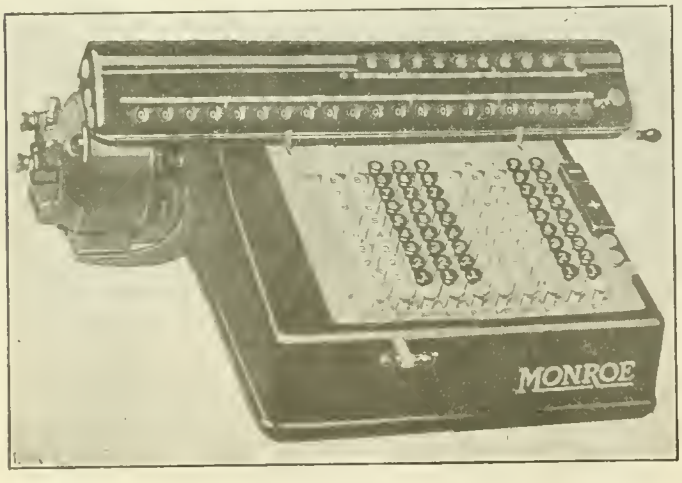


Fig. 3—Top Bolt Cut by New Angling Shear Mechanism; Bottom Bolt Cut by Old Shear

Attention has been given to every detail which would assist in maintaining high speeds. The main shaft is counterbalanced and all unnecessary weight has been removed from reciprocating parts, all of which are made of steel. A new type of "kick-out" attachment pushes the work from the dies rather than knocks it, as was customary with the old type cam-operated kicker. When the work was knocked from the dies, the blow would frequently drive it forward against the heading tool and the work would be caught by the next advancing stroke of the heading tool, before gravity could operate to drop the blank. In the new design, the work being pushed rather than knocked, gravity has time to clear the work from the dies with the machine running at even higher speeds than heretofore. The machine described is of 1-in. capacity and a ⅝-in. size is in process of construction.

Portable Automatic Model Calculating Machine

ELECTRICALLY operated and designed to be used on either a desk or stand, the new portable automatic calculating machine illustrated has been brought out recently by the Monroe Calculating Machine Company, New York. Besides being rugged and built to stand up under long, hard usage, this new addition to the line of Monroe calculating machines is simpler to operate than previous models. There is no crank to turn; as the operator faces the machine, everything is in readiness. The keys can be depressed, carriage shifted, or dials cleared, because the handle is always in the proper location to permit these operations to be performed. There are locks but these can be disregarded because the machine automatically takes care of them. It is possible to perform every calculation on this automatic that can be performed on a hand machine and its portability is an important advantage.



Speed, Accuracy and Ease of Handling Feature This Machine

The machine is quiet, smooth running and makes calculations in a fraction of a second. The light, compact motor is located at the left of the machine under the overhang of the carriage. There are two operating bars at the right of the key board. To add, the operator simply touches the plus bar; to subtract, he touches the minus bar. The flexible key board with its automatic register and control and with an instantaneous dial clear-out, make this an extremely speedy machine. The machine also divides and multiplies automatically, giving proven answers and relieving the operator of worry and effort. A trained operator is not necessary.

Should the electric current be shut off for any reason, the Monroe Automatic can be used as a hand-operated machine by the ready insertion of the operating crank. An ingenious mechanical control prevents locking or damage to the machine as well as safeguarding it against abuse. Monroe Automatics are furnished in two sizes: 20 place and 16 place, for either direct or alternating current, whichever is available.

During 1922, the Monroe Calculating Machine Company also brought out Fractional and British Currency Models, as additions to their regular line of machines.

Mono-Rail Hoist Designed for Low Head Room

An electric mono-rail hoist, made in sizes from 1,000- to 12,000-lb. capacity and known as the Lo-Hed, has been placed on the market recently by the American Engineering Company, Philadelphia, Pa. In addition to the latest modern features of mono-rail electric hoist design, this hoist, illustrated in Fig. 1, is notable in that the required headroom has been reduced to a minimum. This factor will be appreciated from an examination of the line drawing, shown in Fig. 2, the headroom for the one-ton hoist being 10 in., and the three-ton hoist, 14 in. This feature makes the Lo-Hed hoist adaptable to use in rooms where ceilings are low, where definite headroom must be maintained for safety, and where material of large dimensions is handled. In storehouses the hoist provides a greater storage capacity because material can be stacked higher; also larger castings can be handled.

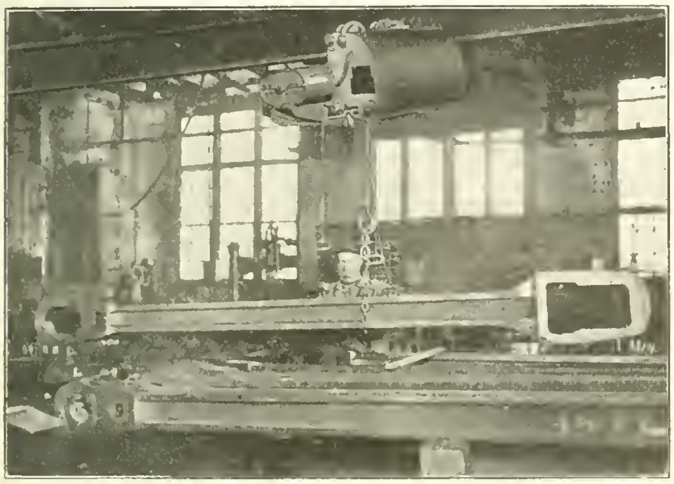


Fig. 1—The Lo-Hed Mono-Rail Electric Hoist Is Adapted to Handling Rods and Other Heavy Locomotive Parts

In addition to minimum headroom, this hoist has a minimum number of working parts, making a simple and durable design. All parts are readily accessible. By taking off the outside metal cover, as shown in Fig. 3, any part can be easily inspected or moved without disassembling the main body or frame of the machine. The motor can be removed while the load is on the hook. This hoist is economical in the use of power having a mechanical efficiency of over 80 per cent. A strong and durable straight spur gear drive is provided. Frictional losses are reduced by the use of Hyatt roller bearings throughout. The Alemite system of high pressure lubrication is used on all bearings not automatically lubricated by an oil bath. Many safety features are incorporated, the hoist having a factor of safety of at least five at full load.

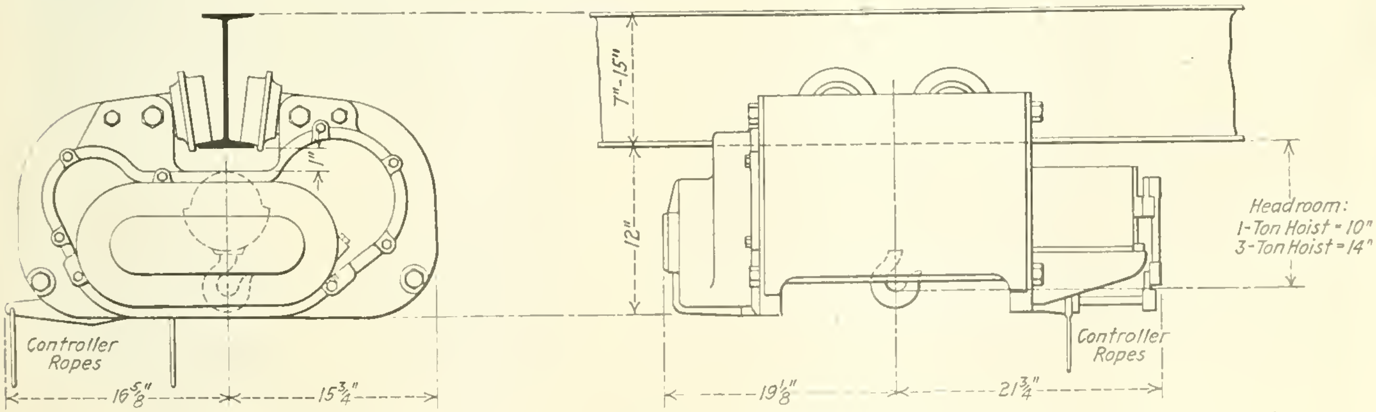


Fig. 2 1-Ton Lo-Hed Hoist. The Design Plainly Provides Minimum Headroom for a Hoist of the Capacities Indicated

All shafts used in this hoist are of high carbon steel, with roller bearing races pressed on the ends. The gears have accurate, machine-cut teeth, and are made from high grade forged steel. All gears are contained in the end housing, being easily removed from their shafts. A four part rope block is supplied with each hoist, these blocks having a steel yoke, provided with a forged steel hook working on a swivel. The sheaves are solid-webbed, machine-grooved, fitted with proper rope guards.

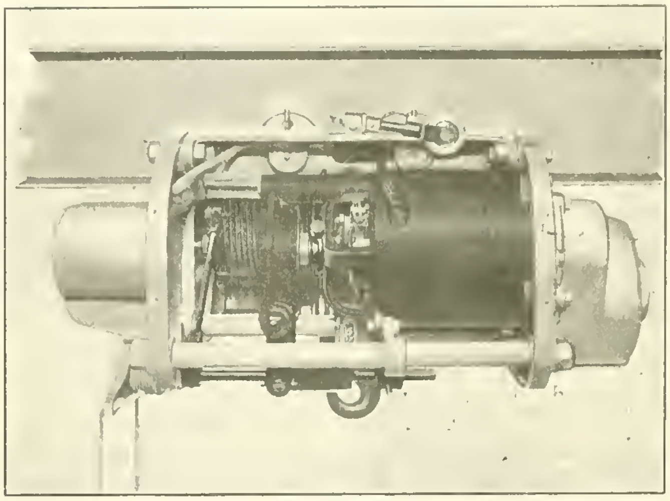


Fig. 3—Side View with Cover Removed. The Simplicity and Accessibility of Motor and Controller Are Evident

The drum used in this hoist is of simple, rigid construction. The right- and left-hand cable grooves are accurately machine-turned and coil the rope in a single layer. These drum grooves are machined to a depth sufficient to take the full diameter of the cable. The cable is connected to the exterior of the drum in a simple manner and can be easily removed or replaced. The controller used in this machine is built especially for hoist service. All parts are fireproof and are completely protected from dust and moisture. A return spring holds the controller in the "off" position. As soon as the operator releases the pull on the controller handles, the hoist stops.

The motor is of standard make, fully enclosed. All motors are equipped with high grade ball bearings and large diameter shafts. No long shaft extensions are required. Motors are fully enclosed when necessary and are guaranteed for the rated capacity of the hoist.

The automatic mechanical lowering brake runs in an oil bath and is provided to control the lowering speed. It is of the screw and disc type, geared to the intermediate shaft and having three discs. Its construction is standard and the same as used on high grade cranes.

The automatic holding brake works on a pulley mounted on the hoisting motor shaft proper and is lined with an asbestos brake band lining. It is operated by a cam on the controller shaft and holds the load safely at any point.

When the load block has reached its upper limit of travel, an automatic device serves to break the electrical circuit and apply the holding brake. This device is positive in its action, a valuable safety feature.

The Lo-Hed hoist is adapted to many uses in railroad locomotive shops, one of which is illustrated in Fig. 1. It is also a great potential labor saver in car shops, storehouses, foundries, power plants and wherever the railroads have material-handling problems.

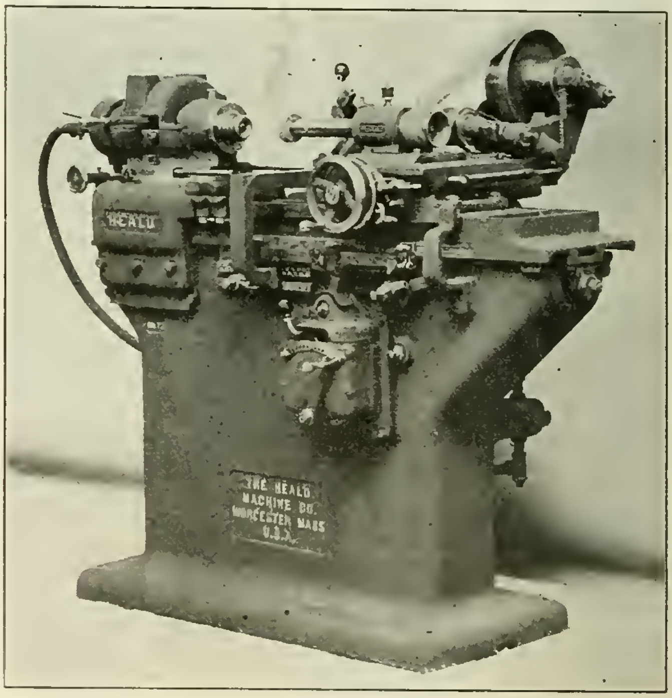
Internal Grinder with Hydraulic Table Drive

An internal grinder adapted to the grinding of hardened motion work bushings and other parts which can be held in a chuck is shown in the illustration. This machine is the latest product of the Heald Machine Company, Worcester, Mass., being known as the No. 72 grinder. It is entirely gearless and, with hydraulic drive for the table, the operator can get any speed or reverse instantly and practically without effort. The base is so proportioned as to take care of all strains and minimize vibrations. The work head consists of a massive casting having a hardened and ground steel spindle running in dust-proof and adjustable bronze bearings of ample size. A lever engaging a friction clutch on the inside of the spindle drive pulley starts and stops the water supply. There are five changes of work speed. The work head is mounted on a heavy bridge which in turn is securely bolted directly to the base. The work can be swiveled up to 45 deg. for taper grinding.

The cross slide which carries the flexible idler and wheel head is mounted on the table. A positive stop enables the operator to grind up to any given size without watching the dial. It is arranged with a fine adjustment to compensate for any wheel wear. A flexible idler with a belt tightener is mounted on the cross slide. This arrangement consists of a flexible driving pulley mounted on ball bearings, automatically keeping the belt drive taut. From this idler, power is transmitted to the wheel head by an endless belt running over a spring belt tightener that automatically takes up all the belt stress and maintains a belt wrap of 85 per cent. It also considerably reduces the side pressure on the wheel head bearing. This idler is furnished as extra equipment to interchange with any of the old style idlers and it is said to increase the possible production from 50 to 200 per cent.

Wheel heads can be furnished in 19 different sizes, enabling the operator to use just the proper size spindle for the job in hand and get the best results possible. These heads are quickly interchangeable having pulleys of the correct size so that there will be no guess work about speeds. An important labor-saving feature is the wheel-truing device which can be dropped into truing position quickly and after finishing this operation be swung up out of the way.

The table is driven by a simple hydraulic arrangement operated by oil, enabling the operator to instantly get any speed from nothing to a maximum. This hydraulic reverse mechanism, which reciprocates the table, consists of an automatic valve located at the front of the base in such a position that the operator's hand will naturally drop to it. A convenient stop is provided so that it is possible to maintain or return to any particular speed without looking at the speed change lever.



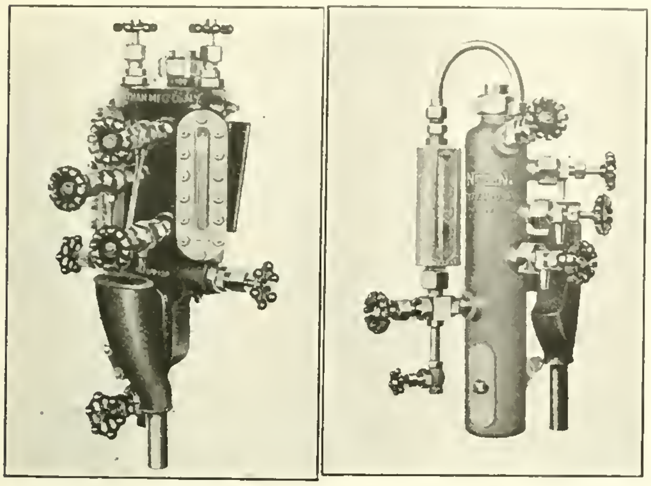
Heald Internal Grinder No. 72 for Chucking Work

The No. 72 grinder swings work 15 in. in diameter and will grind 11 in. deep, swinging 12-in. work inside the standard water guard. The countershaft is recommended to run in a speed from 600 to 620 r.p.m.

Water Columns for Use on Locomotive Boilers

When gage cocks and water gage fittings are screwed directly into the back head of a boiler, the gage cocks sometimes indicate a higher level of water than do the water glasses. This discrepancy in the water level, as indicated by the gage cocks and the glass, is caused by the severe agitation and rapid circulation of the water through the arch tubes and up the back head. After extensive investigation by the federal boiler inspection service of the

Interstate Commerce Commission and following a number of tests on locomotives of various roads, it was recommended that the water glass and gage cock fittings be screwed to an intermediate appliance—a water column—instead of being attached directly to the boiler.


Nathan Type W-B and Type W-O-A Water Columns, Fitted with Reflex and Tubular Water Glasses Respectively

The two types of water columns illustrated are made by the Nathan Manufacturing Company, New York, and have been tested satisfactorily under actual service conditions. The type W-O-A water column (right) with tubular glass, which complies with recommendations contained in the last annual report of the chief inspector, Bureau of Locomotive Inspection, occupies but a minimum of space on the boiler. The body of the column is drawn in at the lower end and the cross section is reduced, without, however, interfering with the necessary volume of water entering the column. By this construction the column is fitted close to the back head, with sufficient room for substantial connection to the water space of the boiler. A further variation in the bottom extension of the water column is secured by elongated pads, thus permitting of application to almost any boiler. If necessary, special lengths may be provided for any unusual installations.

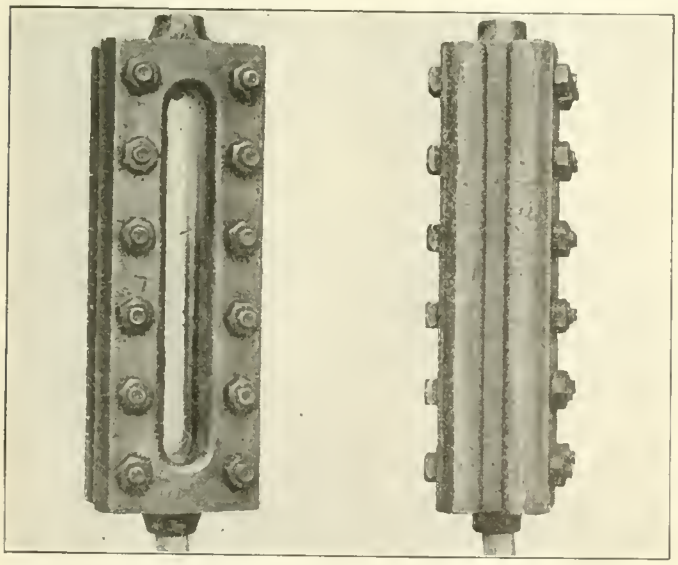
Another feature of this type is the method of attaching the gage cock to the body of the column. By doing away with the usual shank of the gage cock, the distance which the spindle of the gage cock protrudes has been materially reduced. The gage cock is so constructed that it may be removed and replaced quickly with steam in the boiler. The water gage attached to the column and the column itself are provided with necessary drain valves for draining the water gage or the column, independently of each other.

The type W-B water column (left) differs from the one previously described in that it contains two reflex gages instead of the tubular gage. This type is a self-contained water column, comprising within itself the gage cocks and the water gage, eliminating the pipe connections and joints necessary with independent water gages attached to the column. It is equipped with reflex gages, with glasses embedded in the body of the column and so placed that the water level may be observed from both the engineer's and the fireman's side.

A special provision that will be appreciated is the bonnet attached to the upper and lower valve controlling the respective water glass compartments. These bonnets are provided with warning ports which will blow at all times except when the valves are wide open.

Water Gage Glass Designed To Be Unbreakable

THE Duplex glass water gage, illustrated, is a new development recently brought out by the Duplex Glass Water Gage Company, Youngstown, Ohio. The following advantages, substantiated by actual service tests, are claimed for this glass: It permits accurate reading of water level from both sides of the gage, enabling the water level to be determined by both the engineer and fireman from their respective positions in the cab. The glasses used are ½ in. thick and smooth on both sides, eliminating the possibility of corrosion which makes reading difficult. The glass will last indefinitely barring accidents and, having no intricate parts to get out of order, it can easily be assembled by anyone and kept in good operating condition. The Duplex glass embodies all the advantages of the tubular glass without its objectionable features. It eliminates the danger of flying glass in the event of breaking. It will withstand indefinite pressure and can be applied to steamboat, stationary, and other types of boilers as well as locomotive boilers. No additional illumination is required at night other than that provided for the types of glass now in use. A composition gasket, made from sheet Permanite packing is used between the glass and central metal part to make a steam tight joint.


Duplex Water Gage Glass for Boilers

This gage was applied to a switching locomotive in steel mill service for ten months with no maintenance or repair cost. The gaskets were renewed at the end of this period. The same gage was then applied to a railroad switching locomotive and remained in service three months with no repairs or renewals. It was removed at this time on account of the locomotive being transferred from the Youngstown territory. Each of the above tests were unofficial, being made as an experiment with the consent of the local managements.

The Largest Casting so far turned out in South Africa, weighing 50,000 lb., was recently made, according to the Ironmonger, at Salt River Works. The operation proved a complete success and when the casting was dug up, it was found to be without a flaw. It is intended for an anvil block for a three-ton hammer.

GENERAL NEWS

The Chicago, Burlington & Quincy announces that it had completed the fourth year in which no passengers have been killed in train accidents on the lines operated by the company.

Five men charged with having placed quicksilver in the boilers of Southern Pacific engines during the strike in September, were found guilty by a jury at El Paso, Tex., on January 26.

The St. Louis-Southwestern has signed wage agreements with the Association of Metal Crafts, which is an association of the railroad's employees and has no connection with the national shop craft organizations.

Sir Henry W. Thornton, K.B.E., chairman of the board of directors and president of the Canadian National, has been elected a member of the board of directors of the American Railway Association to fill a vacancy therein.

A representative of the Chicago & Alton said that the cost of the strike to his company was $1,907,990. The Alton also paid bonuses amounting to $540,000 to employees, and the Wabash spent $179,000 in the same manner. The total cost of the strike, to the seven railroads which testified at the hearing, was $14,896,000.

The Oregon-Washington Railroad & Navigation Company has been granted a permanent injunction restraining striking shopmen from interference with the company's employees or property by the United States District Court at Spokane, Wash. One picket will be permitted at each entrance to the railroad property.

The Erie Railroad car shops at Buffalo, N. Y., are now operated by the company. For about a year past they have been operated under contract by William H. Fitzpatrick, but reverted on January 30 to railroad management, in compliance with the ruling of the Railroad Labor Board. About 1,200 men have been employed by Mr. Fitzpatrick.

The cost of the shop crafts' strike last summer was the subject of inquiry at a hearing in St. Louis recently, when depositions were taken by representatives of the attorney general to be used in the appeal to the Federal court at Chicago to make permanent the temporary injunction against strike violence. E. C. Wills, assistant general manager of the Missouri Pacific, testified that the strike cost that company $2,000,000 in direct expenses and made necessary the purchase of 15 locomotives at a cost of $3,000,000.

Senator La Follette has introduced a resolution to require the Interstate Commerce Commission to report to Congress and, when Congress is not in session, to the President, monthly, the condition of railroad equipment as revealed by reports of the carriers and inspectors of the commission, the number of persons killed or injured upon the railroads and any other available data bearing on the physical condition of the railroads and their equipment, together with a statement of what action, if any, has been taken by the commission to remedy the situation.

The Dixon Construction & Repair Company, a New Jersey corporation, has asked the United States District Court at Chicago to restrain the United States Labor Board from publishing a decision, made January 6, holding null and void certain contracts between the Dixon Company and the Western Maryland Railroad. These contracts, for repairing Western Maryland cars and locomotives, were held to violate the Transportation Act, as under them Western Maryland employees were taken out from under the jurisdiction of the board and made subject to the rules of a private corporation.

The Railway & Locomotive Historical Society, 152 Harvard street, Brookline, Mass., has issued its fourth pamphlet, Bulletin No. 4, describing old stations in Boston, old locomotives of the Boston & Maine and other New England things, and "the first iron passenger cars." Two of these cars were built in 1860 by B. J. LaMothe of New York City, one for the Boston & Worcester, now a part of the Boston & Albany, and one for the Hackensack & New York, now a part of the Erie system. These cars were of sheet metal, even the floor system consisting of thin bands, stiffened with timber.

"Company unions" have been formed on the Chicago & Eastern Illinois by shopmen, signalmen and telegraphers; and, in conjunction with officers of the road, have agreed on wages and working conditions. These organizations are the Chicago & Eastern Illinois Association of Mechanical Department employees and the Chicago & Eastern Illinois Association of Signal and Telegraph Department employees. The wages agreed upon are in accord with the rulings of the United States Railroad Labor Board, but with provision for graduating the rates of pay according to the skill and experience of various classes of mechanics.

Shop Strike Ended on Northern Pacific

The strike of shopmen on the Northern Pacific has been officially ended by an overwhelming vote. The vote was taken as the result of permission given by strike leaders to the local unions to allow their members to determine for themselves whether to return to work or not. No promises of any kind have been made to the strikers, but officers of the company report that applications for work in the shops are being received in great numbers.

Relocation of New Ladders Under Standardization Rule

The Circuit Court of Appeals, Seventh Circuit, holds that when an improperly located ladder on a box car is renewed under section 3 of the Safety Appliance it must be relocated although there is no renewal of the brakes, notwithstanding the exception to the Interstate Commission's standardization rule of March 13, 1911, to the effect that brakes and ladders on such cars need not be relocated "except when such appliances are renewed."—Pennsylvania v. United States, 283 Fed. 31.

New A. R. A. Directors

The directors of the American Railway Association, chosen at the recent election, for terms expiring in November, 1925, are E. W. Beatty (C. P. R.), A. H. Smith (N. Y. C.), Daniel Willard (B. & O.), H. E. Byram (C. M. & St. P.), Howard Elliott (N. P.), B. F. Bush (M. P.) and C. H. Markham (I. C.). Two members elected to the Committee on Nominations are P. E. Crowley (N. Y. C.) and W. J. Jackson (C. & E. I.). The terms of these two expire in November, 1924.

Group Life Insurance on the New Haven

Life insurance for 7,000 employees has been arranged for by the New York, New Haven & Hartford according to an announcement made recently. This insurance, to be paid for partly by the railroad company, is provided for the benefit of employees in the mechanical and electrical transmission and communication departments. Individuals have the option of including accident and health insurance. The cost to each employee will be 60 cents a month for $1,000 of life insurance and 70 cents a month for accident and health insurance. The Aetna Life Insurance Company will issue the policies.

The New Interchange and Loading Rules

The Mechanical division, American Railway Association, announced that the new interchange and loading rules are ready for distribution. The loading rules are arranged in groups, and the rules in each group may be obtained in separate pamphlets. The groups are as follows: Group No. 1—Rules Governing the Loading of Lumber, Logs, Ties, Fence Posts, Tan Bark and Similar Products; Group No. 2—Rules Governing the Loading of Structural Material, Plates, Billets, Castings, Wheels, Pipe and Similar Products; Group No. 3—Rules Governing the Loading of Mining Cars, Engines, Boiler Shells, Machinery, Derricks and Similar Commodities; Group No. 4—Rules Governing the Loading of Concrete Culvert Pipe, Brick, Stone, Building Tile and Similar Products, and Group No. 5—Rules Governing the Loading of Automobiles.

Russian Locomotive Production Increasing

Russia will purchase no more locomotives from foreign countries, according to Berlin correspondence of the Wall Street Journal. This decision is said to be due to the fact that Russian locomotive builders have greatly increased their output. To date Soviet Russia has ordered 1,200 locomotives from foreign countries, particularly Germany and Sweden, and it is said that most of the locomotives have been delivered.

Telephone Communication Between Chicago and New York Meetings of A. I. E. E.

Simultaneous meetings of the American Institute of Electrical Engineers were held in New York and Chicago on the evening of February 14, 1923. The rooms in which the two meetings were held were connected by special telephone lines with loud speaking telephones in both auditoriums. Frank B. Jewett, president of the A. I. E. E., presided over both meetings and was assisted by R. F. Schuchardt, vice-president, in Chicago. Papers were presented alternately by speakers in New York and Chicago and duplicate lantern slides were used for illustration, the speakers calling for lantern slides by number so that the same slides would be shown in both auditoriums simultaneously. Telephonic communication was also established with broadcasting stations so that the speakers could be heard by the many people in the country who have radio receiving outfits

Cars and Locomotives Ordered

Orders placed by the railroads for freight car equipment up to February 1 called for the delivery of 91,354 cars, according to reports filed by the carriers with the Car Service Division of the American Railway Association. Orders for 23,022 freight cars were placed in January this year, while the remaining represented cars ordered but not delivered during the calendar year 1922. Coal cars under order on February 1 totaled 37,476, of which orders for 13,258 cars were placed in January. The remaining number constituted cars ordered but not delivered in 1922. Box cars on order numbered 43,211, of which orders for 7,594 were placed in January. Reports also showed that 2,082 refrigerator cars were also ordered, bringing the total number ordered but undelivered on February 1 to 6,402.

Locomotives on order on February 1 totaled 1,507 compared with 1,445 on January 1 last, or an increase of 62 for the month. Of the total number of locomotives on order, freight locomotives numbered 1,022, passenger 362 and switching, 123.

Labor Organizations Select Candidates for Labor Board Positions

The railroad labor organizations eligible to participate in the nomination of candidates for appointment to succeed Albert Phillips, whose term as a member of the labor group on the Railroad Labor Board expires on April 15, have definitely decided upon six names which will be submitted to President Harding, according to reports now being circulated from Chicago. The recommendation will include the following:

John H. Sylvester, vice-president Brotherhood of Railway Clerks; J. J. Farnum, Maintenance of Way Employees; D. W. Helt, president, Order of Railway Signalmen; Thomas Pearson, general chairman, New Haven Chapter, Order of Railway Telegraphers; G. C. Milan, Brotherhood of Railway Clerks; Albert Phillips (renomination), Brotherhood of Locomotive Firemen.

The candidacy of John H. Sylvester was favored, it is said, by a majority of the representatives of the larger unions, although a certain strong faction, particularly among the train service organizations, was said to favor the reappointment of Phillips. The Sylvester appointment is said to find favor by reason of the fact that Mr. Sylvester is a representative of Group 2 among the standard organizations, whereas W. L. McMenimen and Albert Phillips are the spokesmen of the Group 1 unions, Group 3 being already represented by A. O. Wharton, whose term expires in 1927, while Group 2 is minus a spokesman on the Board.

Canadian Pacific's Program for 1923

An extensive program of improvements to be undertaken by the Canadian Pacific includes a number of betterments in engine terminals and shop equipment

Coaling plants of the latest type will be built at Ignace and Kenora, Ont.; Winnipeg, Man.; Estevan, Sask., and Red Deer, Alta.

An extension will be made to the enginehouse at Hardisty, Alta., and extensive improvements made to the mechanical plants at Weston (Ont.) shops, Neudorf, Sask.; Reston, Sask.; Minnedosa, Man.; Broadview, Regina, Sask.; Calgary, Alta., and Alyth, Alta.

Steel water tanks of from 60,000 to 100,000 gal. capacity will be built at McAdam Junction, N. B., and in Ontario at Guelph Junction, Nemegos, Markstay, and Grassett, and at St. Johns, Que.

Modern coaling plants will be constructed at Megantic, Que., and Jackfish, Ont., and a 90-ft. turntable to handle heaviest power will be installed at MacTier, Ont.

Additional mechanical and car department equipment will be provided at Hochelaga, Glen Yard and Place Viger, P. Q., and Smiths Falls, Toronto, and North Bay, Ont.

MEETINGS AND CONVENTIONS

Division VI—Purchases and Stores

Division VI—Purchases and Stores—of the American Railway Association will hold its annual meeting in Chicago on May 15, 16 and 17, 1923. Headquarters will be at the Hotel Sherman.

Air Brake Association—Pike's Peak Trip

In connection with the annual convention at Denver, May 1-4, announcement has been made that the management of the Manitou & Pike's Peak railroad are willing to open the road on May 4, instead of the usual date, May 15, and thus permit those attending the convention to make the trip to the summit of this famous mountain. In order that this may be done, it will be necessary to assure a party of 100. The rate of fare will be $4. Those who wish to take this trip should notify the secretary.

International Railway General Foremen's Association

Announcement has been made that the 1923 annual convention will be held at Hotel Sherman, Chicago, September 4 to 7 inclusive. The following topics will be discussed:

Shop Efficiency, Locomotive and Car Departments. Chairman, F. M. A'Hearn, Greenville, Pa.

a.—Apprentices, training and developing.
b.—Relation of foremen and employees.
c.—Methods of increasing efficiency of supervisors and employees.
d.—Discipline.
e.—Increased output per man-hour; costs.

Welding Flanges on Driving Tires, Engine Truck and Tender Wheel Tires. Chairman, H. T. Cromwell, Baltimore, Md.

General Repair Methods and Maintenance. Chairman, J. H. Frizell, Topeka, Kans.

a.—Valves, valve gears and power reverse gears.
b.—Engine, tender and car trucks.
c.—Air brake appliances on passenger and freight equipment.

General Repair Methods and Maintenance. Chairman, W. S. Buntain, Battle Creek Stokers, Coal Pushers and Air Firedoors.

Shop Kinks, Locomotive and Car Departments. Chairman, Geo. H. Logan, Chicago, Ill.

Symposium on Locomotive Terminal Design

The Western Society of Engineers, Chicago, will present a symposium on locomotive terminal design at its rooms in the Monadnock building on Tuesday evening, March 13. L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul, will discuss the subject from the standpoint of the mechanical department; R. N. Begien, general manager of the Baltimore & Ohio, Western lines, will outline the requirements of the operating department; and W. T. Krausch, engineer of buildings, of the Chicago. Burlington & Quincy, will describe the manner in which the engineering department meets these requirements.

Fuel Association Convention Program

Julius Kruttschnitt, chairman of the executive committee of the Southern Pacific, will deliver the opening address at the convention of the International Railway Fuel Association to be held at the Hotel Winton, Cleveland, Ohio, on May 21-24. An address will also be made by T. K. Maher, president of the Maher Collieries Company. A partial list of the papers to be presented is as follows: "Extension of Locomotive Runs," by C. B. Peck, associate editor, *Railway Mechanical Engineer;* "Considerations Covering Use of Oil as a Locomotive Fuel," by M. C. M. Hatch, mechanical engineer, M. K. & T.; "Fuel Saving Aspect of Boiler Water Treatment," by C. R. Knowles, superintendent water service, Illinois Central; "Value of Individual Fuel Performance Records," by L. G. Plant, editor, Railway Review; "Standardization of the Coal Business," by Geo. H. Cushing; "The Other Ten Per Cent," by R. S. Twogood, assistant engineer, Southern Pacific; "Economic Aspects of the Fuel Oil Situation," by C. E. Beecher, U. S. Bureau of Mines; "Economy in the Heating of Stations and Buildings," by Prof. R. W. Noland, Purdue University; "Incentives for Promoting Fuel Economy," by O. S. Buyer, Jr.

There will also be a topical discussion of the paper on the effect of tonnage rating and speed on fuel consumption presented by J. E. Davenport at the 1922 convention.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. F. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, May 1 to 4 inclusive.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcberdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting, Chicago, beginning June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923. Annual meeting, Hotel Sberman, Chicago, May 15, 16 and 17, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcber, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., beginning June 25, 1923.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting March 8, Iroquois Hotel. A paper entitled "Fundamentals of Train Control with Special Reference to Railway Operating Conditions" will be presented by F. J. Dodgson, consulting engineer, General Railway Signal Company.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next meeting, May 21-24, 1923, Cleveland, Ohio.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasb Ave., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Annual convention, Hotel Fuller, Detroit, Mich., May 22 to 25 inclusive, 1923.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting University Club of California, Berkeley, March 8. A paper entitled "As to the Locomotive, What Next" will be presented by G. M. Basford.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Fruenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago.

SUPPLY TRADE NOTES

J. J. Otley, president of the Otley Paint Manufacturing Company, Chicago, died on January 20 from cerebral hemorrhage, at Chicago.

Thomas W. Delanty has joined the sales organization of the Prime Manufacturing Company, manufacturers of locomotive and car specialties, Milwaukee, Wis.

The Uehling Instrument Company, Paterson, N. J., has appointed the Mine & Smelter Supply Company of El Paso, Texas, as its exclusive representatives for CO_2 recording equipment and other power plant recording instruments in Arizona, New Mexico, west Texas and Mexico north of Mexico City.

Clyde M. Carr has retired as president of Joseph T. Ryerson & Son, Inc., but will continue as a director. On account of poor health, Mr. Carr has been unable to take an active part in the management of the firm for the past two years. At the annual meeting of the directors, Joseph T. Ryerson was elected president. Mr. Carr was born in Will county, Illinois, in 1869. He attended Lake Forest Academy and was later a student at Northwestern University for two years. He first became associated with Joseph T. Ryerson & Son, Inc., in 1890, and has taken an active part in the management of the firm's affairs. Mr. Carr served as vice-president until 1911, when he was elected president of the corporation to succeed Edward L. Ryerson. Mr. Carr has always been an active leader in civic and industrial circles. Joseph T. Ryerson, who has been elected president to succeed Mr. Carr, is a grandson of the original Joseph T. Ryerson, who founded about 1842 the business which was incorporated under its present name in March, 1883. The new president has been for 22 years in the steel business. He was born in Chicago in 1880. and immediately after graduating from Yale in 1901 went to work for the American Sheet Steel Company, now the American Sheet & Tinplate Company, at its mill in Vandergrift, Pa. In October, 1902, he entered the service of Joseph T. Ryerson & Son, Inc., at Chicago, and in 1904 was elected treasurer, becoming vice-president in 1911. Mr. Ryerson is actively interested in the National Chamber of Commerce and other general industrial work.

C. M. Carr

Joseph T. Ryerson

The American Bolt Corporation, with headquarters at 17 Battery Place, New York City, has been organized and is a consolidation of the Bayonne Bolt & Nut Company, Bayonne, N. J., the Boss Nut Company, Chicago, Ill., the Standard Bolt Corporation, Columbus, Ohio, and the Michigan Bolt & Nut Works, Detroit, Mich. Justin C. Burns is chairman of the board, at Columbus, Ohio; J. Rich Steers, president, New York City;

Frank S. Bigler, Detroit, Mich.; C. L. Rupf, New York City; J. A. MacLean, Chicago, and R. H. Hill, Detroit, Mich., are vice-presidents. Harley E. Burns is secretary and treasurer, Columbus, Ohio. The company manufactures Boss nut locks, also a complete line of bolt and nut products.

S. I. Hopkins, representative of the Safety Car Heating & Lighting Company, with headquarters at St. Louis, Mo., has been promoted to manager of the St. Louis office.

Michael J. O'Connor has been appointed a special railroad representative of William H. Keller, Inc., Grand Haven, Mich., manufacturers of Keller pneumatic tools. Mr. O'Connor's territory will cover the section of the country situated east of Chicago and his headquarters will be at 631 Fulton building, Pittsburgh, Pa. He is an old railroad man, having served as a locomotive engineman on the Cincinnati, Hamilton & Dayton for twenty years. After leaving railroad work he accepted a position with the Chicago Pneumatic Tool Company, with whom he was employed for four years and after that was connected for six years with the Ingersoll-Rand Company, whom he left to take up his new work.

M. J. O'Connor

The first locomotive to be built on the Pacific Coast was recently completed by the Willamette Iron & Steel Works at Portland, Ore. The locomotive is of the geared type and will be used for logging purposes.

W. P. Thomas, road foreman of engines of the Minneapolis & St. Louis, at Marshalltown, Iowa, has been appointed service engineer of the Franklin Railway Supply Company, Inc., New York.

W. H. Holtom, road foreman of engines of the Michigan Central at Jackson, Mich., has been appointed service engineer of the Franklin Railway Supply Company, Inc., New York.

William G. Willcoxson, formerly with the Boss Nut Company, has joined the sales organization of the Gold Car Heating & Lighting Company, Brooklyn, N. Y. Mr. Willcoxson will have his headquarters at Chicago, Ill.

H. E. Seifried, secretary-treasurer of the Stone Franklin Company, St. Louis, Mo., has been appointed assistant to the vice-president of the Franklin Railway Supply Company, Inc., Chicago, succeeding H. M. Clawson, resigned.

The Sommer-Adams Company, Cleveland, Ohio, recently incorporated, has taken over the line of milling cutters formerly made by the Cleveland Milling Machine Company, and will also manufacture special tools, jigs and fixtures.

The Globe Steel Tube Company, Milwaukee, Wis., has opened a southeastern district sales office at 716 Continental building, Baltimore, Md., and R. R. Lally, formerly of the National Tube Company, has been appointed district sales agent.

The Combustion Engineering Corporation, New York City, has acquired the Quinn Oil Burner & Torch Company also of New York City. W. R. Quinn, former president of the Quinn Company, becomes associated with the Combustion Engineering Corporation as manager of its fuel oil department.

The American Locomotive Company and the General Electric Company have entered into an arrangement providing for close co-operation between the engineering organizations and manufacturing facilities of the two companies, in the design and manufacture of electric locomotives for use on steam or electric railways.

At the annual meeting of the Brake Beam Manufacturers' Institute at the Union League Club, Chicago, on January 18, the following officers were elected: J. H. Slawson, vice-president of the Republic Railway Equipment Company, Inc., was re-elected president; A. H. Peycke, manager of the brake beam department of the American Steel Foundries, was elected vice-president, and F. T. DeLong, vice-president and sales manager of the Chicago Railway Equipment Company, was re-elected treasurer.

L. K. Berry resigned as domestic sales manager of the Warner & Swasey Company, Cleveland, Ohio, on February 1, to become sales manager of the Detroit Twist Drill Company, Detroit, Mich. He will be succeeded by C. J. Stilwell, foreign sales manager, whose jurisdiction will cover both foreign and domestic sales.

Harry A. Pike has been appointed railway representative of the Standard Engineering & Lubricating Company, New York, manufacturers of Triplex water and metal treatment and Beltcling lubricator. Mr. Pike began railroad work in 1880 as general storekeeper of the Lake Erie & Western in Lima, Ohio, now part of the New York Central lines. In 1883 he was appointed chief clerk in the motive power department of the Chicago & Atlantic, now a part of the Erie. In 1885 he was made a representative of the American Brake Company at St. Louis, and three years later went to the U. S. Metallic Packing Company in the same capacity, with offices in Chicago. In 1893 he was appointed a representative of the Chicago Pneumatic Tool Company, and in 1904 was made eastern sales manager of the Flannery Bolt Company, with offices in New York City. After severing his connection with that company he was associated with a number of industrial and other concerns, now returning to the railway supply interests.

At the annual meeting of the Pollak Steel Company, Cincinnati, Ohio, Emil Pollak, for many years president, was elected chairman of the board of directors. Maurice E. Pollak, formerly vice-president, was elected president. Julian A. Pollak was re-elected vice-president, with headquarters at Cleveland, and Edward J. Schriever was re-elected secretary. Edgar Johnson has been elected a director, and Charles Judah, treasurer, was elected to the board of directors to fill the vacancy caused by the retirement of Bernard E. Pollak, formerly vice-president. D. E. Sawyer has retired as general sales manager. The general sales management of the company, formerly handled in the New York office, will be conducted from Cincinnati, but the company will maintain a sales office in the Equitable building, New York City, with Clyde F. Hicks as eastern representative. Maurice E. Pollak was born at Cincinnati, Ohio, and has lived there all his life. He attended the public school, Franklin preparatory school and the University of Cincinnati. On leaving the university he went into business with his father, Emil Pollak, and served his apprenticeship in the shops at Cincinnati, and later became superintendent of that plant, which position he held for several years. In the reorganization of the company in 1911, when the Pollak Steel Company was formed, the Pollak interests took over the Cincinnati plant from the old company, the Block Pollak Iron Company, and Maurice E. Pollak was then elected vice-president in charge of operations. The Cincinnati plant was extended during 1915, 1916 and 1917, and the Chicago plant was acquired in 1916, and has since grown in size. In 1919 the Pollak Steel Company purchased the plant of the Interstate Iron & Steel Company at Marion, Ohio, thereby acquiring another addition to its already large properties.

M. E. Pollak

The Walworth Manufacturing Company, Boston, Mass., has organized the Walworth Ohio Company, with general office at Cleveland, Ohio, to be conducted as a branch of the Walworth Manufacturing Company. The new company has taken over the business and property of the Hiram Rivitz Company of Cleveland. S. R. Mitchell, manager of the Kewanee Works of the Walworth Manufacturing Company, has been appointed vice-president and general manager at Cleveland of the new Walworth unit and will take active charge of the Walworth Ohio Company.

TRADE PUBLICATIONS

Seamless Boiler Tubes.—Bulletin No. 12, covering the properties, use and manufacture of Shelby seamless hot rolled boiler tubes, is a valuable addition to the series of bulletins issued by the National Tube Company, Pittsburgh, Pa. The details of manufacture are clearly described and the text is accompanied by many illustrations. In addition to information in regard to physical and chemical properties and tests there are a number of tables covering tubes ranging from 2-in. to 6-in. diameter which are of value to users of such material.

Coaling Plants.—The Howlett Construction Company, Moline, Ill., has issued a booklet containing line drawings and photographic illustrations of various types of coaling equipment it has recently built for railways, together with illustrations and specifications concerning its line of hoists, car pullers, coaling aprons and other machinery adapted for this use. The principal coaling stations illustrated are concrete plants built for the St. Louis-San Francisco and the Louisville, Henderson & St. Louis, and frame plants built for the Great Northern and the Illinois Central.

The American Society for Testing Materials has published in pamphlet form a list of alloys which is taken from the report of the Committee on Non-Ferrous Metals and Alloys presented at the last annual meeting of the society. This list contains the chemical composition of approximately 1,500 alloys, divided into 17 groups, the alloys in each group being arranged alphabetically. Among the important alloys listed are 275 of brass, 260 of bronze, 165 of nickel silver, 140 of aluminum, 130 of tin base and 105 of lead base.

Oil Burners.—F. J. Ryan & Company, Philadelphia, Pa., has just issued bulletin 1B entitled "Mircs Oil Burners," containing a large amount of information of value to industrial users of oil-burning equipment. Essential factors in the efficient burning of fuel oil are pointed out; also the effect of relative air and oil pressures. Two sets of curves are illustrated from which the correct size of burner and necessary amounts of air needed for correct combustion can be determined. Details regarding the construction and operation of the Mircs burner are also included.

Applying Science to Inhibit Rust.—This is the title of a booklet just issued by the Dearborn Chemical Company, Chicago, describing No-Ox-Id, a recently developed compound for use in protecting iron and steel surfaces against rust. A wide range of applications for the compound, which not only protects by providing a surface covering but chemically inhibits the tendency toward corrosion under the ordinary protective coating, are set forth in the booklet, together with directions for its application by dipping, brushing or spraying, under a wide range of conditions.

Lifting Magnets.—Publication 3015, distributed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wisconsin, is an illustrated 24-page booklet describing C-H Red lifting magnets. The advantages of these high duty lifting magnets are explained, with particular emphasis on important features of construction. Full construction details are given. A large number of clear-cut, interesting illustrations show the adaptability of C-H magnets to many industrial fields. Performance data and resultant savings on some of the installations are given; also operating costs. Lists showing the lifting capacity and ratings of the different sizes of C-H high duty lifting magnets are included. The booklet will be of interest to all confronted with metal scrap or material handling problems.

Feed Water Treatment.—The scientific handling of serious water problems confronting both railroad and industrial users of steam boilers is the subject of a brief but forceful little booklet recently issued by the Dearborn Chemical Company, Chicago. This booklet shows how the Dearborn organization, with 35 years' experience in treating feed water, goes into the matter for its clients from every angle, including (1) the complete mineral analysis; (2) study of plant equipment and operating conditions; (3) expert advice and assistance from the standpoint of practical power production engineering; (4) followed up with laboratory control after treatment is installed, the water being analyzed from time to time and the material adjusted to suit changing conditions that may develop.

EQUIPMENT AND SHOPS

Locomotive Orders

The Norfolk Southern has ordered 4 Consolidation type locomotives from the Baldwin Locomotive Works.

The Chicago Junction has ordered 5, 0-8-0 type switching locomotives from the Lima Locomotive Works.

The New York, Chicago & St. Louis has ordered 30 Mikado type locomotives from the Lima Locomotive Works.

The Lehigh & New England has ordered three 2-8-0 type locomotives from the American Locomotive Company.

The Central of New Jersey has ordered 10 Mikado type locomotives from the American Locomotive Company.

The New York, Ontario & Western has ordered 6 Mountain type locomotives from the American Locomotive Company.

The Denver & Rio Grande Western has ordered 20 Mikado locomotives from the American Locomotive Company.

The Oliver Iron Mining Company has ordered 12, 8-wheel switching locomotives from the American Locomotive Company.

The Republic Iron & Steel Company has ordered 5, 0-8-0 type switching locomotives from the Baldwin Locomotive Works.

The Quebec Development Company, Charlotte, N. C., has ordered from the American Locomotive Company 14, 4-wheel tank engines.

The Chicago, Rock Island & Pacific has ordered 30 Mikado type and 10 Mountain type locomotives from the American Locomotive Company.

The New York Central will have repairs made to from 25 to 50 Consolidation and Mikado type locomotives at the Beach Grove, Ind., shops.

The Mobile & Ohio has ordered 10 Mikado type locomotives from the Lima Locomotive Works and 3 Pacific type locomotives from the Baldwin Locomotive Works.

The New York Central has ordered for the Indiana Harbor Belt 10 Mikado type locomotives from the Lima Locomotive Works and 10 Mikado type from the American Locomotive Company.

The Buffalo, Rochester & Pittsburgh has ordered 5 Pacific type passenger locomotives, 9, 0-8-0 type switching locomotives, 14, 2-6-6-2 Mallet type and 2, 2-8-8-2 Mallet type locomotives from the American Locomotive Company.

The Pennsylvania Railroad has placed orders with the Baldwin Locomotive Works for the construction of 275 engines for heavy freight service, delivery to be made before November 1, next. This number includes 75 locomotives not hitherto allotted out of a total authorization of 300, approved by the board of directors on January 10. It also includes a new and additional authorization of 200, making altogether 500 new locomotives ordered by the Pennsylvania Railroad System since the first of the year. Delivery is just being completed of an order for 100 heavy freight engines placed with the Baldwin Locomotive Works last August. All of the new locomotives now ordered and under construction will be used to replace others of lighter and inferior types which are to be retired from service.

Passenger Car Orders

The Union Pacific has ordered 10 horse baggage cars from the American Car & Foundry Company.

The Union Pacific has ordered 10 steel dining cars and 8 steel observation cars from the Pullman Company.

The Central of New Jersey has ordered three baggage and mail cars from the American Car & Foundry Company.

The Central Vermont will have 8 coaches and 2 baggage cars built at the Port Huron, Mich., shops of the Grand Trunk.

The Buffalo, Rochester & Pittsburgh has ordered 7 coaches, 3 baggage and mail and 6 baggage cars from the American Car & Foundry Company.

The Western Pacific has ordered 20 coaches and 8 dining cars from the Pullman Company and 20 baggage cars from the Pressed Steel Car Company.

The Canadian Pacific has ordered 12 combination mail and baggage cars, 6 cafe parlor car frames and 6 buffet car frames from the Canadian Car & Foundry Company.

The Erie Railroad has increased its accommodations for suburban passengers to and from New York City by the purchase of 14 Pullman sleeping cars which have been converted into day coaches. The cars will seat 84 passengers each.

Freight Car Orders

Swift & Co. is building 200 refrigerator cars in its own shops.

The Lion Oil Company has ordered 100 tank cars from the Chicago Steel Car Company.

The Gulf Refining Company has ordered 100 tank cars from the Standard Steel Car Company.

The Texas Company has ordered 100 tank cars from the General American Tank Car Corporation.

The Minarets & Western has ordered 200, 40-ton flat cars from the Pacific Car & Foundry Company.

The Great Northern has ordered 125 tank cars of 12,500 gal. capacity from the Chicago Steel Car Company.

The Central of New Jersey is having 200 box cars repaired at the shops of the Standard Steel Car Company.

The Interstate Railroad has ordered 500 hopper cars of 55 tons' capacity from the Pressed Steel Car Company.

The Southern Lumber Company, Warren, Ark., has ordered 125, 50-ton logging cars from the Bettendorf Company.

The Illinois Central has ordered 50, 30-yd. air dump cars from the Western Wheeled Scraper Company, Aurora, Ill.

The Canadian National has ordered 100 general service cars of 50 tons' capacity from the Pressed Steel Car Company.

The Mobile & Ohio has ordered 400 box cars, 100 stock cars and 200 hopper cars from the American Car & Foundry Company.

The Hillman Coal Company, Pittsburgh, Pa., has ordered 300 steel hopper cars of 55 tons' capacity from the Standard Steel Car Company.

The Great Northern has divided equally an order for 1,500 ore cars between the Pressed Steel Car Company and the Cambria Steel Company.

The Canadian National has ordered 400 automobile cars from the National Steel Car Corporation, Ltd., and 600 from the Canadian Car & Foundry Company.

The Southern Pacific has ordered 575, 50-ton general service cars from the Ralston Steel Car Company and is having 500 logging cars built in the shops of its Pacific system.

The Atlantic Coast Line has ordered from the Virginia Bridge & Iron Company 500 sets of steel underframes and superstructures for box cars to be built in its own shops.

The New York, Chicago & St. Louis has ordered 1,000 composite hopper cars from the Pressed Steel Car Company and 500 composite gondola cars from the Standard Steel Car Company.

The Buffalo, Rochester & Pittsburgh has ordered 50 caboose cars from the Standard Steel Car Company. This company has also placed an order for 25 extension side dump cars with the Clark Car Company.

The Canadian Pacific has ordered 300 steel underframe flat cars from the Eastern Car Company, 300 gondola cars from the Canadian Car & Foundry Company and will build 50 tank cars in the Canadian Pacific's shops.

The Southern Pacific has ordered 3,700 box cars from the Standard Steel Car Company, 350 flat from the Ralston Steel Car Company, 550 stock from the Pullman Company. The railroad company will build 300 flat cars and 100 caboose cars in its own shops.

The Elgin, Joliet & Eastern has ordered 200 all-steel hopper cars from the Mount Vernon Car Manufacturing Company, 100 all-steel hopper cars and 100 composite gondola cars from the Pressed Steel Car Company; all of the above cars are of 70 tons' capacity. Orders were also placed for 200 composite gondola cars with the Pullman Company and for 200 composite gondola cars with the Standard Steel Car Company.

The Illinois Central has ordered 125 caboose cars from the American Car & Foundry Company, 1,750 composite gondola cars from the Pullman Company, 750 from the General American Car Company and 500 each from the Bettendorf Company and the Keith Car & Manufacturing Company.

Machinery and Tools

The Seaboard Air Line has ordered 2, 30-in. lathes from Joseph T. Ryerson & Son.

The Michigan Central has ordered an 800-lb. hammer from the Niles-Bement-Pond Company.

The Norfolk & Western has ordered a 2,000-lb. hammer from the Niles-Bement-Pond Company.

The Illinois Central has ordered one 150-ton wrecking crane from the Industrial Works, Bay City, Mich.

The Southern Pacific has ordered a 400-ton double-end wheel press from the Niles-Bement-Pond Company.

The Trans-Mississippi Terminal has ordered one set of bending rolls from the Niles-Bement-Pond Company.

The Baldwin Locomotive Works has ordered 2 horizontal rod milling machines from the Niles-Bement-Pond Company.

The Denver & Rio Grande Western has ordered one 75-ton wrecking crane from the Industrial Works, Bay City, Mich.

The Denver & Salt Lake has ordered one 500-lb. Bradley hammer from the Herr Rubincam Supply Company, Denver, Colo.

The Northern Pacific has ordered a 30-in. planer, a 36-in. planer, and a 48-in. planer; also a 100-ton bushing press from the Niles-Bement-Pond Company and several other tools.

Shops and Terminals

Chicago & North Western.—This company contemplates the construction of a new shop building at Madison, Wis.

Northern Pacific.—This company contemplates the construction of a boiler shop at Livingston, Mont., reported to cost approximately $150,000.

St. Louis-San Francisco.—This company has awarded a contract for the construction of a roundhouse at Muskogee, Okla., to C. E. Hamilton of St. Louis, Mo.

Missouri Pacific.—This company has awarded a contract to J. J. Wuellner & Son, Alton, Ill., for the construction of a 147-ft. by 201-ft. brick machine shop at Ewing avenue, St. Louis, Mo

Atchison, Topeka & Santa Fe.—This company contemplates the construction of two new roundhouses, a car repair house and extensive yard improvements at Emporia, Kan., to cost approximately $5,000,000.

Atchison, Topeka & Santa Fe.—This company has authorized the following construction work at Emporia, Kan.: One 120-ft. turntable, a 43-stall roundhouse, a 1,000-ton coal chute, cinder pits, oil and water crane with necessary tracks, a blacksmith building, lavatory and roundhouse office building and car repair yard facilities.

Pere Marquette.—This company has awarded a contract to Battey & Kipp, Chicago, for the construction of a 30-stall roundhouse, a 100-ft. electrically operated turntable, a concrete coaling station and sandhouse, a water tank, a cinder pit and related facilities. When completed the facilities will also be used by the Wabash and the Pennsylvania.

Great Northern.—This company will construct a 30-ft. by 450-ft. addition to its woodworking shop and a 600-ft. monitor on its car repair shed at Great Falls, Mont., to cost approximately $42,000 Bids will be called for about March 1. The company is also calling for bids for the construction of a 145-ft. by 300-ft. addition to the car repair shop at St. Cloud, Minn., to cost approximately $100,000.

PERSONAL MENTION

General

E. C. Howerton, master mechanic Denver & Rio Grand Western at Alamosa, Colo., has been appointed general mechanical inspector, succeeding J. C. Brown.

H. M. Ray, personnel assistant of the Kansas City Southern, with headquarters at Kansas City, Mo., has been appointed personnel supervisor, with the same headquarters.

J. Butler, master mechanic of the Ann Arbor, with headquarters at Owosso, Mich., has been promoted to superintendent of motive power, with the same headquarters.

O. M. Davison, wage supervisor of the Kansas City Southern, with headquarters at Kansas City, Mo., has been appointed supervisor of wages and working agreements, with the same headquarters.

B. M. Brown, master mechanic for the Southern Pacific lines with headquarters at El Paso, Tex., has been promoted to assistant superintendent of motive power and equipment with headquarters at Algiers, La.

A. H. Oelkers, whose appointment to chief mechanical engineer of the St. Louis-San Francisco, with headquarters at Springfield, Mo., has been announced, was born on October 4, 1885, on a ranch near New Braunfels, Tex. He entered railway service in 1901, as an apprentice machinist on the Southern Pacific, at San Antonio, Tex., and held this position until 1904, when he entered Purdue University. He was graduated from the university in 1907, with a degree in mechanical engineering. He re-entered the service of the Southern Pacific in September of that year, being assigned to road locomotive tests and miscellaneous work in the motive power department, with headquarters at Houston, Tex. He was promoted to head draftsman in 1910, and held this position until January, 1912, when he was promoted to mechanical engineer of the lines in Texas and Louisiana. During 1916 and 1917 he served as general shop foreman and supervisor of construction and new equipment, but resigned in August, 1918, to enlist in the U. S. Naval Aviation Service. Following his discharge from the navy in February, 1919, he was appointed master mechanic on the Louisiana lines of the Southern Pacific, which position he held until March, 1920, when he was promoted to assistant superintendent of motive power and engineering. He resigned from this position on December 31, 1922, to enter the service of the St. Louis-San Francisco as chief mechanical engineer.

A. H. Oelkers

J. W. Slack, Jr., has been appointed supervisor of the wage bureau of the Long Island, with headquarters at New York. He will report to and receive instructions from the general superintendent, to whom any question dealing with rates of pay, rules or working conditions will be transmitted for decision, in accordance with present practice.

E. M. Cooney has been appointed motive power inspector of the Chicago & Eastern Illinois, with headquarters at Danville, Ill. Mr. Cooney began railroad work as an apprentice in the boiler department of the Cleveland, Akron & Columbus—now part of the Pennsylvania system—in 1894, was made foreman boiler maker in 1904 and was engaged on special duty service under the superintendent of motive power at Toledo, Ohio, from 1912 to 1915. After serving as master mechanic of the Ohio River & Western from 1915 to 1917 he was assigned to the general superintendent of motive power's office at Pittsburgh, Pa., as general mechanical inspector of the Pennsylvania system Lines West.

Master Mechanics and Road Foremen

L. J. Gallagher has been appointed road foreman of engines of the Northern Pacific with headquarters at Missoula, Mont.

C. Peterson, acting master mechanic of the Denver & Salt Lake, with headquarters at Denver, Colo., has been appointed master mechanic.

J. C. Brown, general mechanical inspector Denver & Rio Grande Western, has been appointed master mechanic with headquarters at Alamosa, Colo.

W. B. Lieck, general foreman of the Southern Pacific at El Paso, has been promoted to master mechanic with the same headquarters, succeeding B. M. Brown, promoted.

H. L. Ellerbush has been appointed master mechanic of the Central division of the Union Pacific, with headquarters at Marysville, Kans., succeeding W. J. Kirsch, transferred.

G. C. Goff has been appointed master mechanic of the Southern with headquarters at Spencer, N. C., succeeding B. McBride who has been transferred in a similar capacity to Charleston, S. C.

W. J. Kirsch, master mechanic of the Central division of the Union Pacific, with headquarters at Marysville, Kans., has been transferred to the Kansas division, with headquarters at Kansas City, Kans.

J. A. Marshall, road foreman of engines of the Northern Pacific, with headquarters at Duluth, Minn., has been promoted to master mechanic of the Lake Superior division with the same headquarters.

J. M. Kilfoyle, terminal master mechanic of the Union Pacific with headquarters at Pocatello, Idaho, has been appointed master mechanic of the Utah division with the same headquarters, succeeding D. Gratian, resigned.

M. J. Powers, assistant superintendent of motive power of the Colorado & Southern, has been appointed terminal master mechanic of the Union Pacific with headquarters at Pocatello, Idaho, succeeding Mr. Kilfoyle, promoted.

E. Becker, master mechanic on the Chicago & North Western, with headquarters at Escanaba, Mich., has been appointed master mechanic of the Green Bay & Western, the Kewaunee, Green Bay & Western and the Ahnapee & Western, with headquarters at Green Bay, Wis., succeeding T. J. McPherson, who has resigned.

Shop and Enginehouse

P. Goggin, machinist, has been promoted to gang foreman of the Boston & Albany at West Springfield, Mass.

V. Brassard, gang foreman of the Boston & Albany, has been promoted to assistant day enginehouse foreman at West Springfield, Mass.

W. H. Dibble, assistant day enginehouse foreman at the West Springfield, Mass., enginehouse of the Boston & Albany, has been promoted to day enginehouse foreman.

E. P. Kelley, day enginehouse foreman of the Boston & Albany at West Springfield, Mass., has been promoted to general enginehouse foreman at the same point, succeeding A. L. Babcock, retired.

Anthony L. Babcock, day enginehouse foreman of the Boston & Albany at West Springfield, Mass., has been retired on a pension. Mr. Babcock was born at Petersburg, N. Y., January 16, 1853, began railroad work as a wiper at Rensselaer enginehouse and after serving as fireman, engineer and machinist was made an engine despatcher in 1897. He was promoted to road foreman of engines in 1901 and made enginehouse foreman at West Springfield in 1903.

Purchasing and Stores

A. Knodt, acting purchasing agent and storekeeper of the Denver & Salt Lake, with headquarters at Denver, Colo., has been appointed purchasing agent and storekeeper.

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Wake Up! Erecting Shopmen

While it would be untrue and unfair to insinuate that erecting shop foremen and men are asleep on the job, the fact remains that they say nothing—at least for publication. Probably the things they say when driving wheels tram out-of-square after the binders are put on are not fit for publication. Be that as it may, erecting shopmen are going to have a chance to say something about their work through the columns of the *Railway Mechanical Engineer* and be paid for the trouble. An erecting shop competition has been inaugurated with a first prize of fifty dollars and a second prize of thirty-five dollars for the best articles dealing with erecting shop practices that are received before June 1, 1923. The articles may be of a general nature, or may cover some special phase of erecting shop work, such as stripping locomotives, distributing material to the various shop departments, bolting frames and cylinders, lining shoes and wedges, maintaining superheater units, handling truck repairs, assembling motion work, wheeling, valve setting, or, in fact, any work ordinarily done by erecting shopmen. The articles will be rated according to the practical value of the method described and the ideas presented and not on the basis of literary merit. It is hoped that every erecting shopman who has developed some method which saves time or labor in handling his work will take this opportunity of presenting his idea to other shopmen to their advantage and, incidentally, to his own. In addition to the prizes mentioned above, any other articles accepted for publication will be paid for at regular space rates. Articles entered in this competition should be mailed to the Managing Editor, *Railway Mechanical Engineer*, New York City, early enough to reach our office on or before June 1.

The Locomotive Engineer of the Future

Practically all railroad mechanical department officers seem to agree that securing proper operation of locomotives by the engine crews is constantly becoming a more serious problem. Modern motive power has practically all the features of a stationary power plant, and to operate it properly a man should have fully as much knowledge as is required of a licensed stationary engineer. Over and above all this the locomotive engineer must be thoroughly familiar with the details of train operation. The position is one which demands more than ordinary ability. Fifteen or twenty years ago men of inherent ability, who took a deep interest in their work, were attracted to the position of engineer. Today the same class of men are not available. Most young men shun hard work and while many of them would like to become engineers, they do not have enough stamina to spend several years as a fireman. When mechanical stokers come into more general use, this condition will be changed, but the number of locomotives now equipped with stokers is comparatively small.

The tendency toward increased complication in motive power, combined with a lowering of the standard of employees in engine service, is creating a serious condition. Unlike the new recruits of fifteen or twenty years ago, the average fireman today spends little time outside his regular hours of employment perfecting his knowledge of locomotive construction and operation. Many roads have gradually made the examinations for promotion less stringent and instead of requiring complete familiarity with the latest types of power, the fireman is considered as qualified to run a locomotive even if he has less knowledge that was required of the men who ran the old plain engines.

There is no escaping the fact that the average fireman of today is not a promising candidate for the position of locomotive engineer. There are two ways in which the railroads can improve this condition, both of which should be used. First, firemen should be instructed and examined periodically to make sure that they are acquiring a thorough knowledge of the modern locomotive. Second, everything within reason should be done to reduce the physical effort of the fireman, so that the position will no longer be referred to as demanding only a strong back and a weak mind.

Increasing Importance of Terminals

While the average locomotive may spend only eight hours a day in actual road service, most locomotive terminals must be operated twenty-four hours a day to care for them. Delays at terminals not only interfere with traffic schedules, but undue time spent on ash pits, in coaling, inspection, boiler washing, or in performing running repairs makes necessary the purchase of additional locomotives to handle the traffic. Unfortunately, many terminals were planned in the days when motive power was much lighter than at present and at a time when cranes and other labor-saving devices were of relatively far less importance. Not only have the parts of the modern locomotive increased considerably in weight, but the increasing importance of greater economy in operation has made it desirable to improve the locomotive by the addition of many devices not formerly used. All of this, however, has added largely to the work required at terminals, for without proper maintenance the full value of many locomotive improvements will not be realized.

In addition, most roads have adopted the plan of making many repairs in the terminal which were formerly done in the back shop. This practice is advantageous in that the mileage between shoppings is thereby lengthened and some relief is obtained for the main shops which have in too many instances been outgrown. In order that the locomotive terminal may properly perform its functions of promptly returning locomotives to the operating department and of rendering the maximum relief to the main shop, it must receive more attention than hitherto has been given to it. Adequate provision must be made for light, ventilation and labor-saving equipment so that both day and night work may be performed under conditions which will render employment less undesirable and much more efficient. Above all, the terminal shop must be provided with better machine tools and of a greater variety. The use of antiquated tools and makeshift devices is too heavy a burden for the railroads to carry much longer. Mechanical department officers who are responsible for locomotive terminal operation and best know the needs of the place can aid greatly towards reducing operating expenses by vigorously advocating needed improvements in layout and equipment of terminals.

Draft Gear Maintenance

When heavy steel underframes were first applied to freight cars, the draft attachments remained in good condition for long periods with very little attention. It seemed for a time that one of the largest items of the cost of car repairs had been almost eliminated, and to a certain degree this was actually the case. However, at the present time defects in draft gear and draft attachments seem to be increasing very materially. If operating conditions are considered, it is easy to see why this period of freedom from failure was only temporary. As long as a considerable proportion of wooden cars were in use this weak equipment absorbed the shocks and protected the steel cars. Now that practically all the cars are of steel, or have steel underframes, shocks are not dissipated as well and high stresses are set up. Furthermore, the tractive force of locomotives has increased rapidly without a corresponding increase in the strength of cars. The present A. R. A. recommendations call for a draft gear of 150,000 lb. capacity. It is not uncommon to find trains handled by two locomotives, each exerting 75,000 lb. tractive force.

It is desirable to keep the capacity of the draft gear well above the forces to which it is subjected because if the gear goes solid, the stresses in the car increase with extreme rapidity. The full capacity of a draft gear can only be developed when it operates at its maximum travel, and for that reason lost motion in the gear should be carefully avoided. Slack in the attachments should not be neglected, because it permits variations in speed between adjacent cars which increase the shocks when the slack is suddenly taken up. An examination of cars in ordinary service will almost always show that a large proportion of them are not in condition to dissipate shocks effectively, and even though this fact is recognized, the parts are usually allowed to run until a complete failure makes repairs absolutely necessary. It would be very convenient if the railroads could put on draft gear and attachments and then forget about them, but with failures becoming more numerous, it is a question whether it would not be cheaper to bring these parts up to standard at regular intervals.

Safety First

The number of accidents in railroad shops has been greatly reduced in recent years owing to the commendable work of Safety First committees and the general educational programs which have been inaugurated. There is still opportunity for improvement, however, and one of the points deserving particular attention is the number of eye accidents. Eye accidents are more numerous than any others particularly in blacksmith shops owing to the flying scale, hot steel chips and emery dust. Forging machines and drop hammers add to the hazards and hot saws send showers of sparks in all directions. The obvious solution is to get the men to wear goggles, but this is easier said than done. Possibly the experience in a large Canadian forge shop may be of interest and suggestive value. With eye accidents on the increase the management decided to overcome objections to the wearing of goggles as much as possible and make goggle wearing compulsory.

The objection that goggles are heavy is reasonable but unavoidable if they are to be strong. When properly fitted the weight is not noticed. When goggles cause headaches the chances are that the lenses are not perfectly flat or colorless, or possibly the eyes are defective. The wearer must have lenses suited to his individual needs inserted in the regulation protective goggle frame. Experience shows that goggles are not hot to wear but in fact protect the eyes from furnace heat and flying articles. Should the middle frame get hot, a bit of cloth in extreme cases can be sewed around the bridge. Will not steam, water and oil fog the lens? Assuredly, and the answer is to wipe it off. Anyone who wears eye-glasses must perform this simple operation which does not interfere with production to any practical extent. A small amount of glycerine soap rubbed on the lens and wiped off with a clean cloth will help reduce fogging. For men who work on very hot jobs it may be necessary to stretch a cheese cloth pad across the forehead with an elastic band to prevent perspiration from running down into the eyes.

Coaxing, pleading and arguing will do no good unless the shop managements take a definite stand and enforce rules for the wearing of goggles on jobs subject to eye hazards. The matter is important since accidents from this cause cost the railroads large amounts of money annually in doctors' bills, damages, loss of service and loss of production. As demonstrated by the experience of the Canadian forge plant, the obvious thing to do is to overcome objections to the wearing of goggles and make their wearing compulsory. There is no question that on many jobs production will actually be increased since men can work both better and faster when they do not have to be continually on guard against dust, chips or scales flying into their eyes.

Responsibility for Damage to Cars

RULE 32 is probably the cause of as many appeals for arbitration as all of the other car interchange rules combined. To a considerable extent the difficulty of administering this rule is inherent in the conditions covered by the rule itself. Indeed, evidence that this is true is contained in the number of cases in which the Arbitration Committee is called on, not so much in its capacity as an interpreter of the rule as to decide disputed questions of fact. With the responsibility for extensive damage determined by the effect rather than the cause, questions of fact are readily established. It is comparatively simple to determine the condition of a damaged car, but the circumstances connected with the damage a knowledge of which is necessary to determine the cause, are seldom established beyond all doubt and many times are not ascertainable at all.

But some of these appeals for arbitration appear to arise from a failure to appreciate the principles underlying this and the other rules related to it as they now stand in the interchange code and as they are being interpreted in its decisions by the Arbitration Committee. Since 1914 there has been a complete change in the construction of the rules bearing on the determination of responsibility for damage to equipment. This change began with the elimination of the so-called combination defects, by which handling line responsibility was defined, and continued with the gradual development in Rule 32 of definitions of the specific causes of accidents which mark the damage as handling line responsibility irrespective of its extent. The former rules protected the car owner in the perpetuation of obsolete and unfit equipment and penalized the handling line unfortunate enough to have to move cars of this character. The present rule offers far greater protection to the handling line against damage caused primarily by the weakness of the equipment than the former combination defects.

But the decisions of the Arbitration Committee in cases arising under Rule 32 show a tendency, if not a deliberate rule of action, to assume that the existence of any of the conditions listed in the rule is proof that this condition is the primary cause of the damage. This conclusion does not always follow, particularly in cases where derailment, wrong signals or no rider protection are reported as attendant circumstances. There are cases of damage for which this strict interpretation of the rules makes the handling line responsible, where equipment of better construction undoubtedly would not have failed.

Before deciding that this tendency is inconsistent with the principle of the rule, however, it must not be forgotten that the owner is entitled to some consideration, and that, in settling questions as to responsibility for damage the owner is at a decided disadvantage because he has no first-hand knowledge of the conditions under which his car was damaged. It is logical, therefore, that in establishing the facts of each case in which owner's responsibility is claimed, the burden of proof be placed on the handling line and a strict interpretation of the rule in favor of the owner is justified. Furthermore, a policy of liberal interpretation of the rule in favor of the handling line, requiring the consideration of such circumstances as the general condition of the damaged car prior to the accident, or the complete escape from damage of other cars associated with it and apparently more directly subjected to excessive stresses, would tend to throw every case arising under Rule 32 into the hands of the Arbitration Committee before a settlement could be effected.

As the matter stands, then, the handling line is protected if it can show a case in which clearly none of the conditions named in Rule 32 exist, but it has little prospect of a favorable decision unless it can demonstrate beyond reasonable doubt that its hands are absolutely clean.

New Books

Proceedings of the Traveling Engineers' Association. 323 *pages, 6 in. by 8½ in., bound in leather. Published by the association, W. O. Thompson, secretary, 1177 East Ninety-eighth street, Cleveland, Ohio.*

This is the report of the Thirtieth Annual Convention, held in Chicago October 31-November 3, 1922. The subjects discussed included: Distribution of power; advantages of self-adjusting wedges, feedwater heaters and boosters; employing, educating and examining engineers and firemen; air brake defects; mechanical firing and operation and maintenance of oil-burning engines.

Metals and Their Alloys. *By Charles Vickers, 800 pages, 6 in. x 9 in., 110 illustrations, bound in cloth. Published by Henry Carey Baird & Co., New York.*

Although partly based on Metallic Alloys by William T. Brannt, the revision has been so thorough and so much new material has been included that this volume is practically a new work. It is a comprehensive and practical reference book on the subject of metals and their alloys, and will be of special interest to the engineer, designer, metallurgist, chemist, and foundryman. It deals with the origin of metals, their combination into various alloys and their physical properties, such as strength, ductility, hardness, bearing properties, lightness and resistance to acids. Modern American foundry practices are well described, although the book is not essentially one on foundry work. Information in regard to smelting and refining is somewhat brief and includes only such facts as the user of alloys would be apt to desire.

Considerable space is devoted to brasses and bronzes—copper, tin, lead, zinc, aluminum, manganese and other alloys. There are chapters on alloys for steam metals, bearing metals, solders and fusible alloys. Iron and steel alloys are covered briefly. There is also an interesting chapter on nickel alloys and monel metal. Sand casting, die casting and rolling are described. A glossary of foundry and other terms, also an excellent index, complete the book and add to its value.

What Our Readers Think

The St. Paul Gondola Car Design

Chicago, Ill.

To the Editor:

In the January issue of the *Railway Mechanical Engineer* on page 4 are some comments on the design of the C. M & St. P. gondola cars described in an article in the November issue. The calculations on which the article was based were a preliminary study and before the cars were actually built several revisions were made.

Your correspondent criticised the use of the strut formula $16{,}000 - 70\frac{l}{r}$ as the product $\frac{l}{r}$ exceeded 120. The values given were materially decreased in the actual design and the stresses reduced to usual practice.

In connection with the bulging stresses imposed upon the side framing of the car, the correspondent apparently overlooked the fact that the internal gusset plates, posts and side braces are designed to withstand these bulging forces. When designing railway equipment, past experience naturally must form the foundation for the design and the calculations are more or less a check on designs already tested out and in actual service. In most cases it is found that theory and practice very closely agree. In the design of these cars both theory and practice were carefully considered in connection with the bulging stresses, as both the direct bulging stresses and the centrifugal forces were taken into consideration. This was not done, however, as suggested by the writer of the letter in your January issue. An open type car must be considered in the same manner as an open water tank. In our particular case, the side planks, which are 2¼ in. thick, are amply strong to distribute the stresses to posts, braces and gussets and there is no appreciable bulging strain in the top chord of the side framing. The only load on this member is produced by the material resting directly against it.

L. K. Sillcox,

General Superintendent, Motive Power, C. M. & St. P.

Drafting the Locomotive

Council Bluffs, Ia.

To the Editor:

The practice of utilizing the entraining action of the exhaust steam from the cylinders of the steam locomotive for the production of draft is universal. It is one of the features of locomotive design that has undergone little modification. As to its sufficiency for the purpose there is no question. As to the efficiency of its ordinary application there is much to be desired.

The writer inclines to the belief that the exhaust will continue to be so used to the exclusion of any other method. In the first place, the exhaust steam must be disposed of. Not to exceed 15 per cent of it may be utilized in a feedwater heater. It has been proposed to operate locomotive condensing, and while turbine driven locomotives are in operation with condensing equipment it would be extremely difficult to design and apply a condenser which would handle the volume of steam used by the modern reciprocating locomotive of large power, even after making allowance for reduced consumption when operating condensing.

The efficiency of the use of exhaust steam for the creation of draft is a field which offers splendid possibilities for investigation and research. The radical defect of practically all drafting arrangements is the necessity for carrying high back pressure. This ranges from 10 lb. to 24 lb. and the power represented is considerable, over 1,000 hp. with large locomotives. This is many times the power that would be required to provide the draft if it were produced by an exhaust fan of even moderate efficiency.

The exhaust jet is an entraining device with an action somewhat similar to the steam injector.

The exhaust jet to produce draft has only to move the gases of combustion against a pressure of 6 in. to 8 in. of water, that being the difference between the pressure within the front end and atmospheric pressure outside.

There are certain variable conditions affecting the working or entraining action of the exhaust jet. These are: First, the velocity of the steam in the jet; Second, the size and form of the jet and the surface area exposed to contact with the gases of combustion; Third, the continuity of the jet, made up as it is of separate exhaust impulses.

Velocity is the only one of these variables which is given much attention. Increasing the velocity enhances the entraining action. Thus the first remedy when a locomotive fails to "steam" is to apply a smaller nozzle tip. The back pressure is increased, but the steam expanding from a higher pressure has added velocity and an increased draft is the result. The loss of power from the increased back pressure tends to offset the gain, so that increasing the velocity in the jet by raising back pressure is a wasteful procedure.

Steam on expanding performs work whether it expands against a moving piston or in an exhaust nozzle. In the latter case the work performed is the production of velocity in the steam causing it to move against the pressure of the atmosphere. Knowing the pressure of the steam at the beginning of expansion and at the termination it is possible to determine the theoretical velocity.

The formula for ascertaining the velocity is as follows:

$$V = 223.8 \sqrt{H_1 - H_2}$$

In which V = Velocity in feet per second.
H_1 = Total heat in steam at beginning of expansion.
H_2 = Total heat in steam at end of expansion.

If the formula be worked for steam at 5 lb., 10 lb. and 20 lb. gage pressure, expanding in each case to atmospheric, the velocities will be found to be

5 lb.	539 ft. per sec.
10 lb.	705 ft. per sec.
20 lb.	917 ft. per sec.

which covers the range of pressures ordinarily met in the exhaust jet. It will be seen that increasing the pressure 300 per cent only increases the velocity about 70 per cent. The formula is based on dry steam and adiabatic expansion and the velocities are the theoretical velocities, actual velocities being of course less. It is therefore clear why attaining increased velocity in the exhaust jet by increasing back pressure is an expensive remedy.

Now consider the second variable, the size and form of the jet. With two jets of equal velocity, the one which exposes the greater surface to contact with the gases will entrain a larger volume. Compare for instance a single jet with a cross sectional area at the nozzle of 30 sq. in. and two jets with an area of 15 sq. in. each. Assume that the velocity is equal and that the amount of steam discharged by the two smaller jets equals that of the larger one. The two smaller nozzles will expose a surface area 40 per cent greater than the single large nozzle and therefore should entrain and move a correspondingly larger volume of gases.

The single round nozzle jet is that form which provides the minimum surface area in the jet for a given cross sectional area. It would therefore appear that it is the least desirable form to use, if this second variable has any considerable bearing on the efficiency of the nozzle.

Now comes the third variable, continuity. The exhaust steam comes to the nozzle in separate impulses. As the speed of the locomotive increases the interval between impulses lessens, until at high speeds the flow of steam through the nozzle becomes almost continuous. The separate exhausts are still distinctly audible but the action on the fire indicates that the flow of air through it is almost continuous. Under such conditions the draft is all that can be desired, the disturbance of the fire is a minimum and the production of cinders much reduced. Could the exhaust pulsations be smoothed out and a greater degree of continuity secured at moderate speeds, much will be gained in the production of draft and fuel losses lessened.

The duty of the boiler is to furnish sufficient steam to develop the rated power of the locomotive. If coal is used for fuel, an amount must be burned that will furnish the desired heat to produce the steam, making due allowance for the boiler efficiency. The combustion of coal—composed of fixed carbon, volatile hydro-carbons, hydrogen, sulphur moisture and ash—is an intricate chemical reaction. To simplify matters only the combustion of the carbon portion of the coal will be considered.

If the carbon is completely burned in the presence of sufficient air, carbon dioxide or CO_2 is formed. Theoretically 11.58 lb. of air are required to burn a pound of carbon to CO_2 if each carbon atom is supplied with the necessary pair of oxygen atoms with no excess of either. Owing to conditions under which combustion takes place in the firebox it is impossible to insure complete combustion if only the right amount of air is supplied and it is therefore necessary to introduce an excess of air to provide surplus oxygen. It has been found that by admitting an excess of 33 per cent combustion will take place with the formation of little or no carbon monoxide or CO. Therefore it is customary to supply about 16 lb. of air for each pound of coal burned.

When insufficient air is supplied part of the carbon is burned with the formation of carbon monoxide or CO. The heat produced in the formation of CO is 4,380 B. t. u. per pound. If the combustion takes place in the presence of sufficient air and CO_2 is formed, the heat produced is 14,540 B. t. u. per pound. If the fire is starved for air, the heat produced will be less and the boiler efficiency will fall off rapidly. High rates of firing, exceeding 120 lb. of coal per square foot of grate per hour, are wasteful for the simple reason that it is impossible to get enough air through the fire to secure complete combustion.

Larger grate areas are needed, larger openings for air through ashpans and to the space under the grates. It may be advisable to apply forced draft, preferably through hollow grate bars and especially through hollow arch tile if it can be arranged, in which case the air would be preheated to a degree. Air admitted above the grates is a detriment if enough can pass through the grates and the fire.

Although the modern locomotive has a large grate area, the rate of fuel consumption has been pushed up to as high as 150 lb. per square foot per hour. The volume of products of combustion handled by the draft is large and would be still greater if the proper amount of air were supplied.

Fuel rates of four or five tons of coal per hour are common for a modern freight locomotive. As the ash in the coal is not dealt with by the draft, assume that four tons or 8,000 lb. of combustible are burned per hour. If 16 lb. of air are supplied per pound of coal there must be passed through the fire 128,000 lb. of air per hour. As the coal consumed is added to the above the total of products of combustion is 136,000 lb. of flue gases.

There should be 9 lb. of steam produced for each pound of combustible or a total of 72,000 lb. of steam per hour. Assuming that the feedwater heater, air pump, and other auxiliaries account for 16,000 lb. hourly, there remains then 56,000 lb. exhaust steam to be used in producing draft.

That the figures may be more readily grasped, it may be better to reduce them to pounds and cubic feet per second. The weight of gases per second becomes 37.77 lb. and of steam, 15.55 lb. This is an average rate—the momentary maximum rate may be much greater. As one cubic foot of flue gas at a temperature of 650 deg. F. weighs .03764 lb., the total volume of the 37.77 lb. of flue gas will be 1,000 cu. ft., approximately. If the exhaust steam is expanded to atmospheric pressure, its volume will be $15.55 \times 26.27 =$ 400, approximately, the figure 26.27 being the specific volume of steam at atmospheric pressure. The total volume of steam and gases combined becomes about 1,400 cu. ft. per sec.

The locomotive under consideration will have a stack about 18½ in. in diameter at the choke or an area of 1.862 sq. ft.

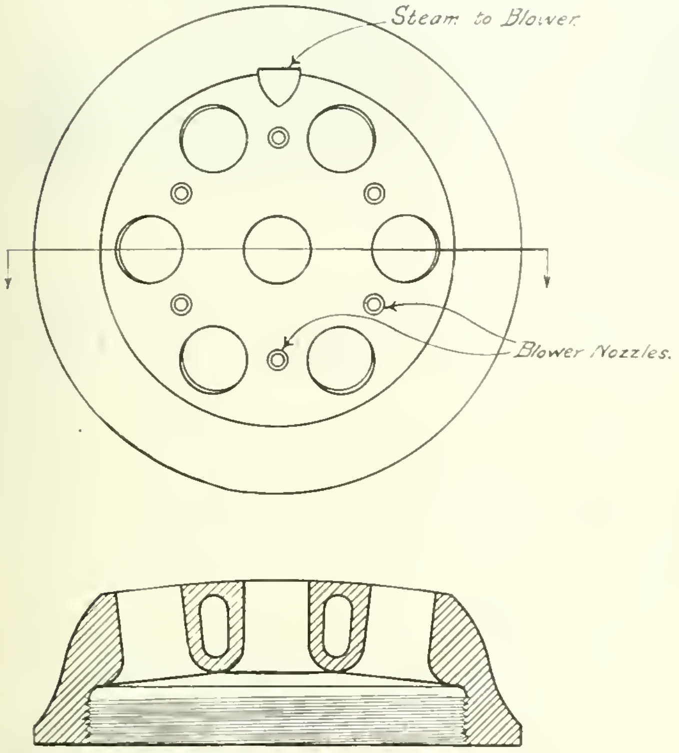


Fig. 1—Suggested Nozzle Cap

Dividing the total volume—1,400 cu. ft.—of gases and steam passing per second by the area of the stack will give the velocity at which they are moving, as 752 ft. per sec. Now, referring to the paragraph on expansion of steam at 5, 10 and 20 lb. pressure, it will be observed that 10 lb. pressure is too low to produce the velocity required to move the gases at 752 ft. per sec.

Suppose that the stack diameter be increased to 30 in. with an area of 4.9 sq. ft. In that case the velocity of the gases would equal 286 ft. per sec. This is reduced to a figure where steam at a much lower pressure will serve the purpose.

It was shown that two jets should be more effective in entraining action than a single jet of an equivalent area. Carry this idea farther and increase the number of jets to seven, making them all of equal size, placing one centrally and spacing the remaining six equidistantly around it. Proportion the jets to secure lower back pressures by making their total area of opening more than that of the single jet. Make each individual nozzle or orifice of the most approved form, i. e., what is known as the ideal low pressure nozzle, except that the cylindrical bore is lengthened a little to secure positive direction to the jet. The entrance of the individual nozzles is rounded by an easy curve, a radius of at least one half the nozzle diameter. Form the entire group in a single casting made in the form of a small segment of a sphere, the individual nozzles being radial or normal to the surface. The jets will be given a slight spread, sufficient to fill the larger stack and the entire space between jets for a considerable portion of the exposed length will be available for entraining action.

If these ideas are embodied in a drawing, the nozzle will appear as shown in Fig. 1. A blower connection has been provided by coring out the interior of the nozzle cap casting and inserting nozzles in the spaces between the main nozzles.

Fig. 2 is a cross section through the front end and shows the form of the nozzle and stack, the form and direction of the steam jets being indicated by broken lines. It also shows another feature intended to secure greater continuity in the flow of the exhaust steam, that of a receiver, secured by enlargement of the exhaust passage ways, these being merged into a single large central chamber at a point near the bottom of the saddle casting.

By breaking up the exhaust into several distinct and separated jets, the entraining surface area is increased to 300 per cent of that of a single jet. The space between jets should be especially effective, the gases therein being exposed on all sides to the moving steam. The radial direction of the jets should maintain this spacing for such a distance as may be required and also enable the steam to fill a larger diameter stack sufficiently to exclude any possibility of back draft.

The writer believes that it has been made clear that the necessity for high back pressures in practically all existing designs is caused by adherence to the use of the single round jet which calls for a small stack and unnecessarily high exit velocities in the steam and gases passing through it.

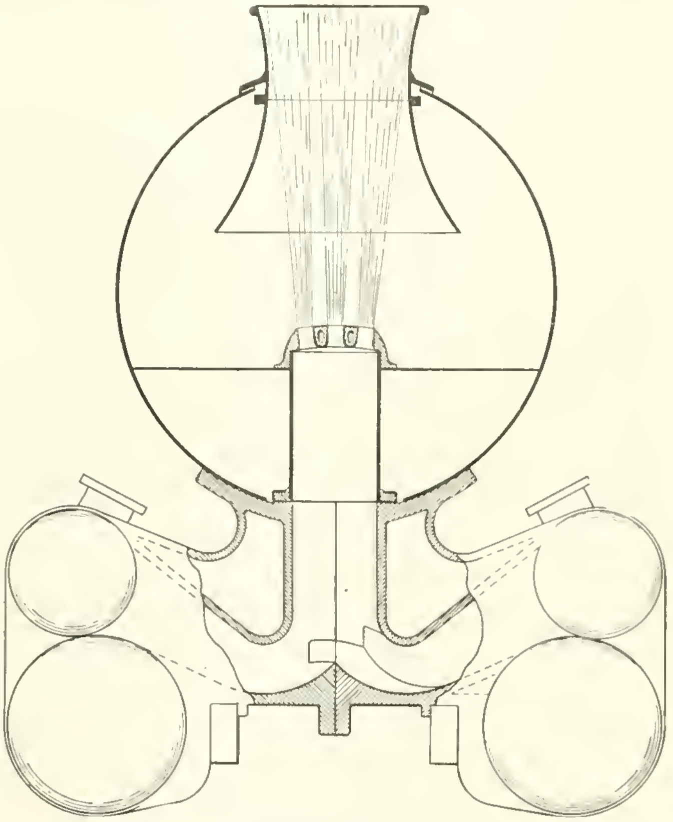


Fig. 2—Section Through Front End

The preponderating merit of the exhaust as a draft producer is its simplicity. That is a feature which it will be difficult to overcome, more so as the improvement of the steam locomotive advances and necessary complication increases in the addition of devices which make for greater economy. It is well therefore to retain the simplicity of this feature, provided its efficiency can be sufficiently increased.

The illustrations herewith, while showing a design which is believed to embody all the desirable features, including that of securing maximum continuity in the flow of steam, must not be construed to indicate that new cylinders are required on existing locomotives. A nozzle of the type shown can be designed for application to existing power which will produce good results although the continuity feature is not fully realized.

Thomas E. Stuart.

Baltimore & Ohio Coal Train—Sixty-three steel hopper cars (55 tons capacity) loaded with 3,351 tons of coal. Gross weight of cars and contents 4,586 tons. Mikado engine, weight 284,500 lb.—Tractive effort 55,000 lb.

Freight Train Resistance and Tonnage Rating

Part III

Importance of Care in Selecting Values for Adjustment—Effect of Car Weight, Weather and Temperature

By Richard J. McCarty, Jr.

Division Superintendent, Delaware & Hudson

FORMULAS for adjusted tonnage ratings have already been given and the necessary allowances for certain factors have been pointed out. The fundamental principles involved in adjusted tonnage ratings also have been taken up and analyzed. There now remain adjustments for weather and temperature together with a consideration of the relationship existing between the adjustment and the different values of resistance.

Relation Between the Adjustment and Car Weights

It was previously stated that the proper selection of car weights is an important matter in establishing efficient adjusted ratings, so in order to show how the adjustment varies with cars of different weights and in order to show the result when the adjustment does not fit the conditions, Tables VII and VIII, and Exhibits F and G have been prepared.

TABLE VII

COMPARISON OF ADJUSTMENTS BASED ON CARS OF DIFFERENT WEIGHTS

STRAIGHT AND LEVEL TRACK-SPEED 5 MILES PER HOUR

Items	Tons per car	Mech. resistance per ton	Mech. resistance per car	Grade resistance per car	Total resistance per car	Adjustment
Lighter car..	20	6.8	136	....	136	67.74
Heavier car..	60	3.3	198	....	198	
Difference ...	40	3.5	62	....	62	
Lighter car..	15	7.6	114	....	114	45.80
Heavier car..	70	3.1	217	....	217	
Difference ..	55	4.5	103	....	103	
Lighter car..	30	5.4	162	....	162	110.85
Heavier car..	50	3.7	185	....	185	
Difference ..	20	1.7	23	....	23	

NOTE—See Exhibit F.

These two tables and corresponding exhibits show that unless the car weights that are selected represent the conditions of operation, adjusted ratings based thereon are apt to cause trains to be over-loaded or under-loaded an amount which depends on how the average weight of the cars of any one train compares to the weights on which the adjusted rating was based. Therefore, it is important to select as a basis, car weights that will give the most accurate ratings for the class of traffic that is to be moved.

Relation Between the Adjustment and Different Values of Resistance

In cases where the actual tons and the adjustment are obtained by tests, the different units and the adjusted ratings will of course be consistent, provided the tests are properly conducted.

In cases where the adjusted ratings are calculated, the same values as are used for obtaining the actual tons should be used in obtaining the value of the adjustment, which insures the proper consistency for the adjusted ratings.

But in cases where the actual tonnage rating of only one train is obtained by test or where the value of the adjustment only is wanted, it is necessary to use great care in selecting values as a basis for the adjustment, for otherwise it might not fit the conditions.

With a view of bringing out these points more clearly, and for other purposes which will appear later, the value of the adjustment with respect to the different values of resistance by which it is produced will be analyzed.

TABLE VIII

COMPARISON OF ADJUSTMENTS BASED ON CARS OF DIFFERENT WEIGHTS

GRADE 1 PER CENT—SPEED 5 MILES PER HOUR

Items	Tons per car	Mech. resistance per ton	Mech. resistance per car	Grade resistance per car	Total resistance per car	Adjustment
Lighter car..	20	6.8	136	400	536	4.87
Heavier car..	60	3.3	198	1,200	1.398	
Difference ..	40	3.5	62	800	862	
Lighter car..	15	7.6	114	300	414	3.92
Heavier car..	70	3.1	217	1,400	1,617	
Difference ..	55	4.5	103	1.100	1,203	
Lighter car..	30	5.4	162	600	762	6.03
Heavier car..	50	3.7	185	1,000	1,185	
Difference ..	20	1.7	23	400	423	

NOTE—See Exhibit G.

As a basis for further analysis there will be used equations (34) and (35) which show the relations that exist between the adjustment and the fundamental values by which it is produced, while Tables IX and X show the same thing by specific figures instead of by formula. It should be understood, however, that the tables just mentioned are made up of entirely arbitrary values, except where actual figures are specified, and that the only purpose is to further illustrate the theory of the adjustment, and to show how, with given car weights, it varies with different values of mechanical resistance.

From these tables, it will be seen that with any two given cars of unequal weight, the adjustment varies with the different values of mechanical resistance, unless the values of mechanical resistance are such that the ratio of the total resistance in pounds per ton of the lighter car, to the total resistance in pounds per ton of the heavier car is a constant quantity, in which case the adjustment would remain constant.

EXHIBIT "F"

Effect of a Given Adjustment on Various Trains of Different Weight Cars. Straight and Level Track—Speed 5 Miles Per Hour

Items (res. in lb.)	Trains to which adjustment applies		Adjustment for 20 and 60 ton cars applied to trains of other wt. cars				
Actual ratings and unit values:							
Tons per car	20	60	15	30	40	50	70
M. R. per ton	6.8	3.3	7.6	5.4	4.4	3.7	3.1
Grade res. per ton	....	....	....	....	....	....	....
M. R. per car	136	198	114	162	176	185	217
Grade res. per car	....	....	....	....	....	....	....
Actual tons	1,980	4,030	1,771	2,493	3,060	3,640	4,343
No of cars	99	68	118.1	83.1	76.5	72.8	62.0
Total M. res.	13,464	13,464	13,464	13,464	13,464	13,464	13,464
Total grade res.	....	....	....	....	....	....	....
Total all res.	13,464	13,464	13,464	13,464	13,464	13,464	13,464
The above trains on adjusted tonnage rating basis:							
Adjustment	67.74	67.74	67.74	67.74	67.74	67.74	67.74
Actual tons	1,980	4,080	1,578	2,665	3,225	3,689	4,414
Potential tons	6,706	4,606	7,108	6,021	5,461	4,997	4,272
Adjusted tons	8,686	8,686	8.686	8,686	8,686	8,686	8,686
No. of cars	99	68	104.9	88.8	80.6	73.8	63.1
Total all res.	13,464	13,464	11,993	14,391	14,190	13,649	13,683
Overload or underload:							
Actual tons	0	0	—193	+172	+165	+49	+71
Mech. res.	0	0	—1,471	+927	+726	+185	+219

EXHIBIT "G"

Effect of a Given Adjustment on Various Trains of Different Weight Cars. Grade 1 Per Cent—Speed 5 Miles Per Hour

Items (res. in lb.)	Trains to which adjustment applies		Adjustment for 20 and 60 ton cars applied to trains of other wt. cars				
Tons per car	20	60	15	30	40	50	70
M. R. per ton	6.8	3.3	7.6	5.4	4.4	3.7	3.1
Grade res. per ton	20.0	20.0	20.0	20.0	20.0	20.0	20.0
M. R. per car	136	198	114	162	176	185	217
Grade res. per car	400	1.200	300	600	800	1,000	1,400
Actual tons	502.4	577.9	487.8	530.1	551.8	568.1	582.8
No. of cars	25.12	9.63	32.52	17.67	13.79	11.36	8.32
Total M. R.	3,416	1,907	3,707	2,863	2,428	2,102	1,807
Total grade res.	10,048	11,557	9,757	10,601	11,036	11,362	11,657
Total resist.	13,464	13,464	13,464	13,464	13,464	13,464	13,464
The above trains on adjusted tonnage rating basis:							
Adjustment	4.87	4.87	4.87	4.87	4.87	4.87	4.87
Actual tons	502.4	577.9	471.6	537.3	556.8	569.0	583.8
Potential tons	122.3	46.8	153.1	87.4	67.9	55.7	40.9
Adjusted tons	624.7	624.7	624.7	624.7	624.7	624.7	624.7
No. of cars	25.12	9.63	31.44	17.91	13.92	11 38	8.34
Total resist.	13,464	13.464	13,016	13,647	13,586	13,485	13,486
Overload or underload:							
Actual tons	....	....	—16.2	+7.2	+5.0	+0.9	+1.0
Total resist.	....	....	—448	+183	+122	+21	+22

A study of these tables emphasizes the importance of having the adjustment based on the same values as were used in obtaining the actual tonnage ratings.

The mechanical resistance per ton for item A of Table IX are actual figures at 5 miles per hour as per Table II, while the values of mechanical resistance for items B, C, D, and E are hypothetical values used to illustrate the principles involved.

Item B is the same as A except mechanical resistance per ton for lighter car is increased and that for the heavier car is decreased.

Item C is the same as A except mechanical resistance per ton for lighter car is decreased and that for the heavier car is increased.

Item D is the same as A except mechanical resistance per ton for both cars increased an equal amount each.

Item E is the same as A except mechanical resistance per ton for both cars increased in the same proportion.

TABLE IX

Effect of Different Values of Mechanical Resistance on the Adjustment

Straight and Level Track—Speed 5 Miles Per Hour

Items		Tons per car	Mech. resistance per ton	Mech. resistance per car	Grade resistance per car	Total resistance per car	Adjustment
A	Lighter car	20	6.8	136	....	136	67.74
	Heavier car	60	3.3	198	....	198	
	Difference	40	3.5	62	....	62	
B	Lighter car	20	8.0	160	....	160	300.00
	Heavier car	60	3.0	180	....	180	
	Difference	40	5.0	20	....	20	
C	Lighter car	20	6.0	120	....	120	20.00
	Heavier car	60	4.0	240	....	240	
	Difference	40	2.0	120	....	120	
D	Lighter car	20	8.0	160	....	160	38.16
	Heavier car	60	4.5	270	....	270	
	Difference	40	3.5	110	....	110	
E	Lighter car	20	10.88	217.6	...	217.6	67.74
	Heavier car	60	5.28	316.8	....	316.8	
	Difference	40	5.60	99.2	....	99 2	

TABLE X

Effect of Different Values of Mechanical Resistance on the Adjustment

Grade 1 Per Cent—Speed 5 Miles Per Hour

Items			Total tons resistance per car per ton	Mech. resistance per car	Grade resistance per car	Total resistance per car	Adjustment
A	Lighter car	20	26.8	136	400	536	4.87
	Heavier car	60	23.3	198	1,200	1,398	
	Difference	40	3.5	62	800	862	
B	Lighter car	20	28.0	160	400	560	7.32
	Heavier car	60	23.0	180	1,200	1,380	
	Difference	40	5.0	20	800	820	
C	Lighter car	20	26.0	120	400	520	2.61
	Heavier car	60	24.0	240	1,200	1,440	
	Difference	40	2.0	120	800	920	
D	Lighter car	20	28.0	160	400	560	4.61
	Heavier car	60	24.5	270	1,200	1,470	
	Difference	40	3.5	110	800	910	
E	Lighter car	20	30.88	217.6	400	617.6	7.47
	Heavier car	60	25.28	316.8	1,200	1,516.8	
	Difference	40	5.60	99.2	800	899.2	
F	Lighter car	20	29.58	191.6	400	591.6	4.87
	Heavier car	60	25.73	343.8	1,200	1,543.8	
	Difference	40	3.85	152.2	800	952.2	

The mechanical resistance per ton for item A of Table X are actual figures at 5 miles per hour as per Table II, while the values of mechanical resistance for items B, C, D, E and F are hypothetical values.

Item B is the same as A except the mechanical resistance per ton for the lighter car is increased and that for the heavier car is decreased.

Item C is the same as A except the mechanical resistance per ton for the lighter car is decreased and that for the heavier car is increased.

Item D is the same as A except the mechanical resistance per ton for both cars is increased an equal amount each.

Item E is the same as A except the mechanical resistance per ton for both cars is increased in the same proportion.

Item F is the same as A except the total resistance per ton for both cars is increased in the same proportion.

Effect of Weather on Tonnage Ratings

The values of mechanical resistance that have been used up to the present point represent favorable weather conditions, but as the mechanical resistance of any given car or train at any given speed increases as the temperature decreases and as it is increased by wind and precipitation, it is necessary to introduce some method by which tonnage ratings can be modified to meet unfavorable weather conditions. This is one of the most important features in connection with tonnage ratings but is probably the least susceptible to an analysis of any practical value.

Obviously, if any classification of tonnage ratings is to be developed on account of weather conditions, it must be based on temperature.

The general practice in connection with adjusted tonnage ratings is to provide four classes of ratings and designate them A, B, C and D, defining each class by temperature limits, the selection of which is principally a matter of judgment, although in some cases conditions might have something to do with it.

Master Mechanics' Proceedings for 1914, page 307, gives a diagram of the mechanical resistance of a light car and a heavy car at various temperatures which diagram reduced to a straight and level track basis gives values as shown in Table XI.

TABLE XI

TEMPERATURE LIMITS FOR WEATHER RATINGS AND EFFECT OF TEMPERATURE ON MECHANICAL RESISTANCE

Classification of ratings	Temp. limits (Fahr.)	Basis for each rating (mean temp.)	Per cent increase in mech. res. in lb. per ton	
			20-ton cars	72-ton cars
A	Above 30 30	70 degrees	Basis	Basis
B	30 15	22.5 degrees	15	15
C	15 0	7.5 degrees	30	30
D	0 −15	−7.5 degrees	55	55

These figures show that as the temperature decreases the mechanical resistance in pounds per ton increases in the same proportion for all axle loads.

A decrease in temperature raises the mechanical resistance in pounds per ton for both the locomotive and the cars, and therefore, the "A" rating must be reduced to an amount that will offset the decrease in drawbar pull that results from the increase in mechanical resistance—mainly journal friction—of the cars.

Of the different elements of locomotive mechanical resistance it is estimated that only 18 pounds per ton out of 25 per ton for the weight on the drivers is affected by temperature.

By increasing the elements of locomotive mechanical resistance susceptible to temperature according to the values in Table XI and using the values of equation (3) as a basis, the following formulas are obtained:

For A rating, $f = 200.56\ (254.6 - G)$ .... From (4)
For B rating, $f = 200.56\ (252.8 - G)$ .... (53)
For C rating, $f = 200.56\ (251.0 - G)$ .... (54)
For D rating, $f = 200.56\ (248.0 - G)$ .... (55)

These formulas can be used to calculate the drawbar pull of the locomotive specified in connection with equation (3) for any grade and any temperature within the limits prescribed by Table XI, but only for the locomotive specified, in connection with equation (3).

It is now in order to pass to the effect of temperature on train resistance exclusive of the locomotive.

By adding to the items of mechanical resistance in equation (37) and a similar equation based on the heavier cars, a co-efficient to represent the increase in this kind of resistance with a decrease in temperature as shown in Table XI the following equations are obtained:

Rating Based on Equations (37) for Lighter Weight Cars

$$\text{A Adj. tons} = \frac{f}{1.00E + G} + CW\ (W + w)\ \frac{1.00e}{1.00r + d} \quad \ldots\ldots(56)$$

$$\text{B Adj. tons} = \frac{f}{1.15E + G} + CW\ (W + w)\ \frac{1.15e}{1.15r + d} \quad \ldots\ldots(57)$$

$$\text{C Adj. tons} = \frac{f}{1.30E + G} + CW\ (W + w)\ \frac{1.30e}{1.30r + d} \quad \ldots\ldots(58)$$

$$\text{D Adj. tons} = \frac{f}{1.55E + G} + CW\ (W + w)\ \frac{1.55e}{1.55r + d} \quad \ldots\ldots(59)$$

Rating Based on an Equation for Heavier Weight Cars Similar to Equation (37)

$$\text{A Arj. tons} = \frac{f}{1.00\ (E - e) + G} + (C - c)\ W\ (W + w)\ \frac{1.00e}{1.00r + d} \quad \ldots(60)$$

$$\text{B Adj. tons} = \frac{f}{1.15\ (E - e) + G} + (C - c)\ W\ (W + w)\ \frac{1.15e}{1.15r + d} \quad \ldots(61)$$

$$\text{C Adj. tons} = \frac{f}{1.30\ (E - e) + G} + (C - c)\ W\ (W + w)\ \frac{1.30e}{1.30r + d} \quad \ldots(62)$$

$$\text{D Adj. tons} = \frac{f}{1.55\ (E - c) + G} + (C - c)\ W\ (W + w)\ \frac{1.55e}{1.55r + d} \quad \ldots(63)$$

in which the first part of each equation represents the actual tons and the second part the potential tons and the adjustment, as previously explained.

From these equations the following corollary may be deduced:

9—As between ratings for different rates of grade, the percentages of decrease of the B, C and D ratings compared to their corresponding A rating, are less as the rate of grade increases.

The reason for this is that tonnage reductions for weather conditions are based on temperature which affects only mechanical resistance and as mechanical resistance is only a part of the total resistance it follows that as the grade resistance increases the mechanical resistance becomes smaller in proportion to the total resistance, and, therefore, the effect on the tonnage of any increase in mechanical resistance by reason of temperature becomes less in proportion as the grade resistance increases.

In connection with the co-efficient of the adjustment in equations (56) to (63) inclusive it follows that when (d) is equal to zero,

$$\frac{1.55e}{1.55r} = \frac{1.30e}{1.30r} = \frac{1.15e}{1.15r} = \frac{1.00e}{1.00r} \quad \ldots\ldots\ldots\ldots(64)$$

From these ratios the following corollary may be deduced:

10—When mechanical resistance only is involved, the adjustment is constant for all temperatures.

The reason for this was explained in connection with Table IX items (A) and (E).

By referring to the co-efficient when grades are involved it follows that

$$\frac{1.55e}{1.55r + d}\ \text{is greater than}\ \frac{1.30e}{1.30r + d}\ \text{is greater than}\ \frac{1.15e}{1.15r + d}\ \text{is greater than}\ \frac{1.00e}{1.00r + d} \quad \ldots(65)$$

From these ratios the following corollary may be deduced:

11—When both mechanical and grade resistance are involved, the adjustment increases as the temperature decreases.

The reasons for this were explained in connection with Table X, items (A) and (E).

Table XII, which has been calculated by the part of equations (56) to (59) that applies to the adjustment, gives in specific figures an illustration of corollaries (10) and (11).

TABLE XII

Effect of Temperature on the Adjustment, Same Values as Tables III and IV

Grade and class of rating	Tons per car		Dif. in units of resist.				Adjustment
	Lighter car	Heavier car	M. R. per ton	M. R. per car	G res. per car	Total res. per car	
By formula—	(W)	(W + w)	(e)	(r)	(d)	(r + d)	$\frac{t}{c}$
No Grade—							
A	20	60	3.50	62.0	0	62.0	67.74
B	20	60	4.025	71.3	0	71.3	67.74
C	20	60	4.55	80.6	0	80.6	67.74
D	20	60	5.425	96.1	0	96.1	67.74
Grade 0.5 Per Cent—							
A	20	60	3.50	62.0	400	462.0	9.09
B	20	60	4.025	71.3	400	471.3	10.25
C	20	60	4.55	80.6	400	480.6	11.36
D	20	60	5.425	96.1	400	496.1	13.12
Grade 1.0 Per Cent—							
A	20	60	3.50	62.0	800	862.0	4.87
B	20	60	4.025	71.3	800	871.3	5.54
C	20	60	4.55	80.6	800	880.6	6.20
D	20	60	5.425	96.1	800	896.1	7.26

By using in equations (56) to (63), the same values of resistance as were used to derive equations (41) and (42), a simple set of formulas may be derived for practical purposes, as follows:

RATING LIGHTER CAR BASIS HEAVIER CAR BASIS

$$\text{A}\quad \text{Adj. tons} = \frac{f\ (d + 272)}{(G + 6.8)\ (d + 62)} = \frac{f\ (d + 132)}{(G + 3.3)\ (d + 62)} \quad \ldots(66)$$

$$\text{B}\quad \text{Adj. tons} = \frac{f\ (d + 312)}{(G + 7.8)\ (d + 72)} = \frac{f\ (d + 152)}{(G + 3.8)\ (d + 72)} \quad \ldots(67)$$

$$\text{C} \quad \text{Adj. tons} = \frac{f\,(d + 352)}{(G + 8.8)\,(d + 82)} = \frac{f\,(d + 172)}{(G + 4.3)\,(d + 82)} \quad \ldots(68)$$

$$\text{D} \quad \text{Adj. tons} = \frac{f\,(d + 420)}{(G + 10.5)\,(d + 96)} = \frac{f\,(d + 204)}{(G + 5.1)\,(d + 96)} \quad \ldots(69)$$

According to corollary 11, which applies to practical conditions, the theoretical adjustment increases as the temperature decreases and therefore, to be consistent any B, C or D rating should each in order have a higher adjustment than that for any one of the preceding classes A, B or C.

By substituting in equation (36), which is the basic formula for the adjustment, the same values as were used in the derivation of the equations (66) to (69) inclusive, the formulas for the adjustment in simple forms are:

$$\text{For A rating: Adjustment} = \frac{4200}{d + 62} \quad \ldots\ldots\text{From (47)}$$

$$\text{For B rating: Adjustment} = \frac{4800}{d + 72} \quad \ldots\ldots(70)$$

$$\text{For C rating: Adjustment} = \frac{5400}{d + 82} \quad \ldots\ldots(71)$$

$$\text{For D rating: Adjustment} = \frac{6480}{d + 96} \quad \ldots\ldots(72)$$

In connection with corollary 11, it is well to remember that the heavier the grade is on any district the less important it is to recognize the increase in the value of the B, C and D adjustments resulting from lower temperatures. As was previously pointed out, over-adjustment of ratings that are otherwise correct results in underloading of trains, while under-adjustment causes overloading, both of which are uneconomical.

Theoretically it is necessary to have separate adjustments for A, B, C and D ratings if accurate ratings are desired. It is very desirable, however, for practical reasons to have only one adjustment for each set of ratings and as the lower temperatures are frequently accompanied by snow and strong winds which prevent the calculation of accurate ratings for such conditions and for which special allowances are necessary as circumstances require, the use of one adjustment is advisable. This can be arranged by making a special deduction from the calculated B, C and D ratings that will approximately off-set the use of the A rating adjustment with B, C and D ratings. For example, if 20-ton and 60-ton cars are used as a basis, the special amount to be deducted from any given B, C or D rating can be arrived at by taking the mean basis weight, or 40 tons per car, dividing it into the calculated adjusted rating to get the average number of cars of that rating and then multiplying that figure by the difference between the proper adjustment and the A rating adjustment.

Although temperature ratings are necessarily theoretical they are very valuable as a basis for the judgment in deciding what should be done under different conditions of weather. All of those who have anything to do with deciding what ratings will be in effect at any time should thoroughly understand the principles involved in corollaries (9), (10) and (11), as the tendency even on heavy grade divisions is to make excessive special tonnage deductions for low temperatures and adverse weather conditions.

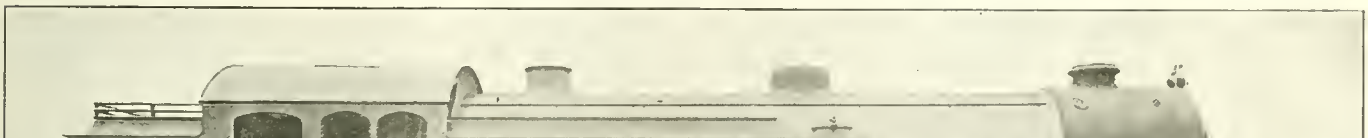
Conclusion

The advantage of the adjusted method is its simplicity and and ease of operation in yard and other offices. With only one adjustment in effect for each direction on any given district, it is an easy matter to add this amount to the weights of the cars as the train tonnage is added up.

As before stated, adjusted tonnage ratings are absolutely accurate only when trains are made up of the same weight cars as were used in obtaining the rating and the adjustment. Experience has shown, however, that the percentage of error with other weight cars is not large enough to seriously interfere with the efficiency of the method if the method itself is properly applied.

In this connection it is well to remember that in any adjusted tonnage rating, the adjustment should represent, in tons, the relative difference in mechanical resistance as between two cars of different weights selected as a basis and that the two cars so selected as a basis should represent as nearly as possible the traffic conditions on any division or district for which adjusted tonnage ratings are being calculated, and unless the adjustment correctly represents this condition, trains may be excessively overloaded or underloaded. Therefore, in any given district, a careful study of operating conditions should be made to see that the fundamental units on which the ratings and adjustments are based accurately fit the conditions.

* * *



Baltic Type Tank Locomotive for Glasgow & South Western Railway of England

In order to handle a rapidly increasing heavy traffic from Glasgow to the Ayrshire coast resorts the Glasgow & South Western placed in service last summer six of the most powerful tank locomotives in Great Britain. They were designed by Robert H. Whitelegg, chief mechanical engineer and locomotive and carriage superintendent of the road, and built by the North British Locomotive Company. They are intended for quick starting, rapid acceleration and high speed running. To facilitate operation in either direction all operating levers are duplicated on either side of the cab. The weight in working order is 222,000 lb. of which 121,000 lb. is on the 72 in. driving wheels. The cylinders are 22 in. by 26 in., and the rated tractive force 26,740 lb. The rigid wheel base is 13 ft. 2 in. and the total wheel base 39 ft. The boiler is 66 in. in diameter, 15 ft. 4 in. between tube plates, carries 180 lb. steam pressure and has a grate area of 30 sq. ft. The evaporative heating surface is 1730 sq. ft., of which 156 sq. ft. is in the firebox and 1574 sq. ft. in the tubes and flues. The superheating surface is 255 sq. ft. The tank holds 2,400 gal. of water and 3½ tons of coal.

Types of Freight Locomotives Ordered in 1922

THE possibilities for high tractive force combined with ample boiler capacity have made the Mikado or 2-8-2 type practically the standard main line freight locomotive on American railways. During 1922 orders were placed by American and Canadian roads for 1,573 freight locomotives. Of these, 1,231, or 78 per cent, were of the 2-8-2 type, 73 of the 2-8-0 type, 157 of the 2-10-2 type, and 104 of the 2-10-0 type. This list does not include locomotives of the 4-6-0, 4-6-2, or 4-8-2 types, which were designed to be employed in either passenger or fast freight traffic. Neither does it include 116 Mallet locomotives, some of which were for hump yard and pusher service and others for road service on heavy grades.

An idea of the size of the Mikado locomotives which are now being purchased can be obtained by reference to Table 1 which covers 1,200 locomotives of this type which were ordered in 1922. The list is arranged according to weight and is complete except for a few orders for one or two locomotives and a few small roads which ordered light locomotives of this type.

Grouped according to weight this list can be totaled up as follows:

Heavy (320,000 lb. or over) 587 locomotives, or 49 per cent.

Medium (300,000 lb. to 320,000 lb.) 291 locomotives, or 24 per cent.

Light (under 300,000 lb.) 322 locomotives, or 27 per cent.

While the Mikado is the most common type of freight locomotive, several roads which handle a large amount of drag freight find the 2-8-0 type a satisfactory locomotive. The principal roads which ordered this type were the Western Maryland, Philadelphia & Reading, Lehigh & New England, Norfolk Southern, and Toledo, St. Louis & Western. A summary of all locomotives of the 2-8-0 type ordered in 1922 is given in Table II.

The Pennsylvania Railroad which handles a large amount of low grade freight and which also has somewhat heavier grades than most other eastern trunk lines is unique in the extensive use of 2-10-0 type locomotives, of which 100 were ordered in 1922 and for which large additional orders have since been placed. These locomotives weigh 371,800 lb. in working order and have a rated tractive force of 87,000 lb. The only other order for locomotives of this type was one given by the Gulf, Mobile & Northern for four engines weighing only 202,500 lb.

A number of the western roads, notably the Union Pacific; Atchison, Topeka & Santa Fe; Chicago, Burlington & Quincy; Colorado & Southern; Illinois Central and Oregon-Washington Railroad & Navigation Company, ordered 2-10-2 type locomotives for use on certain divisions. The weight and size of the cylinders of the 2-10-2 locomotives ordered in 1922 are given in Table III.

Eight roads ordered a total of 116 Mallet locomotives in 1922. Of these, 30 for the Norfolk & Western, 10 for the Denver & Rio Grande Western, and 4 for the Northern Pacific, were of the 2-8-8-2 type with 25 in. and 39 in. by 32 in. cylinders and weighing 531,000 lb. The Denver & Rio Grande Western ordered also five narrow gage locomotives of the 2-8-8-2 type weighing 230,000 lb. Fifteen locomotives of the 2-8-8-2 type with 26 in. and 41 in. by 32 in. cylinders and weighing 494,500 lb. were ordered, 10 for the Union Pacific, 3 for the Oregon-Washington Railroad & Navigation Company, and 2 for the Oregon Short Line. The Chesapeake & Ohio ordered 25 of the 2-6-6-2 type with 23 in. and 35 in. by 32 in. cylinders and weighing 441,000 lb., also 25 additional, probably of the same design, while the Boston & Maine ordered two of the 0-8-8-0 type with 26 in. and 40 in. by 28 in. cylinders and weighing 441,000 lb. for switching service.

Orders placed by the United States Railroad Administration included 244 heavy 2-8-2 type locomotives weighing 325,000 lb. and having 60,000 lb. tractive force, 625 light 2-8-2 type locomotives weighing 290,800 lb. and having 54,600 lb. tractive force, 195 heavy 2-10-2 type locomotives weighing 380,000 lb. and having 74,000 lb. tractive force, and 112 light 2-10-2 type locomotives weighing 352,000 lb. having 69,400 lb. tractive force. It will be noted that 74 per cent of these locomotives were of the 2-8-2 type and 26 per cent of the 2-10-2 type. Of the 2-8-2 type 28 per cent were of the heavy and 72 per cent of the light type. Taken together the average weight of these Mikado locomotives was 300,000 lb. and the average tractive force 56,000 lb.

Table I—Principal Orders for 2-8-2 Locomotives in 1922

Road	No.	Weight, lb.	Cylinders, in.
Delaware, Lackawanna & Western....	40	356,500	28 by 32
Central of New Jersey..............	10	342,500	27 by 32
Lehigh Valley	5	339,000	27 by 32
Northern Pacific	25	337,000	28 by 30
Fort Worth & Denver City..........	2	334,500	28 by 32
New York Central..................	122	334,000	28 by 30
Boston & Albany...................	8	334,000	28 by 30
Clev., Cinc., Chicago & St. Louis....	50	334,000	28 by 30
Michigan Central	11	334,000	28 by 30
Lehigh Valley	10	333,000	27 by 32
Chicago, Rock Island & Pacific.......	30	332,000	28 by 30
Lehigh Valley	5	328,500	27 by 30
Fort Worth & Denver City..........	3	327,680	28 by 32
Baltimore & Ohio..................	85	327,400	26 by 32
Atchison, Topeka & Santa Fe........	15	327,000	27 by 32
Missouri Pacific	46	327,000	27 by 32
Lehigh Valley	5	325,000	27 by 32
St. Louis-San Francisco.............	35	325,000	27 hy 32
Erie	40	320,600	28 by 32
Lehigh Valley	10	320,000	27 by 30
Louisville & Nashville.............	30	320,000	27 by 32
Canadian National	45	315,000	27 by 30
Western Pacific	6	315,000	28 by 30
Missouri, Kansas & Texas...........	40	315,000	28 by 30
Montour	4	313,000	27 by 32
Chicago & North Western...........	78	312,000	27 by 32
Chicago & Eastern Illinois...........	10	310,000	28 by 30
New York, Chicago & St. Louis......	15	307,000	26 by 30
Chicago, Burlington & Quincy........	60	306,000	27 by 30
Grand Trunk	8	300,000	26 by 30
Duluth & Iron Range...............	3	300,000	27 by 30
Chicago, Burlington & Quincy........	22	299,810	27 by 30
Seaboard Air Line..................	1	298,000	26 by 30
Georgia Railroad	5	292,000	26 by 30
Louisville & Nashville..............	22	292,000	26 by 30
Mobile & Ohio......................	10	292,000	26 by 30
Chicago, Indianapolis & Louisville....	4	290,000	27 by 30
Nash., Chat. & St. Louis............	12	290,000	26 by 30
Alabama Great Southern............	10	288,000	26 by 30
Southern	15	288,000	26 by 30
Cinc., N. O. & Tex. Pac.............	25	288,000	26 by 30
Chicago, Milwaukee & St. Paul.......	100	287,000	26 by 30
Central of Georgia..................	10	286,000	27 by 30
Illinois Central	100	282,700	27 by 30
Central of Georgia..................	8	280,000	27 by 30

Table II—Orders for 2-8-0 Type Locomotives in 1922

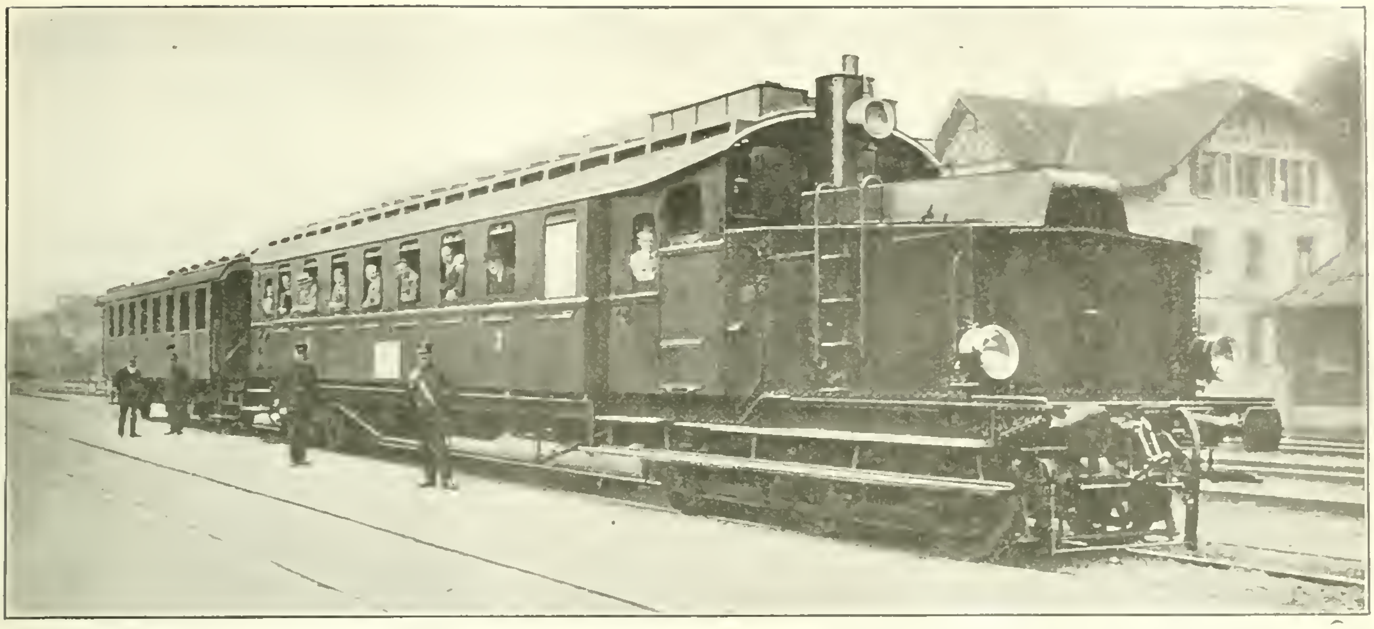
Road	No.	Weight, lb.	Cylinders, in.
Delaware & Hudson.................	1	312,000	32½ and 41 by 30
Lehigh & New England	7	301,500	27 by 32
Western Maryland	10	294,900	27 by 32
Philadelphia & Reading..............	25	285,000	25 by 32
Detroit & Toledo Shore Line..........	3	214,000	23 by 30
Tennessee Coal, Iron & R. R..........	2	209,000	23 by 28
Toledo, St. Louis & Western.........	5	201,000	22 by 28
Toledo Terminal	2	200,000	22 by 28
Green Bay & Western...............	2	199,000	22 by 28
Magma Arizona	1	199,000	22 by 28
Norfolk & Southern.................	5	191,430	22 by 28

Table III—Orders for 2-10-2 Type Locomotives in 1922

Road	No.	Weight, lb.	Cylinders, in.
Atchison, Topeka & Santa Fe.........	6	407,000	30 by 32
	20	396,500	30 by 32
Colorado & Southern................	1	405,710	30 hy 32
	1	400,810	30 by 32
	3	397,170	30 by 32
Chicago, Burlington & Quincy........	10	397,000	30 by 32
Illinois Central	25	382,000	30 by 32
Utah	1	375,200	29½ by 30
Union Pacific	73	370,200	29½ by 30
Oregon-Washington R. R. & Nav.....	15	370,200	29½ hy 30
Alabama & Vicksburg	2	270,000	26 by 28

In addition the United States Railroad Administration ordered 30 Mallet locomotives of the 2-6-6-2 type weighing 448,000 lb., and 106 of the 2-8-8-2 type weighing 531,000 lb.

Comparing the orders given by the U. S. R. A. and those by the railroads in 1922, there is apparently a tendency to even greater employment of the 2-8-2 type and also a strongly marked tendency in the direction of increased weight and tractive force.



Swiss Diesel-Electric Motor Car with Trailer

Sulzer Diesel-Electric Rail Motor Car

Car With 200-hp. Diesel Engine Seats 69 Passengers and Shows Low Fuel Consumption on Swiss Railways

FOLLOWING the experiments with a direct-driven Diesel locomotive on the Prussian State Railways in 1913 orders were placed with Sulzer Brothers, Winterthur, Switzerland, for five self-propelled rail cars to be driven by Diesel engines coupled to electric generators with electric motors geared to the driving axles. Three of these cars were for use on the Prussian railways and two on the Saxon railways. Two of the cars were delivered and operated satisfactorily before the outbreak of the war, but since that time conditions have been such that no further development was undertaken until recently.

In taking up the work again the manufacturers, Sulzer Brothers, decided to take back the cars and equip them with engines of a new and improved type together with new electrical apparatus that had been perfected by Brown-Boveri of Baden. It is one of these rebuilt cars, now being tested out on the Swiss Federal Railways, that is shown in the illustration.

General Description of the Cars

The car is of standard gage and approximately 70 ft. long over buffers. There is an engine compartment at one end and operating platforms at both ends, the car being so equipped that it can be driven with equal convenience in either direction. Seats are provided for 69 third-class passengers with standing room for 16 more. Entrance and exit is made at either end through the roomy driving platforms which are separated from the body of the car by sliding doors.

The light weight of the car is 146,600 lb., 85,200 lb. being on the six-wheel truck on the engine end and 61,400 lb. on the four-wheel truck on the motor end. These weights correspond to an axle load of 28,400 lb. on the engine end and 30,700 lb. on the motor end.

The driving power is obtained from a six-cylinder, four-cycle Diesel engine of the Sulzer "R V" type which is connected to a direct-current generator through a flexible coupling. The fuel is injected directly into the cylinders through the injection valves without the employment of injection air, the necessary pressure being furnished by combustion of a part of the fuel itself. By the adoption of electric starting, obtained by a suitable winding of the generator and by the installation of storage batteries, air compressors with complicated valves and control mechanism which were used on the original installation have been dispensed with and the general design considerably simplified.

The three pairs of cylinders are arranged in a V form, each pair of pistons being connected to a common pin of the three-throw crank axle. The crank case is enclosed and provided with inspection covers while the cam shaft is parallel to the crank axle. The engine when running at 440 r.p.m. develops 200 hp. and is capable of delivering 250 hp. for a short time. It is designed to be run at a constant speed regardless of the speed of the car. The governor and feed pumps are placed in front of the engine, the control being such that each cylinder may be cut out automatically from the driving cab or controlled by the governor in the usual manner.

The exhaust muffler and the air inlet manifold are placed between the cylinders with the fuel tank above them. The capacity of the tank is 350 liters (92½ gal.) which is sufficient for a run of 50 km. (314 miles) under average conditions.

The cooling water after leaving the cylinders passes to a series of ribbed coolers on the car roof. These are so grouped in combination with the water reservoir that by cutting units in or out the desired temperature can be maintained regardless of weather conditions and temperatures.

Vibration is avoided by mounting the engine and generator on a special frame which is not connected to the body of the car but is carried directly on the truck frame through spring connections. The weight of the front end of the car is carried by a spherical pivot which acts as a center pin and rests on a modified truck bolster.

The capacity of the engine is sufficient to drive the car at a speed of 70 km. or 44 m.p.h. on level track. When hauling a trailer weighing 66,000 lb. the available speed is 60 km. or 37 m.p.h.

Electrical Equipment and Control

The main generator is separately excited, the exciting current being furnished by a special dynamo mounted on an extension of the generator shaft. The main generator is of the eight-pole type and has a capacity of 140 kw. with a terminal voltage of 300 while the exciting dynamo is of the six-pole type with an output of 7.5 kw. The accumulator battery feeds the field windings of the exciter. The circuit between the generator and the motors is so arranged that the engine can be run at a constant speed regardless of the speed of the car. This insures easy starting, full control of the speed of the car and economy in fuel consumption.

Two direct-current motors are mounted on the four-wheel truck on the rear end of the car. They are fitted in a common cast steel casing and both are geared to a crank shaft which carries crank discs, connecting rods being employed to transmit the power from the crank discs to the driving wheels. The motors are series wound with six main poles and six inter-poles. The engine is started by using the generator as a motor operated by current from the storage battery underneath the car. Direction switches and controllers are provided on either platform. The controller handle is of the dead-man type and if not held down the current is shut off and the brakes applied. A time relay with a retarding cylinder holds back the application of the brakes until five seconds have elapsed from the time the current is cut off.

The brakes are of the Westinghouse type, the compressed air being supplied by a small air compressor driven by the engine. In emergency applications, the current is automatically cut off. Hand brakes are also provided.

Operating Results

On a somewhat hilly road between Wallisellen, Winterthur and Romanshorn with the car alone without a trailer, the fuel consumption was 84 kilos or 185 lb. for the round trip of 92 miles, which is equivalent to 0.03 lb. of fuel per ton-mile. The load was subject to frequent variations and the engine was shut down on the longer grades, being in operation only about two-thirds of the time.

Records covering a month's service on the Baden, Wettingen and Niederglatt run showed an average fuel consumption of 0.043 lb. per ton-mile. The consumption was at the rate of 0.047 lb. per ton-mile at first but fell to 0.040 lb., probably due to the longer experience and increased skill of the driver. In these records the fuel used for switching, recharging storage batteries, etc., was included while the mileage was taken as that in regular service.

This car has attracted considerable attention in Switzerland and as a result a second car will shortly be placed in service on the Berne-Neuchatel section of the Lotschberg railway. Not only has the fuel consumption been remarkably low but the small stand-by losses and the short time required for attention at terminals have shown that a car of this type possesses decided advantages over steam operation. Fifteen minutes is sufficient to start the engine, charge the air brake system and have the car ready to start. Even less time is required to shut down and leave everything in order.

The car is of moderate power but its range is considerable and its size is much larger than most of the gasoline rail motor cars used in the United States. It is hoped that further experience will lead to the construction of large units which will result in a Diesel locomotive.

"STOP THAT LEAK" is the slogan of a campaign which has been started in the Baltimore & Ohio Employees' Magazine to reduce expenses. Officers in all departments are pointing out opportunities for economies in their various fields, and employees are being urged to contribute suggestions.

Cold Weather Practices as Related to Fuel Conservation*

By W. E. Dunham
Assistant Superintendent, Motive Power and Machinery, Chicago & North Western

As it is practically impossible to determine which of the cold weather problems of the fuel supervisor are the most important or affect the consumption of locomotive fuel to the greatest degree, we will not attempt to take them up in any logical order. It is assumed that winter problems refer to the situations that exist in the northern or colder district where the weather creates a real problem.

In the past we have often heard the remark that with the coming of cold weather we must sharpen up the draft of the locomotive so as to make it capable of handling the extra drain due to the heavier demand for steam. This certainly is a very expensive procedure, particularly expensive to the coal pile. While there may be a heavier demand for steam to heat the passenger trains, there is no materially heavier demand for steam on the part of the locomotive to perform its full quota of work. Following such a practice is almost an admission that the engine has not been drafted properly during the warmer season of the year to most economically consume the fuel furnished. To some this may sound like rather strong language, but to others who have established a close check and supervision of the adjustment of front ends and size of nozzle tips, it will simply confirm the fact which they have already developed.

Instead of the problem being one for the winter months, the adjustment of front ends is a matter of all the year round and when once established should not be altered as has unfortunately been the practice for the changes in the seasons. This, of course, assumes that the fuel is the same in all seasons. It goes without any question that a change of fuel requires a change in drafting, particularly in the size of the nozzle tip, to get the most economical results on the locomotives.

There is the old problem in the heating of passenger trains that is new every winter. While we have been at it year after year, there is still a lot to do to get the heating of these trains down to the point where it is economically and regularly accomplished. The old style straight steam system where the train crew regulates the supply of steam and the drip for each car separately is still in use. With the profligate waste of steam in the front cars of the train, the rear cars of some of the longer trains are usually cold, even though the pressure at the regulator in the locomotive cab is sufficient to blow the hose off. A simple expedient that has corrected this difficulty to a very large degree when tried is to place a plug nipple in the steam line of each car behind the control valve, in which a small hole is drilled of sufficient size to deliver all the steam that can be properly used in heating the radiation that the valve controls. Such an arrangement "educates" the trainman very satisfactorily and saves many pounds of steam and coal.

While speaking of the heating of passenger trains we must not overlook the train line, all the way from the engine cab to the rear of the train. In some cases even now, there is only a very meager covering placed around this 1½-in. or 2-in. pipe to prevent wasteful radiation to the atmosphere. Here is a pipe line that at freezing temperature and with the train standing still, will waste coal at the rate of fully one ton per year for about each two square feet of surface which is close to two feet of length. What that waste will be with the train moving 40 miles an hour through the cold air can readily be imagined. These pipes should be covered with the best obtainable covering and also be protected in such a substantial manner that the covering will not deteriorate or be damaged.

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*From a paper presented at the meeting of the Chicago District Chapter of the International Railway Fuel Association, March 12, 1923.

The subject of pipe covering naturally leads us to the engine cab. The many steam pipes to the pumps, generator turbines, injectors, etc., are causes of wasted coal unless they are covered and insulated in some practical manner. It is sometimes said that the expense required to prevent excessive radiation is not justified by the saving in coal that will result. In some cases such as this, that may be true from the dollars and cents balance. On the other hand, the influence on the engine crew and other employees in seeing that the railway company is in dead earnest in this fuel economy campaign and covers even the small steam pipes that would waste coal, is a mighty factor in getting the desired economy at the scoop and elsewhere.

With the modern hopper bottom ash pan, the cold weather brings up a serious situation at the clinker pit. A makeshift arrangement used at many terminals to thaw out the frozen pan, is an open grate fire that is kept burning all the time at the approach end of the pit. This does the business, but at a fearful cost of coal. A more economical plan and one that is now being tried out successfully is to use an oil torch that can be fired up as required and which can be played on the hopper of the pan and even on the sides as well.

It is here at the cinder pits that we find a great waste of fuel when a congestion develops as the result of not being able to handle the engines promptly over the pit and into the house. Fuel men and their assistants must necessarily watch the cinder pit every hour of the day and night during the winter months. When that place ceases to function regularly and promptly there is trouble ahead for everyone and a large amount of additional coal is burned in keeping engines alive, waiting their turn to be handled.

While we are on the subject of cinder pits, the next thought is naturally turned to the general situation of the approach and departure tracks to the enginehouse and the arrangement of the facilities for supplying the engines with coal, water, and sand. Every engine arriving at the terminal should be able to promptly reach the track assigned for the crew to leave it, then as quickly be furnished with the necessary supplies, have the fire cleaned and be placed in the house or turned for use as may be required. That, of course, is the ideal condition and every detail of the equipment furnished to accomplish that result should function correctly.

Even with the best facilities provided for prompt handling of engines at the terminal, close supervision is necessary to see that engines are left by the crews in proper shape to stand the extreme changes in condition between hauling a train on the road and standing practically still at the terminal. The fires must be left in good condition and the boiler should be full of hot water with the steam close to the working pressure. A last minute building up of the fire and filling up of the boiler is disastrous, to the boiler and flues and that means extra coal burned at the time as well as during the remaining life of the flues, provided they are not in such shape that they can be re-worked. Even if they can be re-worked the loss of heat and fuel in cooling the boiler down so that the boilermaker can do his work properly is great.

The housing, or rather the lack of housing of engines, is possibly the greatest single problem of the fuel man. Without discussing the subject of the distribution of the expense for the extra fuel required to keep engines from freezing due to not being protected from the weather, such a condition uses up tons of fuel uselessly. If the locomotive could, on the other hand, be protected from the direct action of the weather this waste could all be saved. Enginehouses where the doors cannot be closed securely behind the tenders of the longer power, houses with doors so poorly designed and constructed that they leave large openings for the weather to keep the temperature of the house the same as out of doors, houses with poor and insufficient heating equipment all mean wasted fuel. The improper maintaining and operating of the inadequate housing facilities that are provided are matters that the fuel supervisor must keep after constantly and have remedied when defective and slack before they become serious. Simple and inexpensive vestibuling of a few stalls will permit doors to be closed, the tacking of canvas strips over the openings around the doors at the hinge edge and the securing of canvas or heavy roofing paper flaps over the other edges of the doors are expedients that can be used to good advantage and save a lot of this wasted fuel.

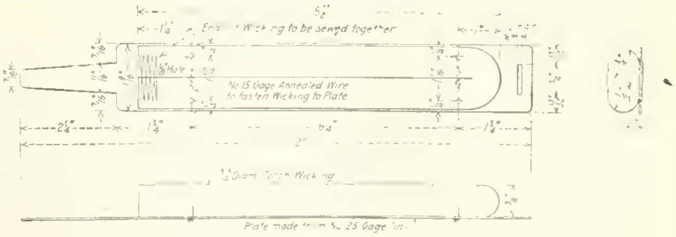
Where engines are necessarily required to stand out of doors during the layover, there is, of course, a very heavy and wasteful use of fuel. This can be decreased very materially all the year round, but especially so during the winter months by the simple expedient of covering the stack to prevent undue consumption of the fuel. Covers in which an opening is provided of just sufficient size to maintain a good fire on the grates conserve the heat that is generated and in that way lessen the demand for forcing of the fire. When about 4,400 tons of coal are burned on one road in a month's time keeping engines alive out of doors it is quite evident that the fuel supervisor has something to do in everlastingly keeping alive the subject of engine housing.

Piston Rod Swab for Air Compressors

By E. A. Miller

THE majority of swabs used on the piston rods of air compressors give trouble either because they do not have effective arrangements for holding them in place, or because the metal parts soon come in contact with the rods. The design shown in the drawing is intended to overcome both these difficulties and has proved very satisfactory in service. It is easily made because it consists merely of a flat plate to which torch wicking is fastened.

The plate is made, as shown, of 25 gage tin with a tapered projection, 2¼ in. long at one end and a ⅛-in. by ¾-in. slot at the opposite end. A piece of ¾-in. torch wicking, 16 in. long, bent double, with the ends well sewn together, is fastened to the plate in two places by 15 gage annealed wire passing through ⅛-in. holes. It will be noted that the fastening wires do not come near the surface of the wicking which is in contact with the rod, so that it can be worn considerably before the swab will need to be replaced. In applying the swab to the compressor the wicking is placed next to the rod and the swab is bent and the projection inserted through the slot and turned back, thus securely holding it in place. One such swab is used on 9½-in. compressors and three on 8½-in. cross-compound compressors.



5½"
1¼"
Wicking to be sewed together
⅛" Hole
No 15 Gage Annealed Wire to fasten Wicking to Plate
2¼"
1¾"
1¾"
Diam Torch Wicking
Plate made No 25 Gage Tin

A Simple and Effective Piston Rod Swab

In Arkansas a bill has been introduced in the lower house of the general assembly which provides that whenever a passenger train is one hour late a special train must be run on its schedule, except when the lateness is excusable because of the wreck. Failure to observe the proposed law would be punished with a fine of $1,000 for each offense.

As to the Locomotive—What Next?

Co-ordination with Other Facilities; Harmonizing Features of Design, 2-8-4 Wheel Arrangement Proposed

By G. M. Basford

Consulting Engineer, Lima Locomotive Works

ACCEPTANCE of the locomotive as the most promising single factor for reduction of the cost of transportation is proceeding rapidly. It has not always been looked upon as a possible cost reducer. There are reasons. Consider locomotive history which divides into three eras.

First: The beginning of steam rail transportation. We must admire those who pioneered without precedent, giving us elements, principles and even construction that endured for a half century without radical engineering changes.

Second: The period of increasing weight and power with practically no persisting improvements making for higher efficiency in fuel or in weight. During this time locomotives were crude pullers of trains. Too many unmodernized locomotives are just that today.

Third: The era for reducing ton-mile per hour costs by means of improved locomotives. It is the era for co-ordination of the locomotive into the rapidly developing scheme of efficient railway operation. Engineers inside and outside the railways and railway officers, executive and operating, are beginning to co-operate. Never before in locomotive history have six railroads simultaneously striven for better locomotives to reduce their cost of transportation as six roads are striving today.

Many operating officers do not yet realize how much the improved locomotive can help them. They do not yet realize how much help they need from the improved locomotive. Through a natural development these officers control the expenditures. They are the ones, in general, who decide questions of investment in improved locomotives and in all facilities that render the locomotive more productive. Because of tradition the steam locomotive is handicapped today as to its productivity. Operating officers are in position to remove this handicap. We must tell them about it.

Locomotive Earnings

William Elmer throws light on this subject in his paper before the American Society of Mechanical Engineers, June, 1921. He shows that in 1920 the average freight engine earned $570 per day or 40 cents per minute but that it made less than 60 miles per day. On another occasion (before the Central Railway Club in January, 1923) Mr. Elmer shows that for the month of October, 1922, the average daily mileage of serviceable freight locomotives was 84 miles. Are we to be satisfied with these figures? A locomotive is too expensive to be running only 7 hours out of 24 hours.

For a $47,000 Mikado engine the fixed charges are $14.40 per day or one cent per minute. It would be good business policy as far as fixed charges are concerned greatly to increase the first cost of the locomotive if a small percentage of the fuel may be saved thereby. Locomotive loading is so important as to cause a loss of $100 per day with an error of 10 per cent in overloading or underloading on a single division having heavy traffic. This reveals the importance of the operating side of the question we are trying to answer, as the locomotive referred to burns from $10 to $15 worth of fuel per hour and wages amount to about $4 per hour.

As to the use made of locomotives are we to be satisfied when they are approximately but half the time in the hands of the operating officers and the other half in the hands of mechanical officers? Of course, there is a lot of avoidable delay in each case. Here is an opportunity for co-ordination of loading, using and maintaining not to be overlooked.

Co-ordination of two kinds lies before us. First, the locomotive must be harmoniously co-ordinated as a vital element into the great transportation machine. It must fit and perform in time and in tune with physical and operating improvements which are coming forward with great rapidity and promise. Second, the locomotive must be co-ordinated within itself. Every feature of design must be made to harmonize with every other for the production of more ton miles-per-dollar of total cost.

Our locomotive is a machine within a greater machine. This demands of locomotive men a thorough understanding of track, operation and signaling. It demands of operating men, track, bridge, terminal and signal men a thorough understanding of the locomotive which must be considered as a huge investment capable of producing dividends greater than it has ever produced. It demands of engineers who would improve the locomotive a careful study of all phases.

Recently an Eastern road invested $14,000,000 in a new line to reduce a heavy grade. It is up to the locomotive to increase the return on this investment. In railroad operation there are few features of improvement that do not call for corresponding improvement in the locomotive. These items require more elaboration than space and time permit of giving here. A mere list, however, reveals the problem.

These days are gone when old road engines would do for switching. Switch engines call for most careful design, that they may make every track of a yard more productive. Road engines coupling to heavy trains at yards must be equipped for rapid acceleration to clear the outgoing track quickly for following trains.

Engine Terminals

Locomotive terminals would justify a chapter by itself. Many a locomotive terminal limits the productivity of the locomotive power of its road today. Every improvement in this field calls for a corresponding improvement in the locomotive to take full advantage of the investment. Think of ash pits, inspection pits, coaling stations, roundhouse and roundhouse shop facilities. These are coming forward rapidly. Soon every roundhouse will have traveling cranes, post cranes, drop pits, means for handling parts too heavy for archaic, man-killing methods, means for washing boilers quickly with hot water so that boilers need not be damaged by washing and filling with cold water. It is a six to ten hour job gradually to cool a boiler down. Improvements are also ready for rapid firing up of boilers, for saving time and labor in dealing with ashes, sand and coal. Again, shop equipment is receiving more attention than has been given to it for many years. But our railroad shops are many years behind the requirements. Every order for new locomotives should be accompanied by a corresponding program for more machinery and facilities for maintenance.

Long Locomotive Runs

Formerly locomotives were designed and built for short railroads, then for divisions because the roads grew that

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*Abstract of a paper presented before the Pacific Railway Club, March 8, 1923.

way. Now they must make long continuous runs. The Southern Pacific was a leader in this change. The Santa Fe is also a leader. The Missouri, Kansas & Texas has broken all long run records. But we must build engines that will more nearly approximate the continuous service of marine engines and this can be done. One road does with 16 engines work formerly requiring 21, by increasing the run from 150 to 260 miles. Oil fuel overcomes one of the greatest obstacles to long continuous runs. The locomotive must be co-ordinated with this operating improvement and coal burners must be made to do it. Great savings are being effected by longer locomotive runs. This is one of the most important operating improvements of our day. It calls for co-ordination in locomotive design, construction and maintenance and adequate facilities for maintenance.

Up to the Locomotive

What must the locomotive be and what must it do to earn most for these large investments? What must it do to overcome high wage and fuel costs? The next new locomotives must be built, operated and maintained to perform a new part in the reduction of the cost of transportation. Placing new locomotives on our rails for say 30 years of service is a matter to be approached thoughtfully. If we are to save the race against government ownership we must regard the locomotive in a new light. All the new ones must be built and bought for efficiency, for maximum earnings on the investment. It must have appropriate maintenance.

This era began with plain engines. Modern locomotives are efficient and necessarily complex power plants. Between these two there is a vast difference. Improvements were developed independently, usually not by the builders but by independent companies, each devoting its efforts to its particular problem. This has brought highly developed individual factors for increasing capacity or improving efficiency. In the combination of these factors with improved detail design, co-ordinating the locomotive into a truly efficient power plant, lies our present problem. Weight questions now predominate. The locomotive must be designed as a whole. It must not be condemned to run for life without certain efficiency factors because weight limits do not permit of applying them. Because of weight limits locomotives are being built today without boosters, stokers and feed water heaters. These particular engines cannot even be built for later application of these efficiency factors and must run wastefully for the next 20 or 30 years. But truly co-ordinated designs will permit of obtaining the savings these factors are ready to effect.

Superheaters

The further progress of superheater design must necessarily be along the lines of more boiler and more superheater capacity per square foot of tube area available. Obviously, boiler sizes cannot continue to increase, and if we are to build larger capacity locomotives we must make them more economical in steam consumption, or produce more power from a given boiler size, or both. This is the aim of the type E superheater. In the selection of a superheater consideration also must be given to cost, weight and maintenance. The type E superheater is more expensive in first cost than the type A and can only be justified where the demands upon the boiler thus fitted warrant its installation. An important development in superheating lies in placing the throttle in such position as to provide superheated steam for the auxiliaries.

Thermic Syphon

The thermic syphon supplies two greatly needed features: First, increased absorption surface in the firebox for radiant heat; second, improved circulation at the place where it is needed most, at the hottest part. This factor adds weight, but every pound of weight is where it will do the most good. Efforts to provide re-entering radiant heating surface from firebox sheets have been made but never before has the maintenance problem been solved in this connection. No new locomotive should be built without this improvement or its equivalent, if you can find its equivalent.

Feed Water Heaters

Feed water heaters are coming forward rapidly. They catch and return to the boiler a proportion of the heat that is on its way to waste. They also reclaim about 15 per cent of the water used. They compel the exhaust steam to help the boiler and the firebox. Incidentally, the feed water heater is a good example of the necessity for co-ordination. It calls for design and development in unison with the superheater and other factors. No locomotive should be built without this conservation feature. Locomotive people in the past have not felt the need of it, but they need it now. They need it for increased capacity, for fuel conservation and for elimination of water stops. Closed heaters and open heaters are now operating on locomotives with success.

Mechanical Stokers

Mechanical stokers remove the limitations to the amount of coal that can be put on the grates of a locomotive. They provide means for getting more horsepower into the firebox, more than the best and strongest of firemen can throw through the firedoor. Mechanical stokers have made the big, powerful coal-burning locomotive possible. In relieving us of one limitation they have introduced another, that of burning the coal that they can supply.

Improved Valve Motion

Improved valve motions have contributed to increased capacity. They have emphasized the importance of steam distribution, of valve setting and of valve motion maintenance. They have helped the boiler materially and have contributed their quota toward developing locomotive practice along the lines of economy and certainty of operation. Look at the article in the *Railway Mechanical Engineer*, June, 1922, page 315, to see how one road saved twenty dollars per trip by correcting valve setting. This indicates the value of another phase of co-ordination.

Power Reverse Gears

Power reverse gears have done their part. Cut-off adjustment is most important in securing maximum cylinder power without waste of steam. It is absolutely impossible to obtain and maintain correct adjustment by hand with varying demands for power because locomotives have become too big for hand adjustment. Efforts are being made to secure the right cut-off adjustment automatically, an important thing to do. Cut-off adjustment merits infinitely more attention than it is receiving. By incorrect cut-off adjustment it is easy to lose 10 or 15 per cent saving that some efficiency factor has made. Locomotive engineers need to be shown just what cut-off to use for every speed. Bright minds have already worked out this part of our co-ordination problem.

Water Purification

Boiler water treatment and facilities for quick washing of boilers contribute their part. Some years ago the speaker rode on an engine that could not blow its whistle because of the character of the water used. Think of what such water did to the firebox sheets and flues and the cost of this handicap. Water treatment and boiler washing equipment help the firebox. Money invested in improving boiler water supply is sure to yield large returns. Do not expect a boiler to work against the handicap of boiler scale, one of the most effective heat insulators known.

Steam Separators

Knowing as we do that the locomotive boiler is forced and that forcing carries much solid water over into the superheater, we must extend the use of so-called steam separators to relieve the superheater of double duty. It is enough to ask the superheater to superheat steam. Whatever we do to increase the activity of the firebox and its circulation increases the importance of keeping the water back in the boiler. Steam separators are working satisfactorily. What are you doing about this?

Alloy Steel Parts

Beginning in 1884, the application of the principle of lightening reciprocating and revolving weights in this country has certainly been deliberate. This improvement is coming forward rapidly. During the past year 20 railroads have built over 1,000 engines with reciprocating parts of alloy steel to the relief of not only the firebox, but of rails and bridges. Weight limitations have been rather arbitrary. Static weights are not the only weights to consider. Track officers are beginning to take dynamic augment into account and when these forces are considered, they co-operate for still more powerful locomotives. Simple alloy steels which do not require quenching and tempering remove the only obstacle to this greatly needed development. A saving of a blow of 3,224 lb. per side of an engine every time the drivers turn, in say 30 years, is not to be overlooked. Neither is a saving of 1,800 lb. in actual weight of moving parts to be ignored. What do you think of reciprocating parts of a big freight engine that weigh 2,600 lb.? I call it brutality, not engineering.

Fan Blast

No thoughtful person can fail to see that the method of producing draft by the blast of the exhaust jet is inefficient and wasteful. Its automatic adjustment of the draft to the demand for steam and its simplicity are the only justifications for its persistence. It soon must give place to something better. This has not yet been made completely successful, but it must be worked out to a conclusion. We pay too much in fuel for the draft of big engines today. Let us encourage efforts in this direction. I am informed that a test on a certain big Mikado engine showed a loss of over 800 hp. to blow the fire in the usual way.

Excessive Weight on Trailers an Important Problem

Trailing wheels were added to carry large fireboxes. They are needed for power at speeds when high boiler horsepower is demanded. The booster puts these wheels to work at low speeds, in starting and at critical points on grades and turns this loss to advantage at times when high boiler capacity is not needed. It helps the operating officer to increase tonnage, to increase acceleration to speeds. It is the means whereby a trailing wheel locomotive is placed in the class above itself as to tractive power. It avoids the necessity for another pair of drivers, needed in starting but superfluous when the train is rolling. The booster is a necessary improvement. It increases the weight of the back end of the engine and we must provide for this weight. It most certainly cannot be taken out of the firebox weight but must be taken care of in addition thereto. No locomotive with trailing wheels should be built without utilizing these wheels for traction in starting and on the critical points on grades.

Ash Pans

Long locomotive runs reveal weakness in this neglected item. Pans must be larger. They must have greater air openings in order to reduce the vacuum below the grates. A ratio of 14 per cent of the grate area is considered satisfactory if the rate of combustion is low enough, but with 14 per cent over one inch of vacuum has been measured in the ash pan. Why not make this area of opening 20 per cent of the grate area? Why not make openings as large as possible? We should supply at least 33 per cent excess air which means 16 lb. of air per pound of coal. Do you realize that at a combustion rate of 120 lb. of coal per square foot of grate per hour nearly one ton of air must be supplied every hour for every square foot of grate area? What locomotive gets that much? Do you realize that at 10 lb. of air per pound of coal and a consumption of 10,000 lb. of coal per hour the firebox will demand 1,300,000 cu. ft. of air, or 100,000 lb. per hour?

Grates and Grate Areas

Test plant records indicate that we are forcing fires to the point of inefficiency. Fig. 1 indicates a drop of 6 per cent in boiler efficiency as the rate of combustion goes up from 110 lb. of coal per square foot grate per hour to 140 lb. Grates call for immediate intensive study. Why should the air openings through grates vary from 26 to 50 per cent in 62 cases of grate practice for soft coal engines recently studied? Differences in the character of coal do not explain this variety of figures. Who is in position to defend such chaotic practice?

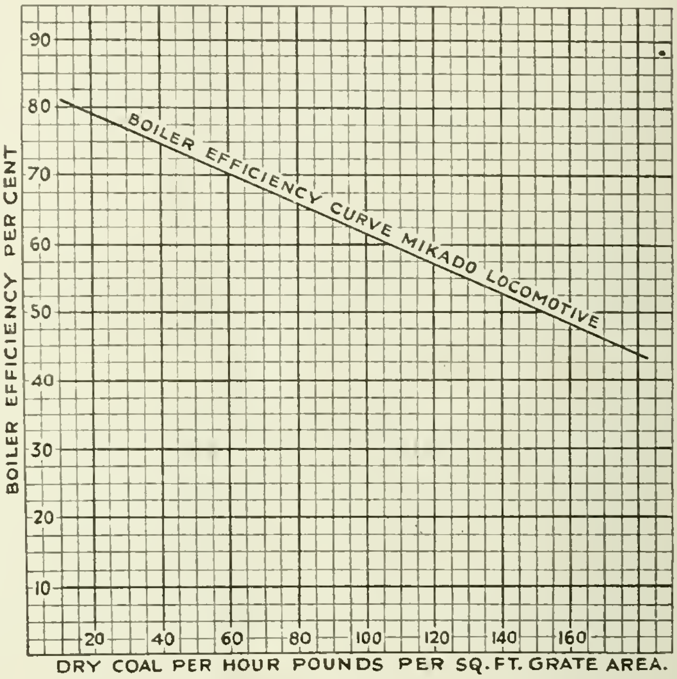


Fig. 1—Boiler Efficiency Decreases Steadily as the Rate of Combustion Is Increased

Grate area affects losses in sparks and cinders. Run of mine coal with a large proportion of slack will make more sparks and cinders than lump coal, and what about lignite? This calls for lower velocity of air through grates. Velocities of gases through the firebox range from 100 to 300 ft. per sec., as fast as 200 miles per hour. We cannot wonder that this lifts sparks and cinders from the fuel bed. For years we have fired much more coal than has been burned.

Coal does not burn on the grates. The fire itself is mainly a gas producer. At the rate of 120 lb. of coal per square foot of grate per hour and 12.25 lb. of air supplied per pound of coal and with a high volatile coal (Westmoreland with 14,430 B. t. u. heat value per pound) 2,000 cu. ft. of gas is evolved every second. A firebox of 311 cu. ft. capacity is filled with gas six and a half times every second. This reveals the task we are asking fireboxes and boilers to perform. We must do our best to take as much of this heat as we can while it is in our hands. This calls for firebox volume and combustion space. These add weight. The job of the firebox is to absorb radiant heat. This discussion does not attempt to cover the absorption of the heat after it is created. It may be said, however, that progress in the direction of reducing the rate of combustion by providing larger grates helps in the next step—that of absorbing the radiant firebox heat. When grates are large enough it is easier to get the volume the firebox requires, but this again brings us face to face with the problem of weight.

Firebox designers are faced with the fact that the firebox evaporates about 40 per cent of the total. Firebox heating surface is from 5 to 10 per cent of the total heating surface but it effects from 25 to 50 per cent of the total evaporation.

Why is it necessary to fight for steam in a fairly well designed and proportioned coal burning firebox when that same firebox yields steam "to burn" when oil fuel is introduced? Oil burning temperatures that range about 2,500 deg. F. as compared with about 1,800 deg. F. for coal is the answer. Coal fire temperatures may be raised by forcing but with correspondingly increased spark and cinder losses. We must get greater volume of heat from coal.

In locomotive service oil has always been burned in fireboxes designed for coal. Oil leaves no ash, discharges no sparks or cinders and, if it has air enough and room enough, it burns completely. In many oil burning engines, however, the combustion space is too small and the action resembles a blowpipe flame. This puts tube and firebox sheets to a test that they would not encounter if more combustion space was provided. Why not design a real oil burning locomotive firebox, which the writer believes has never been done? Would it have a circular cross section and a long combustion chamber? To get the utmost out of oil, weight must be added at the back end. Therefore, the weight problem is common to oil and coal burning.

High rates of combustion brought the wide firebox. The wide firebox brought the trailing wheel. The stoker eliminated the limitation of the human hand, arm and back. Locomotive improvements that make for greater capacity, for efficiency and economy have delayed the next step but increasing demand for power has again brought a limit. Again it is the firebox. Not only must we provide weight for the larger grate and the locomotive furnace but we must have the booster and the stoker—all at the back end of the engine.

Threatening Limit to Locomotive Progress

While locomotives have been increasing materially in size in the last few years, certain limiting features have not been correspondingly increased. Locomotive designers have met this limitation by the addition of front truck and driving wheels to take care of the additional tractive power.

In conventional locomotive designs the firebox has been carried by one pair of wheels located underneath the grates. The wheel load of the trailer is, of course, subject to the same limitation of weight as the drivers. In practically all modern designs trailers have been loaded up to their limit. Weights as high as 60,000 or 63,000 lb. have been used. Most roads do not like to exceed 55,000 lb. and some confine the limits below that figure. It is evident that the size of firebox as related to the grate area and firebox heating surface is obviously limited by the allowable weight on the trailer axle.

In the search for means for increasing the power of the locomotive we have now come squarely up against this limitation of trailer weight. Greater and greater horsepower outputs are required which call for larger firebox volume and more grate area for burning the coal. With the present construction we are limited by the trailer wheel load mentioned above. The consequence of this has been that the size of grate area and fireboxes have not kept pace with the increase in cylinder horsepower output. An attempt has been made to make up for this by adding heating surface in other parts of the boiler which are not carried directly over the trailer, but this is only a partial remedy for the difficulty. The result is that the grate being limited as indicated, there has been a constant tendency to burn more and more coal upon a given area of grate or to increase the rate of combustion. In some modern designs the rate of combustion per square foot of grate to meet the maximum horsepower demands has gone as high as 130 lb. based upon first-class coal. In fact, the rate has gone much higher. It has been conceded that a rate of 120 lb. of coal per square foot of grate is a figure which should not be exceeded, and numerous tests indicate that if a lower rate could be secured increased boiler efficiency would result. To sum the matter up, further development and extension of locomotive power is dependent upon adequate methods of taking care of larger grate areas and firebox heating surfaces than present construction allows.

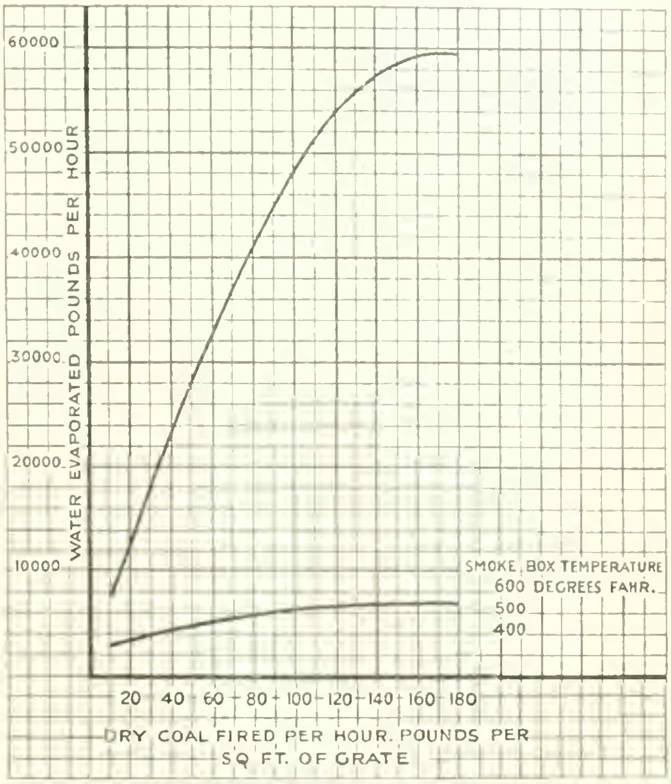


Fig. 2—Increasing the Rate of Firing Beyond the Capacity of the Firebox Does Not Give a Corresponding Increase in the Amount of Steam Generated

Fig. 2 gives a good idea of the influence of the rate of combustion upon locomotive performance. This curve shows total water evaporated plotted against dry coal fired per hour in pounds per square foot of grate for a Mikado type locomotive. There is a break in the curve after about 130 lb. per square foot of grate per hour is reached. That the performance of the boiler is not limited by the ability of the heating surface to absorb heat is shown by the smokebox temperature curve. There is no break in this smokebox temperature curve at the point where the evaporation begins to fall off. This conclusively shows that it is a combustion condition that causes the falling off in rate of evaporation.

Using Fig. 2 as an example, suppose that we have a locomotive designed to burn 120 lb. of coal per square foot of grate per hour, and that this design is based upon using coal of 12,500 B. t. u. If the engine receives a tank of coal averaging 11,000 B. t. u., the rate of coal per square foot of grate per hour would immediately jump to 137 lb., at which point the curve is rapidly sloping away and proportionately a very large amount of coal must be added to secure a relatively small increase in total evaporation. Consequently the increasing rate of combustion interposes resistance to efforts to produce more power.

The condition thus cited is not an unusual one in railway practice. Reports show engines failing for steam on account of bad coal. As a matter of fact, the engines failed because the rate of combustion had to be forced above the possibilities of the grate. If our locomotives were designed for about 100 lb. per square foot of grate per hour for an engine designed with the boiler proportions about as indicated in Fig. 2 we would be working on a portion of the curve where there is all even slope, and there would be a margin for poor coal.

These are test plant figures and it may be urged that they do not reflect road conditions. A road test on 4-8-2 class engine on an important road gives results as shown in Table I. The average of three runs with an average train shows that 91.17 lb. of coal were burned per square foot of grate for the time the throttle was open. The average of three runs with a heavy train shows that 124.79 lb. of coal were burned per square foot of grate while the throttle was open.

Table I—Rate of Combustion and Efficiency from Road Tests of 4-8-2 Locomotive

Run No.	Coal per sq. ft. grate time throttle open	Boiler efficiency (dry coal basis)
2	92.13	61.05
4	88.57	62.04
6	92.82	62.05
Average	91.17	61.71
10	124.76	55.51
12	129.36	51.01
14	120.26	57.93
Average	124.79	54.82

This indicates conclusively that in actual practice we are duplicating test plant conditions set forth in Fig. 2. It is also important to note that the average boiler efficiency for the lower rates of combustion was 61.71 per cent, whereas when the boiler was forced and the rate of combustion was 124.79 lb. per square foot per hour the efficiency of the boiler fell off to 54.82 per cent. Grate area has become the most important single limiting factor in locomotive development. How to increase it and still meet wheel load conditions is the problem locomotive designers are facing.

History repeats itself. In 1895 the Chicago, Burlington & Quincy found its rate of combustion mounting to 200 lb. of coal per square foot of grate per hour. Engine No. 590 with a wide firebox reduced it to 112 lb. to do the same work. We have again reached the firebox, the grate area limit. We are again forcing locomotives beyond the point of economical operation. We are burning coal at from 140 to 180 lb. per square foot of grate area per hour. Think back to the arguments that brought wider fireboxes 25 years ago. Furnace limitations brought improvement then. They call for improvement now. We caught up then by adding a trailer axle.

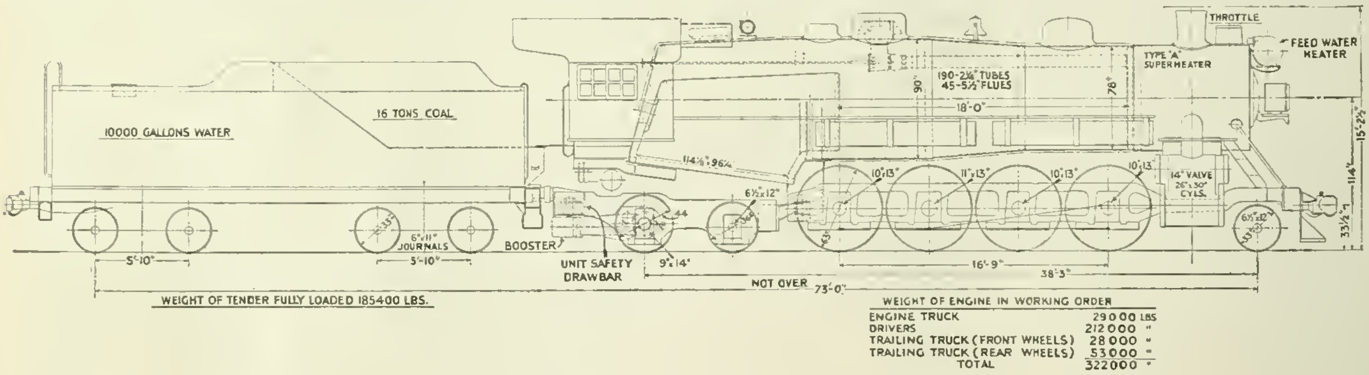


Fig. 3—Proposed Design to Overcome Firebox Limitations

Another trailer axle appears to be our recourse now. Other improvements have delayed this necessity but we must now catch up with the improvements.

The locomotive design illustrated in Fig. 3 shows a proposed solution of the problem which has not yet been worked out in practice. This is the result of a large amount of study and planning. It is designed to permit of any desired size of firebox within ordinary limits of width and length. Stokers can be used and the booster applied and still not exceed prevailing trailer load limits. Fundamentally, the design consists of an articulated frame, the articulated point being placed back of the rear driving wheels. The frame members under the firebox are placed outside of the trailing wheels, thus giving maximum ashpan space and permitting an easy and desirable booster, stoker and foot plate application. The cab, ash pan and cab parts are carried on supports attached to the boiler mudring. Suitable bearings are placed at the rear of the firebox connecting with the articulated frame.

This design removes the limits imposed by the single trailing axle. It permits of a grate and firebox design to suit any coal conditions and any desired rate of combustion; it allows an increase in ashpan capacity of from 75 to 100 per cent. It reduces to a minimum the lateral offsets on curves between the rear engine frame and the tender.

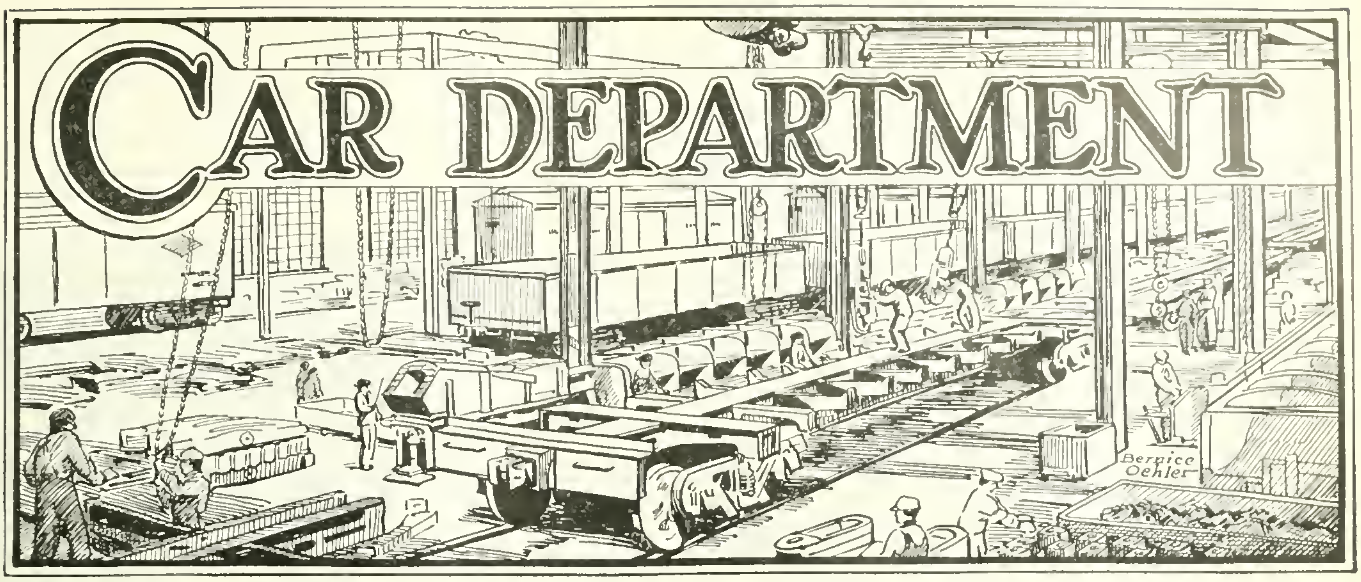
This Lima 2-8-4 type locomotive was designed for a limiting load of 54,000 lb. per axle. It has the following principal characteristics:

Weights in Working Order

Engine truck	29,000 lb.
Drivers	212,000 lb.
Trailer unit (front wheels)	28,000 lb.
Trailer unit (rear wheels)	53,000 lb.
Total	322,000 lb.
Heating surface—firebox, syphons and arch tubes	375 sq. ft. approx.
Heating surface, tubes and flues	3,162 sq. ft.
Heating surface, total	3,537 sq. ft. approx.
Superheating surface	915 sq. ft.
Grate area	76.2 sq. ft.

Locomotive wheel action on the rail calls for a study of the wave effect of the weights imposed by the various wheels. Fiber stress in rails is affected by two things other than speeds: First, the weight on each individual locomotive wheel and, second, the distance between the points of application of those weights. Progress of the locomotive on the track produces waves in the track. The track reacts, as much as it has time to react, after each wheel passes. Trailing wheels are far enough behind the drivers to allow the track to spring upward behind the rear drivers. The trailers knock it down again. Because of this, trailer weights are most important and so also is the distance between the trailer wheel and the rear driver. If trailer wheels carry say 75 per cent of the average weight on driving wheels the rail stress produced by the trailers becomes almost as great as the stress from the drivers themselves (American Railway Engineering Association Proceedings, Volume 21, 1920, page 719). This strongly supports the suggestion of four wheels under the firebox with wheel spacing and wheel loads that will prevent the destructive track effect of present trailer practice by an additional pair of wheels which will tend to keep the track down until the second trailer axle has passed. The four wheel articulated trailer promises to help to answer this rail problem.

Tradition says that the locomotive must be as simple as a grindstone. Railroad operation today says that it must be powerful and efficient. Power and efficiency in locomotives are not to be had except by complication, by adding to the locomotive factors that increase power that cannot be added in any other way and factors that save waste that cannot be saved in any other way. Every one of these factors increases weight. This weight must be provided for. In my opinion the four-wheel articulated trailer is the solution. We have put the additional carrying wheels under the wrong end of the engine. Why not put them where they are most needed, under the business end, under the firebox?



De Luxe Passenger Cars for Chinese Railway

Modern Steel Equipment Conforming to American Practice Built for the Tientsin-Pukow Line

THE Tientsin-Pukow Railway, owned by the Chinese Government, is one of the most important north and south lines in China, the Pukow terminus being on the Yangtze river opposite Nanking, while Tientsin is the port of Peking. The American Car and Foundry Export Company has supplied five trains de luxe to this road, all of the cars being of steel. The total order includes 43 cars: 10 first-class, 10 second-class and 10 third-class sleeping cars; 5 drawing room and sleeping cars, and 5 dining cars, all of which were 72 ft. 6 in. long. There were also 3 private cars, 76 ft. 6 in. long.

The general design of the cars is the selection of the director general of the railway and his associates, all of whom are Chinese. In general, they have adopted the American arrangement of floor plan in the dining cars, while for the sleeping cars compartment sleepers are used for each one of their three classes—first, second and third.

An exterior view of one of the private cars is shown in Fig. 1. In outside appearance, all of the cars are similar. An arched roof is used, and the roof is built with double carlines so that there is a free circulation of air between the steel ceiling on the inside and the outer sheathing.

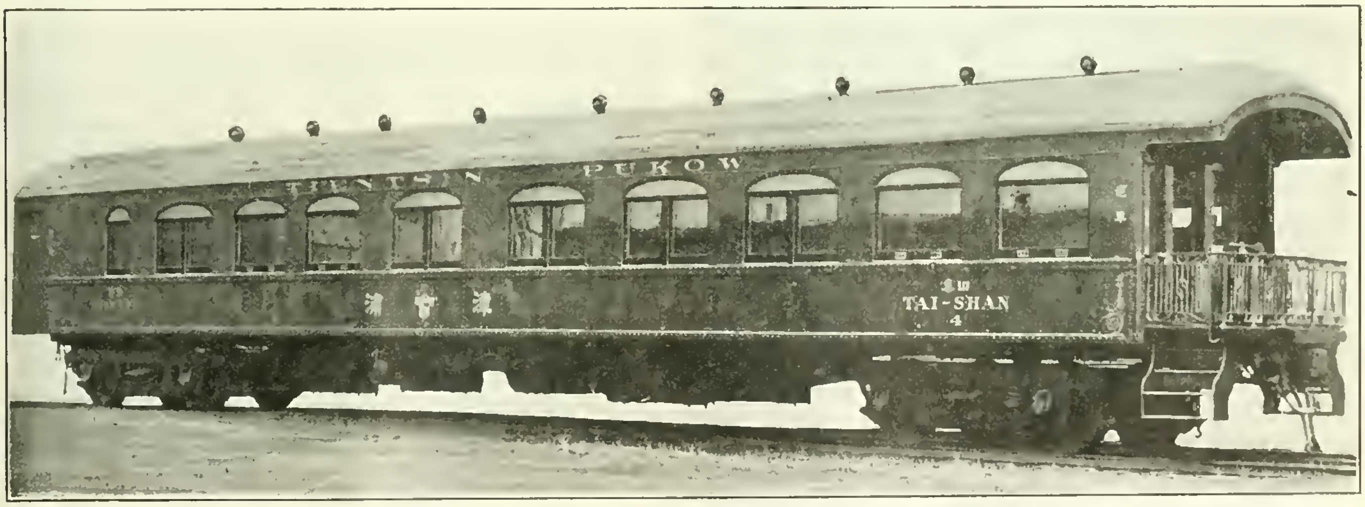


Fig. 1—A Private Car of Modern Construction for the Tientsin Pukow

In the first-class compartment sleeping cars, each compartment has its own lavatory and the beds are placed transversely, instead of longitudinally, in the car. The capacity of this type is 16 passengers per car.

In the second-class compartment, The Mann type of berth has been used, two upper and two lower berths per compartment. The backs of the sofa seats fold up to form the upper berth. There are seven compartments in each car, making the total capacity 28 passengers.

In the third-class compartment, each compartment has six berths, one formed by the sofa seat, one by the sofa back, and the topmost one by a hinged berth swinging out from the side of the car. Forty-eight passengers can be accommodated in each of these cars.

The interior of a private car is shown in Fig. 2, that of a first-class compartment sleeping car in Fig. 3, of the dining car in Fig. 4, and a section of a combination drawing room and a sleeping car in Fig. 5.

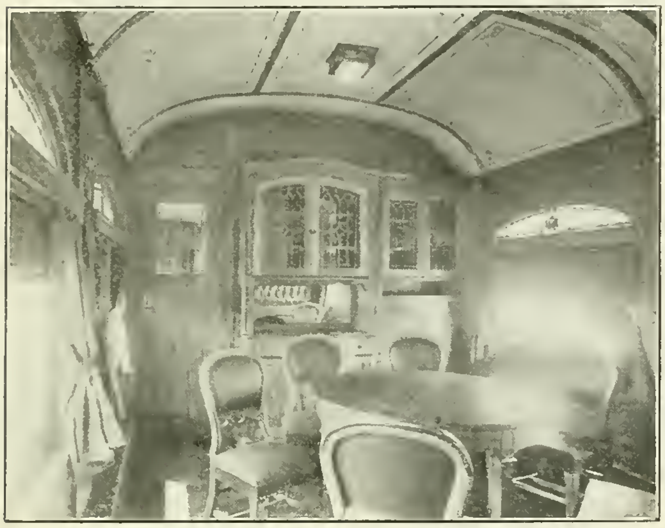


Fig. 2—Interior of Private Car

All of the cars are modern throughout, having steel construction, electric lights, steam heat, and equipment along the lines of the best practice in this country. A four-wheel truck with steel frames is used for all the cars.

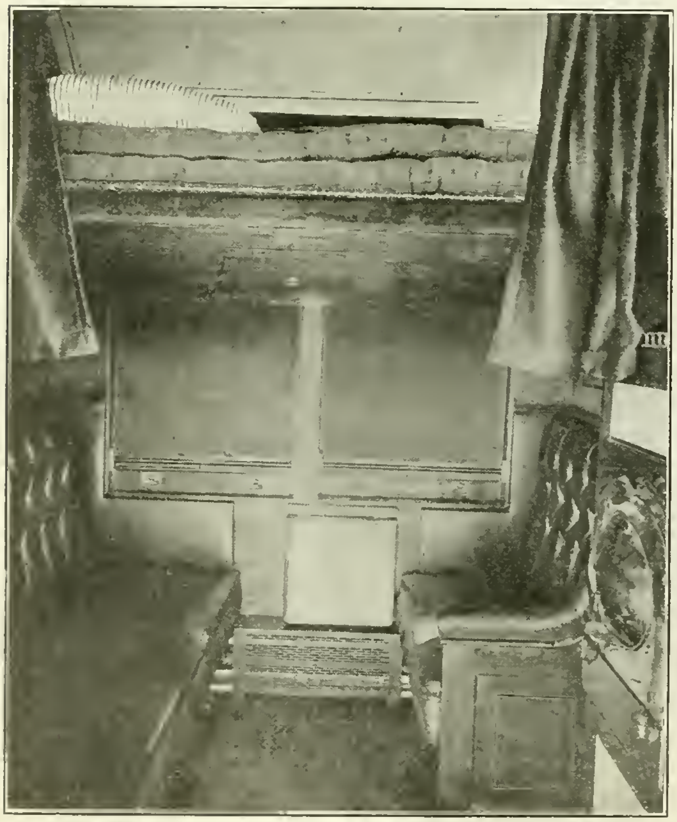


Fig. 3—Interior of Compartment in First-Class Sleeping Car

This equipment was completely erected and varnished inside and out in the American Car and Foundry Company's shops at Wilmington, Del., before shipment. The cars were dismantled and shipped in sections from Wilmington, Del., to Pukow and reassembled there quickly without having sustained any damage in transit. By a special method developed by the American Car and Foundry Company it was possible to erect the cars, rivet the sections together and put them into service, without even the addition of a coat of varnish, in the railway shops at Pukow. The work was done most efficiently by the Chinese workmen employed in the railway shops. The installation of the heating equipment and a very large amount of plumbing work, and the electric lighting installation, wires for which were run in conduits, presented no difficulties at all to the force of workmen who were employed.

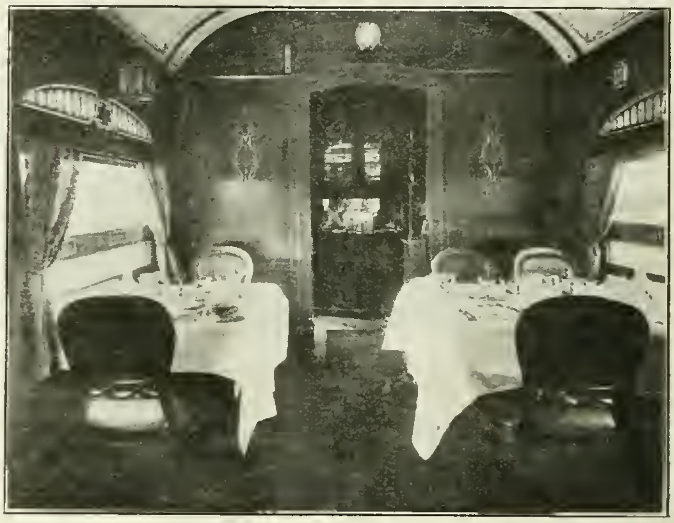


Fig. 4—The Dining Cars Conform to American Practice

The American Car and Foundry Company has recently built at the Wilmington, Del., shop narrow gage steel cars for the Chilean State Railways. As in the above, these cars comprised among others sleeping cars of modern steel construction, fully equipped in the builder's shops, and then taken apart in sections, boxed, and shipped by sea to Coquimbo, Chile. These cars arrived at Coquimbo a short time before the earthquake and tidal wave, and by reason of the congested condition of the Coquimbo shops, they were erected about 100 miles along the line from Coquimbo. Because of this the cars were not destroyed, while the larger part of the equipment in Coquimbo simply disappeared, being swept away by the tidal wave.

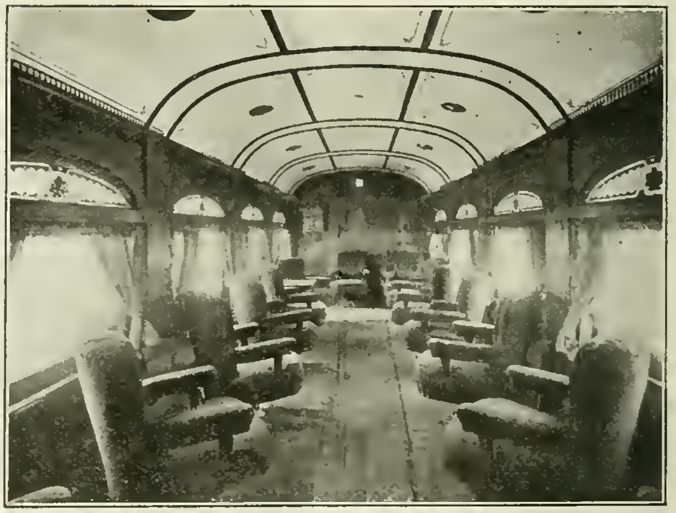


Fig. 5—Interior of a Combination Drawing Room and Sleeping Car

Treated Timber Decreases Service Cost of Cars*

Wood, which is subject to decay, is used more extensively in car construction than any other material, and a detailed study of this subject reveals the fact that 82 per cent of all timber removed from cars was removed because of decay. Consequently preservative treatment of car material must be given consideration by the officials of all railroads.

The two important phases of this subject are the cost and the effect on the lading. Obviously the lading of stock, flat or coal cars will not in any way be affected, regardless of the kind of treatment.

In 1918 the Marsh Refrigerator Service Company, Milwaukee, Wis., placed in service several refrigerator cars with creosoted sills, sub-flooring and roof boards and to date has not received any complaints about contaminated lading. In 1920 the Chicago, Burlington & Quincy placed in service four dining cars with creosoted sub-flooring. No contamination of foods or complaints of passengers have been noted on these cars. In view of these facts it is, then, safe to assume that the treatment of grain car sills will not cause contamination of the lading.

We have, then, the following material that can be treated by any process desired without any contamination of lading:

Sills for stock, flat, coal, grain and refrigerator cars; posts for stock, coal, grain and refrigerator cars; flooring for stock, flat and coal cars and sub-flooring for refrigerator cars, and roof boards for refrigerator and stock cars.

In our consideration of the treatment of this material the only question is, "Will it pay?"

Answers to questionnaires sent to the mechanical superintendents of the leading railroads bring out the following facts as to the average life of certain parts of cars:

Stock car decking	2 to 6 years
Stock car sills	5 to 8 years
Stock car roofing	4 to 6 years
Stock car side posts	4 to 6 years
Stock car end posts	6 to 8 years
Flat car decking	6 to 8 years
Refrigerator sills	4 to 5 years
Refrigerator sub-flooring	3 to 4 years

No one claimed more than 8 to 9 years life for any of the above parts.

Unfortunately there has been very little treatment of car material, so this committee is not in position to offer any conclusive evidence of the average life of treated material. However, in 1911 the Chicago, Burlington & Quincy placed in service 200 stock cars with treated sills and decking (treated by the Bethell process, 12 lb. of creosote per cu. ft.) and to date not one of the treated sills has been taken out except those that were broken in wrecks. None of the decking has been removed except that broken either by heavy loading or wrecks.

We feel sure that well treated sills and posts on all classes of cars will never have to be renewed, except as they are broken in wrecks, and we know that the Burlington will get an average life out of their stock car decking (subjected to harder usage than any other with the possible exception of refrigerator decking) of at least 16 years. The majority of this decking, after 12 years' service, is in perfect condition today. It is certain to give further service for at least the normal untreated life, or four years additional; therefore, we may expect at least 16 years' life.

Using the above figures of four years as the average life of untreated stock car decking and 16 years as the average life of treated stock car decking, the costs are as follows:

Untreated	
648 ft. b. m. (36-ft. car) at $40 per M	$25.92
Labor laying deck on car	7.50
Total cost	$33.42
Cost per year	8.36
Treated	
648 ft. b. m. (36-ft. car) at $40 per M	25.92
Treatment of 648 ft. b. m. at $15.43 per M	10.00
Labor laying deck on car	7.50
Total cost	$43.42
Cost per year	2.71

These figures on the cost of treatment are based on the cost of treating fir lumber with the straight creosote process at the Galesburg treating plant in the month of April, 1922, and include the following costs: unloading lumber from car to ground for seasoning; loading seasoned lumber from ground to tram for treatment; loading treated lumber from tram to car for shipment; supervision and overhead of operating treating plant, and preservative absorbed by the lumber (12 lb. creosote per cu. ft. at 12 cents per gallon).

There are probably as many different methods of figuring the cost of treatment as there are organizations using treated material. However, this committee cannot nor is it appointed for the purpose of extensively working up data as to the best methods of figuring cost. The above method is used, not to show the exact saving, but to form a working basis from which to prove that there will be a saving. We wish to call attention to the fact that it does not figure the cost of equipment nor does it make any allowance for the legitimate profit to which a commercial firm would be entitled.

The above is the highest priced treatment known. Treating with an empty cell process, 6 lb. creosote per cu. ft., the cost of treatment would be reduced $4.39. Treating with the Card process, 3 lb. creosote, ½ lb zinc chloride per cu. ft., the cost would be reduced $5.78. Treating with the Burnettizing process, ½ lb. zinc chloride per cu. ft., the cost would be reduced $7.97.

As previously stated the committee is handicapped by lack of data as to the number of years' life obtained by treatment but let us assume for the time being that we may expect 16 years' life from stock car decking treated by any of the above processes, we find that the yearly maintenance costs are:

Untreated decking	$8.36
Bethell process treated decking	2.71
Empty cell treated decking	2.41
Card treated decking	2.33
Burnettizing treated decking	2.19

The above figures do not represent all of the saving. In these figures there has been no consideration of the loss of service of the car while it is in the repair yards having decayed parts renewed, neither has there been any consideration of the destruction of other material that is in good condition necessitated by the renewal of bad order parts. Another point that cannot be given definite figures is the saving effected by holding down the price of the car material. The price of timber, the same as any other commodity, is governed by the supply and demand. By conserving the supply and cutting down the demand, which we can do by preservative treatment, it will be possible to hold down the price of lumber. The time has undeniably come when the necessity for the conservation of our forest supplies makes it prohibitive for us to use untreated lumber any place where we can appreciably increase its life by preservative treatment.

To give the lowest possible annual maintenance car material must be treated by one of the standard pressure processes. While it is true that dipping, spray or brush treatments will increase the life of timber, it is also true that by pressure treatment the life will be so much further increased that the extra cost will be entirely warranted. This is particularly true with fir and hardwoods.

The collection of data based on results obtained over a period of several years by different processes is necessary in order to definitely decide what treatment will be the most practical. However, at the present time the committee believes that treatment should be made by one of the processes using creosote, and are further of the opinion that full cell treatment by the Bethell process will give a bigger net absorption than is necessary. However, where the ideal treatment is not available, one of the inferior treatments would be a profitable investment.

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*Report presented by the Committee on Car Material at the nineteenth annual meeting of the American Wood Preservers' Association, held at New Orleans, La., January 23-25, 1923.

We recommend that in the construction of new cars, the treatment outlined above be applied to all material that can be treated without harmful contamination of lading. We also recommend that a sufficient stock of treated standard material be kept on hand at the repair shops to be used in making repairs to bad order cars.

The committee is composed of the following members: F. S. Shinn (C. B. & Q.), chairman; K. C. Barth, Service Bureau, American Wood Preservers' Association; H. C. Bell (N. & W.); S. M. Elder (B. & O.) and Frank McCrory (C. R. I. & P.).

Lumber for Italian Passenger Cars

The kinds and quantities of the different woods employed in building a passenger car for the Italian State Railways are treated in considerable detail by Ing. Gaetano Castlefranchi in a recent issue of Il Legno, an Italian lumber-trade magazine. The article is especially interesting because of the detailed analysis of the available varieties of wood and the cost.

The car with which the article deals is the standard third-class coach used for most passenger traffic on the main lines. It has four compartments at each end, a lavatory in the middle and a corridor running along the side.

Six woods enter in the construction of these carriages: Teak, oak, elm, Southern pine, fir and walnut. The frames are teak, the Siam variety being considered the most desirable since it is easily worked and has few defects. Java teak has too many knots and wormholes. The interlacing fibres of Borneo teak make it too liable to crack when worked. African teak—not related to true teak—might be serviceable, but is almost unknown in Italy and would have to be imported in considerable quantities of selected and uniform grades before judgment on its adaptability could be rendered. Walnut can not be used for the frame because it rots too readily when brought in contact with nails or bolts.

Southern yellow pine has been found best for siding. European larch could not well replace Southern yellow pine, because the former wood has so many knots that its yield in usable sheathing would make the ultimate expense unduly high.

Such woods as beech, maple, linden, cherry and sycamore, as well as several kinds of Italian lumber, which on first thought might serve as carsiding, are out of the question since experience has shown that, when worked, they warp or split easily. Well-seasoned beech has not been given a sufficient trial for manufacturers to be assured regarding its fitness, but Italian experts believe that this wood, even after being seasoned, is likely to rot when exposed to moisture.

When the cost of the lumber placed in the finished carriage is derived from the price and quantity as purchased in its original marketable form, according to Italian mill practice, it must be considered that the cubic volume of the purchased lumber runs from 130 to 135 per cent of the volume of the finished wood finally used. For example, sawing oak logs into boards fit for use gives percentages of the weight of the original logs in various products, as follows: Bark, 7; sawdust, 8; firewood, 17; chips, 10; general waste, 20; finished boards, 38. Since, on the basis of a 38 per cent yield of boards from the logs and a cost of the latter at present coming to 34 lire ($1.73) per 100 kilos (220.5 lb.), the 380 kilos (838 lb.) of boards obtained from a metric ton (1,000 kilos, or 2,204.6 lb.) of logs would cost 340 lire ($17.34), plus 90 lire ($4.59) for labor and general expenses, or a total gross cost of 430 lire ($21.93). However, this gross cost is subject to a reduction of 52 lire ($2.65), the selling value of the by-products, since the prices of the sawdust, firewood and chips are, respectively, 8 lire, 16 lire, and 21 lire ($0.41, $0.82 and $1.07) per 100 kilos. Consequently the final net cost of the 380 kilos of boards obtained from a metric ton of oak logs amounts to 378 lire ($19.28), or 0.98 lire ($0.05) per kilo (2.205 lb.). At this price, a cubic meter (35.3 cu. ft.) of oak boards, taken as weighing 920 kilos (2,028 lb.) would cost 900 lire ($45.90). To this cost should be added further losses and expenses due to milling, sampling, seasoning, etc., which would bring the cost per cubic meter to 990 lire ($50.49) or $119.08 per 1,000 ft. board measure.

Commenting on the calculation of the yield in finished material from an original given weight of logs, it is admitted that the proportion of finished boards may seem rather low, but in arriving at the results, ample allowance was made for knots, other defects, etc.

While oak logs give only 38 to 40 per cent finished material for car construction, and Slavonian oak planks 60 per cent, Southern yellow pine timber yields 54 per cent.

The quantities, prices, and costs of the lumber used in building a third-class carriage, are given in an accompanying table.

The oak used in the calculations of this table comes from Slavonia, Jugoslavia. While this imported lumber has a higher price, 560 lire ($28.56) per cubic meter, than Italian oak, priced at 480 lire ($24.48), the latter gives a yield of only 51 per cent in usable material as against a yield of 60 per cent for Slavonia oak. The amount of Italian oak planks which it would be necessary to buy would be 2.26 cubic meters, as compared with 1.90 cubic meters of Slavonia oak planks, in order to provide the 1.13 cubic meters of finished material required.

Kinds and Quantities of Lumber Used for Third-Class Cars

	Teak	Oak	Elm	Southern Yellow Pine	Fir	Walnut
1. Volume of finished material required, cubic meters	8.60	1.13	0.65	4.1	2.25	0.035
2. Form of lumber purchased	Boards	Large planks	Large planks	Timbers	Boards	Large planks
3. Purchase price of lumber, lire per cubic meter	2,600	560	430	630	295	1,000
4. Percentage yield of finished material from lumber, per cent	67	60	51	54	60	75
5. Unit prime cost of finished material required, lire per cubic meter	3,880	930	860	1,160	490	1,330
6. Unit labor cost and general expense, lire per cubic meter	100	100	100	100	100	100
7. Value of marketable waste and by-products, lire per cubic meter	70	55	50	40	35	40
8. Net unit cost (items 6 minus 7) of finished material, lire per cubic meter	30	45	50	60	65	60
9. Total unit cost (items 5 plus 8) of finished material, lire per cubic meter	3,910	975	910	1,220	555	1,390
10. Amount of lumber purchased to provide required quantity (item 1) of finished material, cubic meters	12.9	1.9	1.13	7.6	3.46	0.06
11. Total cost of lumber purchased (item 3 times item 10) Lire	33,540	1,064	486	4,788	1,110	60
Total	41,048 Lire ($2,093.45)					

The grand total cost of all lumber used equals 41,048 lire ($2,093.45). The value in lire per cubic meter multiplied by 51 and divided by 424 will give the value in dollars per 1,000 board feet at the December, 1922, rate of exchange, according to which the lire equaled $0.051.

Thermal Stresses in Steel Car Wheels

Results of Investigation by the Bureau of Standards to Determine Effect of Heating Due to Brake Applications

By George K. Burgess and G. Willard Quick

NINETEEN steel wheels have been tested in the laboratory of the Bureau of Standards under conditions approximating those encountered in service caused by heavy brake applications. The rims of the wheels were heated to a temperature of 380 deg. C. (716 deg. F.) by passing an electric current through a band of soft steel encircling the wheel. The resulting stresses were calculated from strain-gage measurements after correcting for thermal expansion. Eight worn wheels and eleven new wheels representing five types of manufacture were tested and none failed in the tests. As a result of heating the rim, the hub moved with respect to the rim, inducing tensile stress on the face and compression on the back near the hub. Near the rim the stresses were in compression on the face and in tension on the back except for worn wheels where no stress was induced on the face. The maximum surface stresses developed were slightly above the yield point of the material, producing a permanent set for the first tests on new wheels while no set resulted from tests on old wheels or in succeeding tests on new wheels.

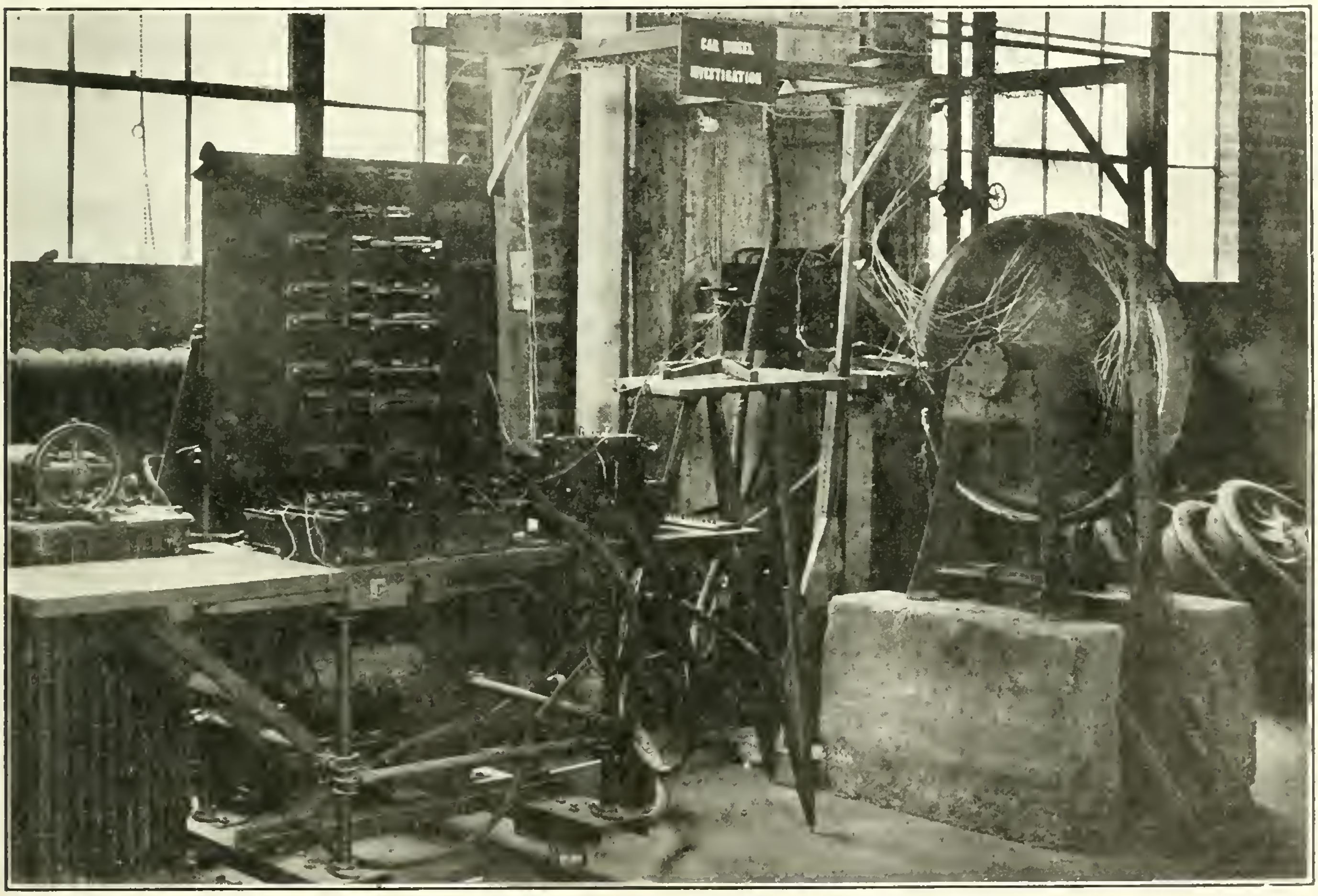

Fig. 1—Car Wheel in Test Stand Ready for Bureau of Standards Thermal Test

This investigation was the result of a conference of representatives of several manufacturers and purchasers of steel car wheels held at the Bureau of Standards in 1920. Experienced railway men stated that the tread becomes heated to a dull red on long, heavy grades by the application of brake shoes. It was agreed that it would be of general interest and of value to investigate the stresses thus set up, the plan being to conduct the tests in a manner identical with the procedure followed in the investigation of Thermal Stresses in Chilled Iron Car Wheels* with some additional tests on steel wheels at as high a temperature as possible to obtain with the special equipment used and including also a survey of the stresses thereby induced in the back of the plate.

Other problems present themselves in connection with the subject of stress caused by brake application; as the effect of speed, shoe pressure and length of application in producing thermal stresses. At Purdue University an investigation of these problems, with the wheels revolving while a brake shoe is held in contact with the tread, is in progress. In the investigation at the Bureau of Standards the manner in which

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*See *Railway Mechanical Engineer*, August, 1922, page 460.

thermal stresses build up in wheels, the magnitude, nature and location of stresses have been studied.

Wheels Tested and Method of Manufacture

The wheels were 33-in. steel car wheels representing the product of six different plants and five methods of manufacture. Two new wheels furnished by each of four different manufacturers, one new wheel and two special wheels —one with a thin web and one with a straight web—from another mill, together with eight worn wheels† representing the product of four different plants, made a total of 19 wheels upon which one or more series of measurements were made. The manufacturers co-operating have been designated by the letters U, V, W, X, Y, and Z. Table I gives a brief description of the method of manufacture. Fig. 2, Fig. 3, and Fig. 4 show sections of the various standard wheels.

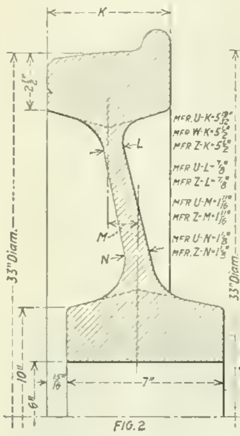

FIG. 2

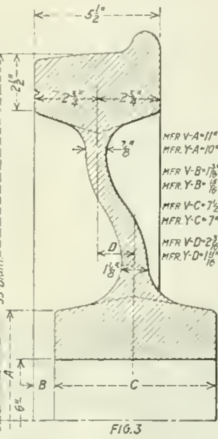

FIG. 3

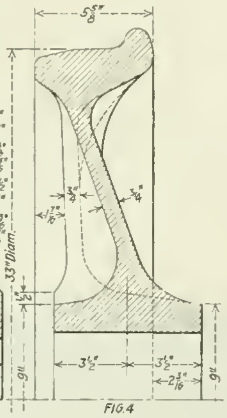

FIG. 4

Fig. 2—Sections of Forged Wheels of Manufacturers U, W and Z
Fig. 3—Sections of Forged Wheels of Manufacturers V and Y
Fig. 4—Section of Cast Steel Wheels of Manufacturer X

Table I—Wheels Tested

Mfrs.	Method of manufacture
U	Forged and rolled from an individual ingot.
V	22 in. by 22 in. ingot rolled into 15 in. round which is sheared into blanks. The blanks are forged and rolled into wheels.
W	Ingot rolled into plates from which biscuits are cut. These biscuits are forged and rolled into wheels.
X	Cast in a revolving mold. First part of pour is high in manganese,
Y	Same procedure as manufacturer V.
	forming the tread, while low carbon steel forms plate and hub.
Z‡	90 in., 12 sided, fluted ingot with sand lined sink head is cut cold into blocks of proper weight. These blocks are heated in a continuous furnace after which they are forged and rolled into wheels.

Procedure for Thermal Stress Tests

In the thermal stress tests the wheel was mounted on a hollow water-cooled 6-in. axle. The axle in turn rested upon supports. A soft-steel resistor 3½ in. in width and ¼ in. in thickness was placed on the tread of the wheel, but insulated from it by a thin sheet of perforated asbestos, and an alternating current of 1,000 to 1,500 amperes at 15 to 30 volts was passed through it. Undue radiation of heat into the air was prevented by the use of asbestos covering. Fig. 1 shows the arrangement of this apparatus.

The tread of the wheel attained a maximum temperature of approximately 380 deg. C. (716 deg. F.) in each run. To determine the distribution of temperature in the wheel from tread to hub copper-constantan thermocouples of No. 30 B. & S. gage wire were used—seven couples along a vertical radius at approximately 2-in. intervals and seven others similarly located along the horizontal radius. Readings were taken along both radii for the purpose of obtaining duplicate results. Two other thermocouples were inserted into the tread of the wheel. Thus, four couples, one at the gap in the resistor, were placed at equidistant points in the tread of the wheel and assurance given that uniformity of tread temperatures was attained. The 16 copper-constantan thermocouples can be seen in Fig. 1, extending from the wheel to overhead supports and then down to the potentiometer on the transformer table.

A 2-in. Berry strain gage was used for measuring the deformations. Five or six sets of readings were taken at 1-in. intervals on the vertical and horizontal radii on both the face and back of the plate. The location of the points at which strain-gage and thermocouple readings were taken are shown in Fig. 5.

It was only necessary to survey the stresses along the radii of the wheels, since preliminary measurements had shown that the tangential stresses were of a compressive nature and of relatively small magnitude.

Identical rates of power input were maintained for each test in order to obtain comparative results. It was necessary to increase the power input near the end of the test to attain the desired tread temperature in a comparatively short time. The amount of power applied per minute during the different periods of the test was as follows:

First half hour	570,000 ft. lb.
Second half hour	690,000 ft. lb.
Third half hour	770,000 ft. lb.
Fourth half hour	797,000 ft. lb.

In these tests the resistor completely encircled the wheel and was thermally insulated. Under these conditions a larger percentage of the energy entered the wheel than would have been the case had the same wheel been subjected to brake application in service, due to the fact that part of the energy destroyed by friction between the shoe and wheel goes to heating the brake shoe, and thence by radiation to the air, and, further, the shoe only bears on a small part of the circumference, thus allowing the heat in the uncovered part of the tread to radiate instead of entering the wheel.

Readings were taken of the temperature, strain, and power input at regular intervals, a strain gage reading of the cold wheel being also taken before the test was started. When the desired tread temperature was reached, the power was shut off and the asbestos covering on the resistor removed to permit more rapid dissipation of the heat. Temperature and strain gage readings were also taken during cooling and after the wheel was at room temperature.

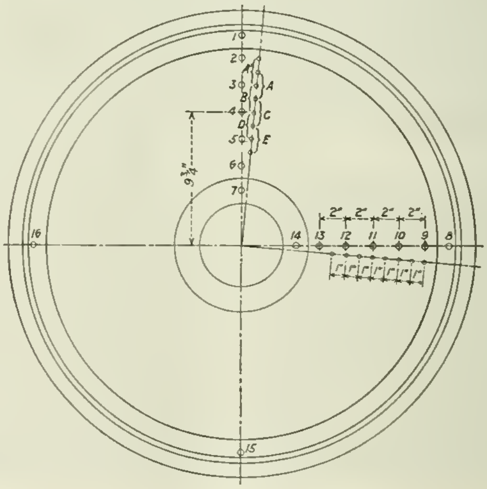

Fig. 5—Location of Thermocouple and Strain Gage Holes

The elongation as determined by the strain gage is attributable to two causes: (1) An elongation due to the thermal expansion of metal, and (2) elongation caused by the strain due to the temperature gradient from tread to hub of the wheel. By knowing the coefficient of expansion and the temperature rise it was possible to calculate the thermal expansion. By deducting the elongation due to this expansion from the total elongation, the elongation due to stress alone was determined. The relation between stress and strain on samples actually taken from the wheels made it possible to convert the strain readings into stress values.

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†Furnished by the Pennsylvania Railroad.

‡One standard design, one thin plate, one straight plate.

Physical Properties and Composition of Material

The coefficient of expansion of specimens taken from one wheel of every manufacturer was determined for the range from 20 deg. C. to 400 deg. C. (68 deg. F. to 752 deg. F.). An average of the results is given in Table II.

Table II—Thermal Expansion of Wheel Sections

Temperature rise		Composite total expansion inches per inch	
Deg. C.	Deg. F.	Forged or rolled	Cast
50	90	.00056	.00060
100	180	.00117	.00125
150	270	.00180	.00194
200	360	.00248	.00267
250	450	.00319	.00345
300	540	.00393	.00391

The mechanical properties of the steels were determined on two 8-in. gage-length specimens taken from the plates of one rolled steel wheel of each manufacturer, while 2-in. gage-length specimens were taken from a cast-steel wheel because, due to the corrugated plate it was impossible to obtain 8-in. samples. Table III gives the averaged results of the tensile tests.

Table III—Average Results of Tensile Tests

Mfr.	Yield point, lb. per sq. in.	Ultimate strength, lb. per sq. in.	Elongation in 8 in., per cent	Reduction in area, per cent
U	52,100	123,300	13.5	14.1
V	......	119,500	12.5	13.6
W	43,400	107,000	13.8	14.8
X	50,700	85,000	14.5	23.6
Y	53,300	122,000	11.2	10.5
Z	61,900	130,200	11.2	13.9

The modulus of elasticity averaged 29,260,000 lb. per sq. in. for the forged wheels and 30,500,000 lb. per sq. in. for the cast steel wheel.

The chemical composition of one wheel submitted by each manufacturer was determined. Drillings were taken from the plates of the forged steel wheels about midway between the hub and the rim. For the cast steel wheels, of varying compositions, ten drillings were taken across the whole diameter, No. 1 and No. 10 being in the rim, No. 5 and No. 6 in the hub and the others in the web. The results of the analyses are given in Table IV.

Table IV—Chemical Composition of Wheels

Manufacturer	Position	Carbon	Sulph.	Phos.	Mang.	Silicon
U	3	.67	.019	.029	.77	.19
V	3	.73	.015	.028	.73	.21
W	3	.66	.014	.027	.67	.17
X	1	.32	.025	.023	1.60	.29
	2	.26	.019	.022	1.15	.29
	3	.25	.022	.022	.76	.28
	4	.18	.018	.019	.72	.28
	5	.20	.015	.021	.69	.24
	6	.25	.022	.021	.67	.28
	7	.20	.022	.020	.68	.28
	8	.24	.022	.023	.92	.28
	9	.21	.021	.020	.86	.27
	10	.30	.023	.023	1.66	.29
Y	3	.77	.032	.032	.69	.16
Z	3	.75	.026	.019	.66	.25

Brinell hardness determinations were made on radial sections cut from two rolled and from one cast type of wheel. Impressions were made at 1-in. intervals along the radius, the first one being about 1/8 in. from the rim. There was very little variation in hardness along the radial section of the rolled wheels, the average being about 250. For the cast wheel the hardness varied widely from rim to hub. These wheels were hardest near the rim and softer in towards the hub with a position quite deficient in hardness at the middle of the rim where shrinkage holes occurred. The Brinell hardness was 325 at 1/4 in. from the tread, 250 at 3/4 in., 220 at from 2 in. to 3 in. and 150 near the hub.

Results of Thermal Stress Tests

For the new rolled steel wheels of regular design the maximum stresses developed on the face of the plate were in tension near the hub and in compression near the rim, while on the back of the plate the conditions were reversed. These stresses are produced by expansion of the rim causing the hub to move relative to the rim. The average movement of the hubs of the standard design wheels ranged from .07 in. to .10 in. Fig. 6 shows typical time-stress curves for the face and Fig. 7 for the back of the plate of new steel wheels.

Of the two special wheels furnished by manufacturer Z the one with a thinner plate developed stresses similar to but of somewhat greater magnitude than those developed in the wheels of regular design. The tread of this wheel was also lighter than that of the regular wheels. The stresses developed in the special wheel with the straight plate were in tension on both the face and the back of the plate.

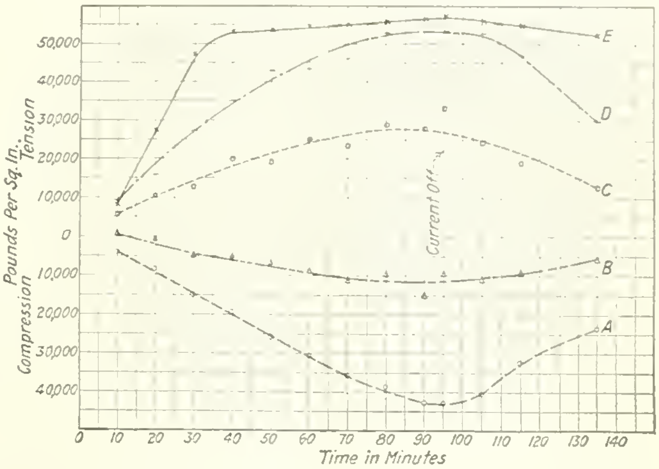


Fig. 6—Stress-Time Curves Showing Average Stresses Developed on Face of All New Wheels of Manufacturer Y (See Fig. 5 for Location of Measurements)

For the worn wheels tested, in which considerable metal had been worn from the tread, the stresses developed on the face of the plate were in tension near the hub and gradually diminished to practically zero at the rim, while on the back of the plate the stresses were of about the same nature and magnitude as for the new wheels. The neutral axis on the face of the old wheels is shifted out towards the rim. This difference for worn wheels may be due to the work on the tread, static loads, impacts, the thinner tread or a combination of these factors.

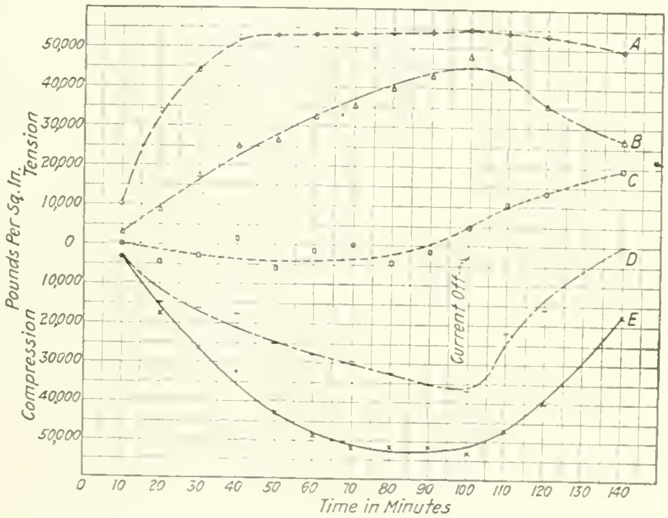


Fig. 7—Stress-Time Curves Showing Average Stresses Developed on Back of All New Wheels of Manufacturer Y (See Fig. 5 for Location of Measurements)

In the tests on the cast steel wheels, the stresses were more complicated because of the nature of the plate, which is of a corrugated design.

From the first test on new wheels, a permanent set was observed on the surfaces of the plates, at positions of maximum stress, indicating that the material was strained beyond the yield point at the points on the surface. The greatest compressive stress observed was 68,800 lb. per sq. in. and the greatest tensile stress 58,100 lb. per sq. in.

In succeeding tests on new rolled steel wheels of standard section and in all tests on old wheels there were no permanent deformations noted, showing that the stress is not increased beyond the yield point on repeated heating. The tests on the old wheels indicate that the heating they had been subjected to in service stressed them beyond the yield point on the surface of the plates at certain positions, and relieved any manufacturing strains, rendering these wheels in the same condition as new wheels after the first thermal test in this investigation.

The maximum tread temperature ordinarily reached about 380 deg. C. (716 deg. F.) in 90 minutes. Special tests were made on two new rolled wheels and one new cast wheel at the highest temperature attainable with the equipment, about 500 deg. C. (932 deg. F.). The time to reach this temperature was about 60 minutes longer than was required to reach 380 deg. C. in the regular tests but the stresses developed were no greater. The greater strain in the plate appears to be offset by greater expansion due to the higher temperature, thus giving a flat, stress-time curve between 380 deg. C. and 500 deg. C.

Summary and Conclusions

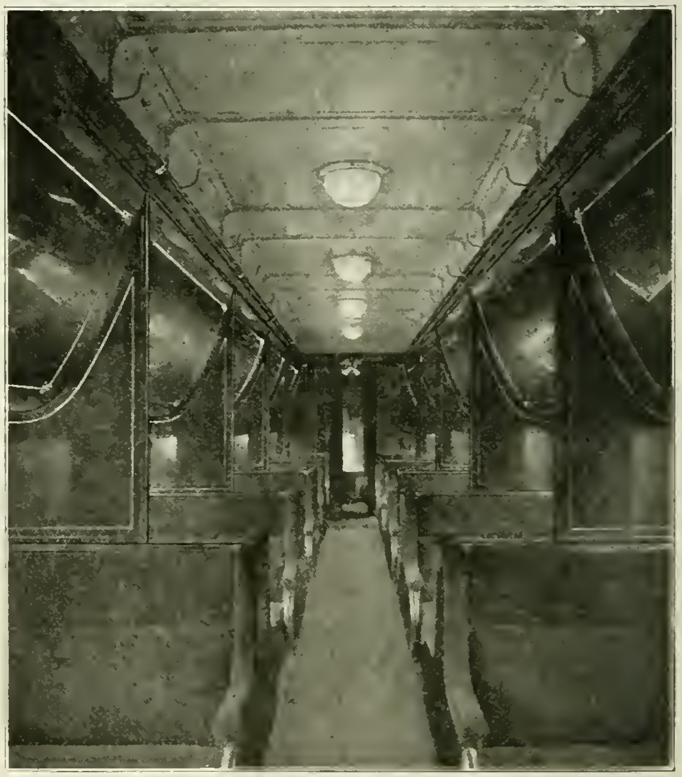
Nineteen 33-in. steel wheels have been tested in a manner approximating conditions encountered in service through long applications of brakes on heavy grades. In the tests the rims of the wheels were heated electrically and the hubs were kept cool by passing water through the hollow axle upon which the wheels were mounted. The maximum tread temperature was 380 deg. C. (716 deg. F.) in the regular tests and in the special tests a maximum temperature of 500 deg. C. (932 deg. F.) was attained. From observations of the deformations in the plates of the wheels the stresses have been computed after correcting for temperature. Six manufacturers furnished new wheels representing five different methods of manufacture. Eight old wheels manufactured by four of the companies were also tested. The general results of the tests may be summarized as follows:

1. None of the wheels failed.
2. When the rim is heated the hub moves with respect to the rim, inducing stresses in the plate which, for the first test on new wheels, are in tension near the hub and in compression near the rim on the face, while on the back of the plate the stresses for the same positions near hub and rim are about equal in magnitude but reverse in nature to those on the face.
3. For worn wheels, the stresses are of the same character, except near the rim on the face where very little stress is found. This difference is due to the shifting of the neutral axis on the face from the center of the radius towards the rim and is caused by conditions of service.
4. The maximum stresses were slightly above the yield point of the material as determined in tensile tests.
5. A permanent set was apparent only for new wheels on the first tests. For old wheels and in succeeding tests on new wheels, there was no set apparent, showing that the stresses above the yield point were not increased by repeated heating, and that the old wheels had been rendered, by service, in a condition similar to that of new wheels after the first thermal test.
6. For forged wheels the character and magnitude of the stresses developed in the surface of the plate are little affected by the method of manufacture. The stresses developed in the cast-steel wheels were, because of the corrugated form of plate, more complicated than those in the forged wheels.

The Bureau of Standards is undertaking a study of the residual stresses in steel car wheels from the manufacturing processes. In this work sections are being sawed from the wheels and stresses so relieved will be calculated from deformations measured with a strain-gage.

Permanent Head Boards Increase Privacy of Pullman Sections

THE first step in the development of greater privacy for sleeping car passengers during the daytime, now being undertaken by the Pullman Company, is shown in the illustration. Some 60 standard Pullman sleeping cars are now in service equipped with permanent head boards which extend out from the side of the car for something more than half the width of the seat, so that the forward edges are flush with the top of the closed berths and the side walls of the upper deck. The permanent head board adds considerably to the privacy of the standard section during the daytime. It also permits the occupants of each section to freely control the ventilation without causing drafts which may be displeasing to the occupants of adjoining sections. At night the partition is completed by locking a removable half head board on the rigid partition. The berths are made up in the usual way.



Sections of Standard Pullman Sleeping Cars Separated by Permanent Head Boards

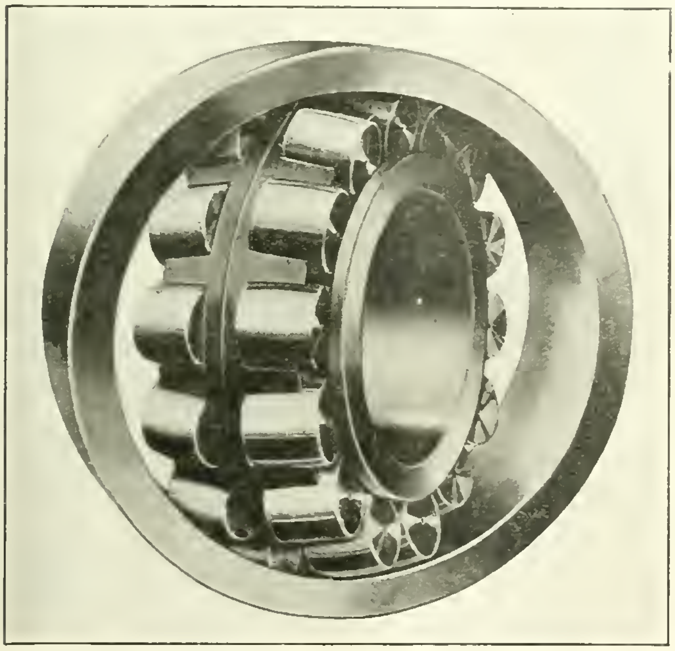
The arrangement illustrated has been received with favor by travelers wherever the cars of this type have been in service and experiments looking toward the further development of the idea are now under way at the Pullman Works, Chicago.

Advantages of the Spherical Type Roller Bearing

A New Design Which Combines Self-Alinement, Low Frictional Resistance and High Capacity

By H. E. Brunner
Chief Engineer, S-K-F Industries, Inc.

ANTI-FRICTION bearings have found limited application in railroad work in the past principally because the shocks which bearings on locomotives and cars receive are unusually severe. Numerous attempts have been made to develop special bearings adapted for such service but in general they have not been successful. The conditions under which the bearings on freight and passenger car journals and railway motor shafts operate require a bearing with the low frictional qualities and precision of a ball bearing combined with load carrying capacity comparable with that of a roller bearing but not obtained at the sacrifice of true rolling or by enforced rigidity. A new design of roller bearing which combines these characteristics has recently been placed on the market. As sufficient experience has already been had in a large variety of heavy machines to establish its merit, the purpose of the present article is to describe the construction and to analyze the design from a technical point of view.



Spherical Roller Bearing, with Inner Race Turned to Show Construction

The Aktiebolaget Svenska Kullagerfabriken of Gothenburg, Sweden, undertook in 1918, to study the problem of anti-friction bearings for heavy duty service. A careful analysis was made of the limitations affecting both the ball and the roller bearing in applications of the kind in question. This was followed by extensive tests of a large number of different types of bearings, the results of which were systematically studied. In this way there were discovered certain desirable characteristics of the various types and likewise objectionable ones, from the point of view of the heavy type of service for which it was necessary to provide.

With the conclusions of this experimental work at hand, the task was to devise a bearing which would incorporate the maximum number of desirable features without any of those which had been found to be detrimental. The problem was further extended by the necessity of adapting the design thus developed to the already established standard sizes for ball bearings. This was accomplished with notable success and the "spherical type of roller bearing" is the result of the research and study outlined above.

Referring to Fig. 1 a longitudinal section through the mid plane of the bearing will be seen. Part *A* is the inner race of the bearing. It is secured to the shaft or journal according to the usual methods employed with ball bearings operating under corresponding load and speed conditions. A shrink fit, press fit or tapered sleeve, together with a suitable locknut may be used. Parts *R* are the two rows of rollers. Part *B* is the outer race, ground spherical on the inner surface from the center point *O* of the bearing. The outer race of the bearing is mounted in the housing according to the usual method for a ball bearing, which normally provides a slight clearance to facilitate creeping of the race in the housing while in service.

It will be seen from the figure that the bearing is a self-contained and self-alining unit, two properties that are of the greatest importance. The former means that when the bearing is being installed, there is no adjustment required internal to the bearing itself, thus precluding the possibility of damage through initial maladjustment. The spherical surface of the outer race provides for self-alinement of the bearing to compensate for shaft deflections and unavoidable inaccuracies in machining and locating the housings. These two features are of particular importance in the field of heavy machinery, for which the bearing is designed.

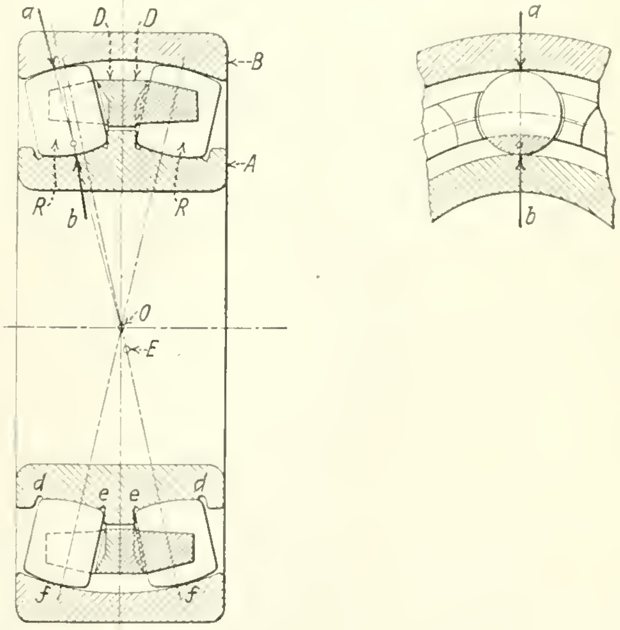


Fig. 1—Sectional Views of the Spherical Roller Bearing

The internal construction of the bearing will be made clear by further reference to Fig. 1. On the inner race the roller *R* contacts with the groove *de* throughout its length thus providing the line contact of the roller bearing. On the outer race the roller contacts at the point *f* and due to the closeness of the roller curvature (in a longitudinal plane) radius *Ef*, with the race curvature radius *Of*, the contact is very intimate. It will be seen that the rollers are barrel shaped and have their largest diameter toward the inboard end. Actually the contact between the roller and the outer race will be a substantial area, due to the elasticity of these parts, and consequent deformation under load. From this it will be seen that the spherical type roller bearing embodies the theoretical characteristics of both point contact of the ball bearing and line contact of the roller bearing. The desirability of this combination of point contact on the outer race with line contact on the inner race was one of the conclusive results of the experimental work which preceded the development of this bearing. It should be observed that the line contact is provided on the inner race, which as is well known, is the weaker element on the typical type of annular bearing. The result is an excellent equalization of stress between the inner and outer races.

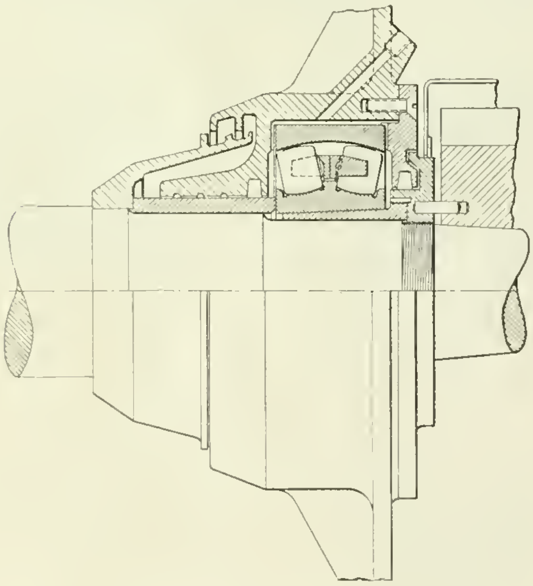


Fig. 2—Spherical Roller Bearing Applied to Motor Armature Shaft

Any type of bearing which aims to obtain line contact must provide some means for maintaining the parallelism of the axes of the rollers with the shaft. Otherwise the skewing of the rollers destroys the line contact and substitutes a very objectionable form of point contact. In the spherical type of roller bearing the axes of the rollers are held parallel with the axis of the shaft in a positive manner by means of the guiding flanges *ee* on the inner race. Referring to Fig. 1, it will be seen that both the flanges *ee* and the ends of the rollers are ground spherical surfaces, with their center at the point of intersection of the shaft axis and the axes of the rollers. Since the guiding flange and the roller ends have the same center and the same radius of curvature, they contact over an area shown at *g* in the end view. The arrows *a* and *b* which represent the resultant forces on the roller from the outer and inner races, respectively, are inclined to one another by a small angle. (The included angle of the cone circumscribing the roller.) This means that there is a wedging force holding the roller in contact with the guiding flange and developing the reaction *C* at the center of the area of contact with the guiding flange. As soon as a roller skews in the slightest degree there is no longer a contact area between the end of the roller and the guiding flange. The contact is then at a single point on the edge of the roller, and the force *C*, together with the resultant of the inner and outer race reactions *a* and *b*, forms a couple which immediately counteracts skewing tendency and returns the roller to its position of equilibrium. The rollers are maintained in a parallel relation with the shaft axis by this positive action, which provides in the design of the bearing itself, a stable equilibrium of the roller. The advantage of this provision is immediately reflected in the low coefficient of friction shown in tests of the bearing; this being somewhat greater than that of a ball bearing, but markedly lower than in other types of roller bearings.

The retainer *D* is carried on the land of the inner race and serves only to separate adjacent rollers and to prevent their contacting with one another. The retainer is usually made of bronze and is so designed that it holds the rollers from dropping out when the inner race is deflected relative to the outer race, as for cleaning.

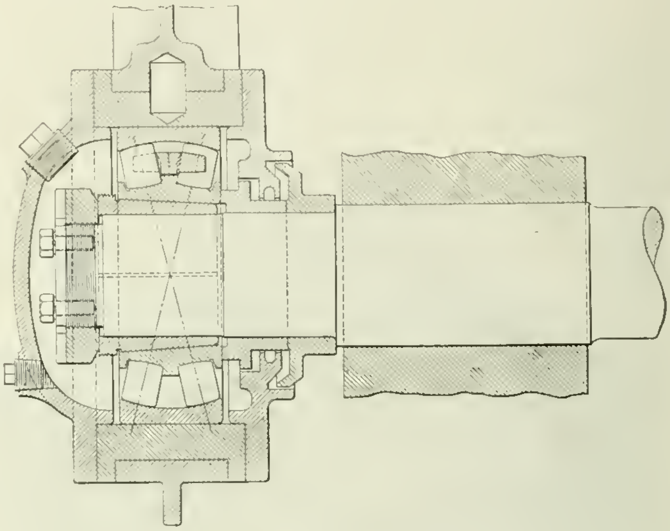


Fig. 3—Journal Box for Motor Rail Car Equipped with Spherical Roller Bearing

The spherical roller bearing, developed as it was to meet the requirements of a specialized field of heavy duty applications, has already found a wide demand. Some of the present installations and typical designs are shown in diagrams herewith.

Fig. 2 illustrates an electric railway motor with a spherical type roller bearing on the pinion end of the armature shaft. The inner race is secured to the shaft by means of a tapered sleeve. A ball bearing is used on the opposite end of the shaft where loads are comparatively light for the given space limitation.

Fig. 3 illustrates in principle the method of applying the spherical roller bearing to a motor rail car. Because of its self-alining quality the bearing is particularly well adapted to the construction employing a journal box clamped in the pedestal. An unrestrained mounting can be had by employing this bearing in the rigid box as shown. The advantages derived are immediately evident in the greater flexibility of the truck and the reduced stresses which are imposed upon the bearing.

Careful consideration has been given the means of securing the bearing to the journal so as to permit of easy installation and at the same time providing a positive locking of the bearing to the shaft. The tapered adapter sleeve together with the very substantial lock nut and key should appeal to the railroad man because of its extreme simplicity and absolute security.

The dust guard is specially designed to permit of proper functioning under conditions of misalinement between the box and journal. The conventional double lip and groove in conjunction with the internal flinger provide for the retention of the lubricant.

The spherical type of roller bearing is equally well adapted to trucks employing the standard types of pedestal construction. Such design insures flexibility in a greater degree than that now obtained in standard practice. It appears to offer a possible solution to the problem of providing a less rigid truck construction, particularly in the field of motor rail cars.

Attention is directed to the provisions for excluding dust and dirt from the housing and for prevention of leakage of the lubricant. The latter consideration is of particular importance in the motor mounting shown in Fig. 2.

It is believed from the experience had with the operation of this type of bearing to date, that its field of application will be broadened beyond the scope originally contemplated in the design of the bearing. This applies particularly as regards the speed rating. It has further been found that, in equivalent sizes the spherical roller bearing has about twice the load capacity of the corresponding ball bearing. The thrust capacity of the bearing is substantial, making it well adapted to the carrying of combined loads.

The question of lubrication is very similar to that incurred with ball bearings under similar load and speed conditions. Oil is considered preferable, but grease may be used where conditions of design require. The saving in amount of lubricant required as compared with plain bearings is precisely the same as with ball bearings.

The housing construction and the provision of suitable seals to exclude dirt and water from the bearings is the same as in the standard practice with ball and roller bearings.

The spherical roller bearing was originally developed and applied in Sweden. Since that time bearings have been installed in the United States, England, France and a number of other countries. The installations that are in service have shown conclusively that this bearing meets an imperative need and is well adapted to the requirements of heavy duty service.

The self-contained and self-alining feature of the spherical roller bearing, together with its exceptionally low coefficient of friction and rugged load carrying capacity, characterizes it as a distinct advance in the development of anti-friction bearing. It offers possibilities that conform with the progressive principles of modern engineering practice.

Kiln Drying of Lumber*

By F. O. Farey

Chief Chemist, Robert W. Hunt Company, Montreal

THE types of kiln in most general use are the compartment kiln for uniformly drying a complete charge, in which the circulation of air is up in the center and down and out at the sides, and the progressive kiln, in which the movement of the lumber and the circulation of air is from one end to the other.

Operation of Kilns

The results obtained depend on the ability, judgment and care of the operator. One of the essential points is the way lumber is piled. Proper utilization of available space and proper circulation of air are essential. You must not pile lumber in a progressive kiln the same as in a compartment kiln. For the compartment kiln lumber must be piled endwise so that the stickers will not obstruct the circulation and form cool pockets. If this passage is obstructed the lumber at these points will dry more slowly and you will have a variable product, not only in moisture content but in checking, internal stresses, and warping, both in and after removal from the kiln. The natural passage of the air is originally vertical between the piles and then laterally between the boards to the sides and vent holes. If stickers block this passage it is almost impossible to get a circulation between the boards. For the progressive kiln, conditions are reversed. Cross piling is also essential so that the stickers will not obstruct the passage of air as it progresses from one end of the kiln to the other. An example is given of two piles in the same kiln having vertical-lateral circulation. On the eighth day when the temperature should have been fairly uniform the thermometer readings were as follows:

	Cross piled lumber	End piled lumber
Center of pile	100 deg. F.	142 deg. F.
Underneath	168 deg. F.	152 deg. F.
Above	146 deg. F.	146 deg. F.

The difference in temperature between the center and bottom of cross piled lumber was 58 deg. F., while the difference in end piled lumber was 10 deg. F. The end piled stock dried in 10 days from 30 per cent moisture to 6 per cent, while the cross piled stock took 13 days to dry from 30 per cent to 12 per cent. In a kiln with end to end circulation the reverse conditions would have been true. It is obvious that lumber should be piled to suit the circulation of the kiln with a view to give the best passage of air through the pile and maintain all parts at as nearly the same temperature as possible. This can only be done by using judgment and carrying on such experiments as will prove or disprove the correctness of that judgment. Not only must consideration be given to the direction of piling and placement of the stickers, but the size of each pile and the thickness of the stickers. Stickers should not be less than 1 in. thick and increased to not less than 2 in. when the thickness of the lumber is 3 in. or greater.

Test Apparatus

The best method of testing the circulation of air in a kiln is to make some kind of smoke cloud. The Forest Products Laboratories at Madison have devised a chemical smoke which eliminates fire risk and which follows the natural air currents with no tendency of its own to rise or fall, which is the objection to some other smoke clouds.

While the smoke cloud is a valuable means of determining circulation, it is not all that we are required to know about what is going on in the kiln. We must, at all times, know the temperature and humidities not only at each end, but inside and near the lumber piles themselves. This requires the use of thermometers and hygrometers of various types. Probably the best of these are the glass thermometers and the wet and dry bulb hygrometers. It is, however, difficult to use them, since no one would care to enter a dry kiln two or three times a day when some of the higher temperatures are reached. This can be overcome by the use of recording thermometers and hygrometers. The recording instruments must be continually checked against wet and dry bulb glass instruments of known accuracy.

No operator should hesitate to ask for necessary instruments, which will enlarge or facilitate his knowledge of what is going on in the drying chamber, and then to ask for such means as may be necessary for the rectification of unsatisfactory conditions. It may cost a few dollars to properly equip a kiln, but any management which takes unnecessary chances with thousands of dollars' worth of lumber is exercising a short-sighted policy.

Drying Schedules

The question is continually asked as to the proper drying schedule for a certain kind of lumber, whether one wood is easier to dry than others, what temperatures to use and how can lumber be dried in a shorter period of time. It is easier to dry some kinds of wood than others. Lumber will dry faster in thin sections, since the distance through which moisture must transfuse from the interior is less. Also certain woods, such as many of the so-called soft woods, allow the transfusion to proceed at greater speed. Relative densities of the same species, relative proportion of spring and summer wood, also the direction of the grain in the sawed timber affect the time and treatment.

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*Abstract of a paper presented before the Canadian Railway Club, January 9, 1923.

Much depends on the judgment of the operator after he has examined the material. He should know the approximate moisture content. This cannot be determined by feeling. The only reliable way is to cut off a section at least 2 ft. from the end and determine the moisture content by drying and weighing. A cross sectional sample is usually sufficient, but at times it is necessary to know whether the moisture is the same on the inside and outside of the section. Also at times it is necessary to know whether there are internal strains, even though the moisture may be uniform and no surface checks are noticed. These strains are set up in air drying as well as in kiln drying and unless stresses are relieved by steaming you will, in all probability, increase the defects which already existed at the beginning.

The term "steaming" does not necessarily mean filling the chamber with a cloud of steam, which will condense and give a wet surface to the wood, but increasing the relative humidity to 95 or 100 per cent at the kiln temperature.

Even in the same batch of lumber there will be a wide variation. Some will show higher moisture than others, some will show checks and internal stresses, while other portions will be normal. A sufficient number of tests must be made to know the worst condition. The kiln should then be operated to suit the conditions of the poorest lumber. An operator must know how each charge must be handled and how good he wishes the product. You would not treat rough lumber for some construction with the same respect as you would lumber for furniture.

When the original condition is known the operator must then decide what treatment must be given. It is not possible to give hard and fast schedules for any given lumber. A quite extensive series of schedules, however, have been worked out by the Forest Products Laboratories at Madison, Wisconsin, and given in Technical Note, No. 175, under the heading of hard wood and soft wood drying schedules. This is valuable as a guide since one is often called upon to treat wood different from the kind usually handled. Differences in equipment and the way in which the wood responds to treatment will tell the experienced operator how and when these schedules may be modified.

Without giving these methods in detail, it may be stated that the treatment of soft wood is divided into three general schedules, each modified into three or four subdivisions depending on the kind of wood and the thickness of the sections and original moisture. The initial temperature for the most severe treatment varies from 180 to 200 deg. F., and a relative humidity from 85 to 30 per cent, depending on the original moisture content, down to the mildest treatment having an initial temperature of 135 deg. F. and 85 per cent humidity. The temperature is raised in this schedule to 175 deg. F. and the humidity is lowered to 30 per cent as drying progresses. The hard wood schedules are divided into eight divisions. The most severe treatment compares closely with the mildest soft wood treatment for basswood and birch up to 1½ in. thickness down to the mildest treatment where the initial temperature of 105 deg. F. and relative humidity 85 per cent and a final temperature of 135 deg. F. and a relative humidity of 40 per cent as drying progresses, the latter schedule being applied for certain Southern lowland oaks of 1½ in. thickness.

From green timber with high moisture content down to a content of about 25 to 30 per cent, based on oven dry weight, the greatest care is required. This is what is known as the fiber saturation point. Above this, water exists in the cells in a free condition and must be eliminated slowly and uniformly. Below this percentage the water is combined with the fibers, and drying usually may be somewhat hastened.

No shrinkage occurs above the fiber saturation point, water being evaporated from the outside sections without change in volume. As soon as there is a difference in water content a gradual transfusion takes place from the inner sections. This proceeds until the outside fibers contain moisture below the fiber saturation. Then shrinkage starts around the outer portions but does not yet start in the inside. Thus you have an outside area trying to reduce its volume, but prevented by a resistant interior. One of two things is bound to happen when this condition exists, either the tension will become so great on the outer fibers that they are no longer able to stand the strain, and the wood starts to check or these outer fibers will take a set in an expanded condition, allow the passage of water from the interior to pass through them and finally completely dry out themselves without taking their normal shrinkage. The interior sections as they lose their moisture below the fiber saturation point tend to shrink. Here there are two opposing forces at work. The innermost zones still have their original volume and are under pressure and the intermediate zone is in tension as occurred in the outer fibers originally. One of three things may now happen. If the outer fibers had started to check, the probabilities are that the intermediate section will check in the same place, since at that point there is no fibrous bond between the intermediate and outer zones. If the surface had set in an expanded condition one of two things may happen. The fibrous bond with the outer portion may be sufficient to hold the interior to the same volume and the whole section dry and set in an expanded condition. This may or may not be given the term "case-hardened." If the fibers of every zone have set uniformly throughout it is not called "case hardening" but simply a set in an expanded condition. If, however, the setting or shrinkage has not been uniform when the moisture content throughout the section is the same, and there are set stresses existing throughout the different zones, the condition is called "case-hardening." If these internal stresses exist to a sufficient extent due to internal shrinkage, and the fibers are not strong enough to withstand the tension put upon them, either the annular rings will separate, producing "shakes" or checking will proceed radially, giving a honeycombed condition.

There is no visible means of detecting wood set in an expanded condition, but after the lumber has been taken from the kiln and the fibers begin to take up moisture from the air, the set and set stresses are relieved at first on the outside, setting up other stresses of a reverse nature. These outer zones are now in a condition to shrink in their normal course when allowed to dry again. This will cause checking and warping. If, however, the lumber which has set in an expanded condition is allowed to pick up moisture throughout the whole section all set and set stresses are relieved and the whole board or timber will be in a condition to shrink normally, as it would have done if the drying had been properly carried out. One is thus liable to have a large shrinkage in a section when the moisture content was relatively low as it came from the kiln.

The moisture content is not a criterion of future shrinkage, nor is the shrinkage obtained in the usual tests made immediately upon removal from the kiln a direct index of the shrinkage which may occur when the lumber is put into service.

In the drying schedules suggested by the research work at Madison, the initial humidities range from 80 to 85 per cent, which, at the usual temperatures, gives a condition which will prevent the outside fibers from drying below 15 to 20 per cent. In view of the fact that moisture is being transfused from the interior, the moisture in the outside areas is maintained at or about the point at which shrinkage occurs and the speed of the evaporation for different woods is regulated by the temperature. As the 25 per cent saturation point is approached for the entire stock, the outside areas dry further and begin to shrink. Here is where trouble is liable to occur, either from checking or case-hardening. Here the contents of the kiln must be watched to observe how the wood is reacting, and it is desirable to remove samples and test as described later.

At the sign of checking, hollowing, or pinching of surfaces or internal stresses as determined by test, measures must be taken to counteract the action. Surface areas must be allowed to take up moisture to relieve strains by increasing the atmospheric humidity. Introduction of steam in sufficient quantities is the usual method, and where the moisture content of the wood is relatively high, say around 15 per cent, humidity is increased to 100 per cent from one-half hour to several hours, depending on the extent of the trouble. Not more than six hours for each inch thickness of timber is practically certain to relieve the most severe conditions. Temperature is often raised 20 to 30 deg. during the steaming and, if so, care should be taken to allow the kiln and stock to cool to the drying temperature before materially lowering the general humidity.

Steaming should be resorted to any time danger appears and may be required several times during the period of drying. It also raises the temperature of the interior of the timber, thus allowing a more rapid transfusion of moisture, but unnecessary steaming or over steaming may do more damage than good by working the wood and slowing the process.

Timber should be examined before it goes into the kiln, not only for moisture content, but for checking and casehardening conditions when received. In this case steaming is the only remedy to relieve initial stresses. Also mouldy conditions may exist or mould may develop in the kiln under low temperature and high humidities. This mould may be killed by steaming at 170 to 180 deg. F., for not more than an hour and maintaining a 100 per cent humidity with live steam. The quicker the temperature is brought up the better, as it is not desirable to heat the interior of the timber more than necessary, and it is essential for the kiln to cool to drying temperatures in nearly saturated atmosphere.

Some steaming may be resorted to at the end of the drying process, especially if tests show that there are stresses existing and interior moisture above 7 per cent.

In all steaming or conditioning processes the kiln and lumber must be cooled to operating temperatures and humidity conditions high enough to prevent drying must be maintained during cooling.

A reduction of time of drying can only be accomplished by vigilance and an exact knowledge of all conditions, at all times.

A superheated steam process which will dry lumber from the green state to 10 per cent moisture in 24 hours or less has been worked out at Madison for some lumber, such as firs, Western hemlock, Western and Southern yellow pine. This is carried on by forcing superheated steam at high velocity in alternate directions through the kiln. This consumes more steam than the older process and temperatures must not be maintained for more than two or three days.

The writer has been asked if any special processes had been developed for drying oak timbers. There are schedules for oak up to 2 in., or 3 in. in thickness, and there is no reason to doubt that much larger sections could be treated with equipment where all conditions of temperature and humidity are under perfect control. However, some types of oak are very difficult to handle, and it depends on whether the results obtained are worth the possible loss, time, trouble and cost of treating this timber.

There have been questions as to whether the kiln dried lumber is equal to air seasoned lumber. Lumber in general is just as good if properly kiln dried as if air seasoned; it should be better, because in the kiln all factors can be kept under control, whereas in air the temperature and relative humidity are beyond control and may vary decidedly from time to time.

There is a feature in connection with kiln drying in which most of you are more or less directly interested—to what extent should the drying process be carried and what moisture should be left in the wood when used for various purposes?

The final moisture content of wood is a function of the temperature and the relative humidity of the atmosphere to which it is exposed. If too wet it will dry out and shrink. If too dry it will take up moisture and expand. The relative humidity has far more effect than the temperature, but this is often affected by a change in temperature.

All moisture results should be based on percentage of water to the basis of the dried samples, and not as it is often calculated on the basis of the sample received. This practice has been adopted by technical experts and will undoubtedly come into universal practice. For instance, a sample weighing 6 lb. dries to 4 lb. Instead of dividing the loss by six it is divided by four (the dry weight) giving 50 per cent moisture.

Since no data of the moisture content of lumber taken from cars or old buildings, seemed to be available, numerous samples were taken from different parts of cars under repair at Montreal, and samples of wood which had been stored in heated buildings. The results obtained should not be considered as conclusive for other places, or periods, but are given as an idea of what experimental work should be undertaken by individuals interested in wood construction.

That they may be better understood, these results are reported both on the basis of the samples as received and on the oven dry weight:

	Per cent moisture on basis of original sample			Per cent moisture on basis of dry sample		
	Max.	Min.	Av.	Max.	Min.	Av.
Car sheathing and lining	12.8	9.8	10.7	14.6	10.9	12.0
Decking (car)	18.3	11.0	13.8	22.4	12.2	16.1
Roofing (car)	28.7	9.6	18.9	40.6	10.5	24.3
Car frame timbers	14.0	10.0	11.9	16.6	11.0	13.5
Wood stored in heated building	6.7	5.4	6.2	7.2	5.8	6.6

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Indian Creek, Pa., (Allegheny Mountains) on the Baltimore & Ohio

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Per Diem When Repairs Do Not Conform to Rule 120

Under date of September 22, 1920, the Pittsburgh, Shawmut & Northern submitted an inspection report and asked for disposition of the Seaboard Air Line steel hopper car No. 30344, under Rule 120. The cost of repairs shown on the inspection report was $500 labor and $550 material. The owner authorized repairs according to original construction, on October 12, 1920, and the car was returned to service on December 1, 1920. On May 7, 1921, however, the car was received on the Seaboard Air Line and an inspection developed the fact that the repairs authorized as shown on the inspection certificate had not been made. The bill rendered by the Pittsburgh, Shawmut & Northern covered a total cost of repairs, including both labor and material, of $176.83. Inasmuch as the minimum expenditure for labor to bring the car under the provisions of Rule 120 is $180, the owner contends that the Pittsburgh, Shawmut & Northern should make settlement for the per diem according to paragraph b, Rule 8, of the per diem rules. The Pittsburgh, Shawmut & Northern considered that it was proper to report the car under Rule 120 and that dismantling would have been the proper disposition. To this, however, the owner would not agree. The Pittsburgh, Shawmut & Northern was not equipped to rebuild the car and contends that it should not be penalized for per diem while waiting for disposition from the owner or because of its inability to make the heavy repairs required under Rule 120.

The decision of the committee confirms the contention of the owner that inasmuch as the labor cost of repairs was less than the limit prescribed in Rule 120 and partial repairs were not authorized, the car as repaired would not be subject to Rule 120.—*Case No.* 1237, *Seaboard Air Line vs. Pittsburgh, Shawmut & Northern.*

Handling Line Responsible for Damage Caused by Lack of Precaution in Coupling to Train

On January 8, 1922, the underframe of Central of Georgia box car No. 26132 was broken in two over the transom and the car otherwise damaged, in a Wabash freight train while the locomotive was coupling onto the train. In setting out this car, which was the seventh from the locomotive, a main line frog was damaged. No other cars in the train were damaged and it proceeded after setting out the Central of Georgia car. The car was reported by the owner to be 14½ years old. The Wabash requested disposition under Rule 120, claiming that the car was not derailed, cornered or sideswiped at the time of the accident. In complying with the request of the owner for information concerning the circumstances surrounding the damage, photographs were submitted which indicated that the car had been derailed, one of the trucks knocked off center and placed inside the car. The Central of Georgia therefore refused settlement under Rule 120. The photographs, the Wabash contends, show the condition of the car on a siding several months after the accident. The Wabash was unable to state, however, at what speed the locomotive was moving at the time of the accident, but maintained that it was moving slowly. The engine was reported to be moving backwards without signal, the head brakeman catching the front end of the locomotive and riding with it until the accident occurred.

The following decision was rendered by the Arbitration Committee: "The evidence is not conclusive that one end of the car was down on rail or ground as a result of the impact.

"It is evident, however, that in backing up with locomotive, there was no one in position to give proper signal. Therefore, handling line is responsible as per Rule 32, section (d), items (2) and (4)."—*Case No.* 1246, *Central of Georgia vs. Wabash.*

Responsibility for Missing Air Hose—Car Not Offered in Interchange

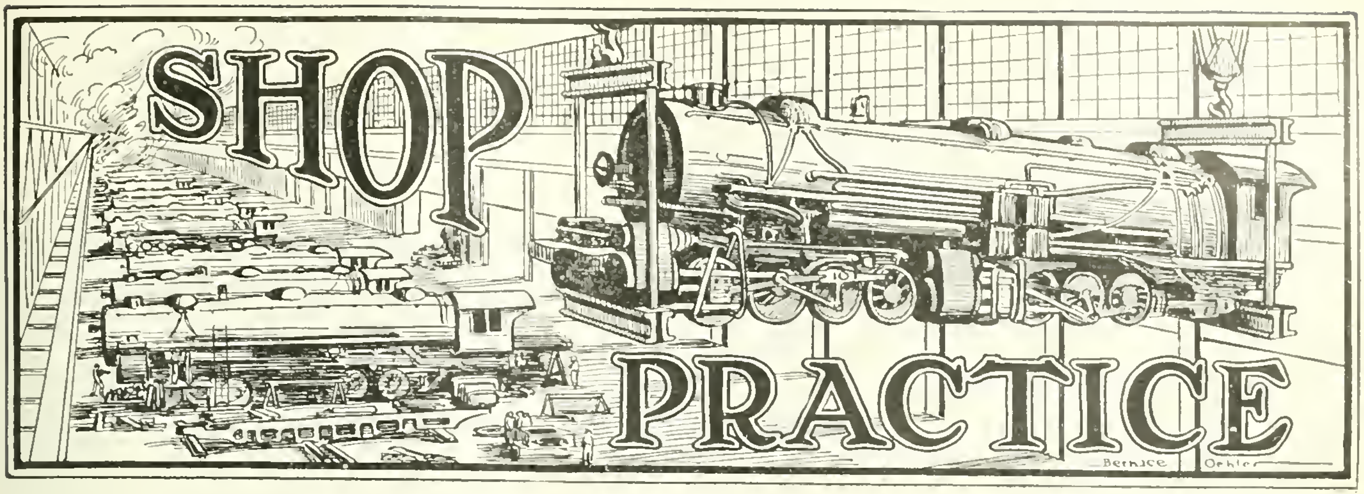
On September 1, 1920, the Chicago Junction replaced a missing air hose and angle cock on Sand Springs Railway car No. 406, billing the owner for $3.25. The owner took exception to the charge, claiming that the hose and angle cock missing is a delivering company responsibility under interchange Rule 58, notwithstanding the fact that repairs were made before the car was delivered in interchange. The hose and angle cock were lost or stolen between the time the car was received by the Chicago Junction and placed for loading at an industry on its line and when it was received loaded from the industry in the transportation yard. The repairs were then made and the car delivered to the Atchison, Topeka & Santa Fe. The Chicago Junction contends that there is no record of the hose and angle cock being stolen while the car was in its possession, that it was not delivered in interchange with these parts missing, and that under Rule 43, the owner is responsible.

The Arbitration Committee decision states that: "The car was not interchanged with the air hose and angle cock missing; therefore, Rule 58 does not apply. The car owner is responsible under Rule 43."—*Case No.* 1240, *Chicago Junction vs. Sand Springs Railway.*

Repair Card the Basis of Decision in Claim for Wrong Repairs

On November 14, 1920, at its shops at Port Arthur, Tex., the Texas Company obtained joint evidence showing that the A end of its car T.C.X. No. 1261 was equipped with a Sharon coupler having a 5-in. by 5-in. shank with a 6½-in. butt. The Texas Company maintained that the car was equipped at both ends with standard 5-in. by 7-in. by 6½-in. couplers when the car left Port Neches on October 14 for a trip during which it moved only over the lines of the Kansas City Southern and the St. Louis-San Francisco. During this trip, on October 22, 1920, the Kansas City Southern made repairs and billed for the replacement of a broken coupler yoke and cast steel carrier iron. The St. Louis-San Francisco made no repairs to the car during this trip. The Texas Company maintained that the standard coupler must have been replaced with one having the smaller shank when these repairs were made on the Kansas City Southern, and in support of this view called attention to the common practice of replacing a coupler removed from a car with another to which a yoke had already been riveted. The Kansas City Southern maintained that at the point where the repairs were made it has a blacksmith and that the new yoke was applied to the coupler which was removed from the car and that therefore it was not responsible for wrong repairs.

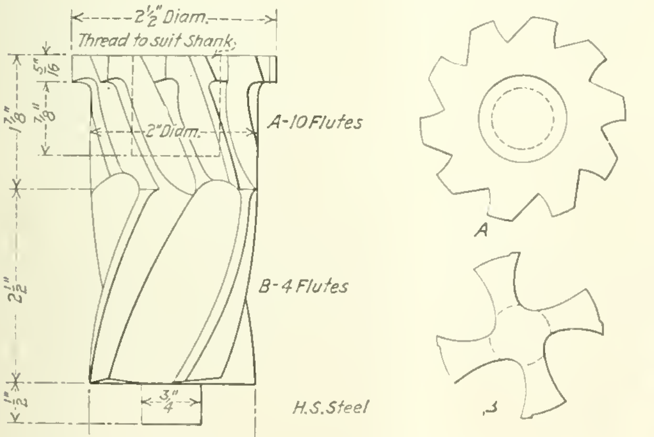
The Arbitration Committee decided that: "The billing repair card of the Kansas City Southern does not show the coupler to have been applied; therefore the Kansas City Southern is not responsible. Case 1208 is parallel."—*Case No.* 1244, *Kansas City Southern vs. The Texas Company.*



Cutting and Reaming Boiler Tube Sheet Holes

By George Bexton
Tool Foreman, Grand Trunk Shops, Stratford, Ont.

FOR rapid and smooth cutting of boiler tube sheet holes, the combination cutter and reamer illustrated has been found very satisfactory. It reduces costs and speeds up the work. Previous to the development of this tool cutting was done in two operations. All the tube holes were cut out to within 1/64 in. of the size required, by a tool similar to the cutter illustrated at *B*. Then the tool was changed to a reamer similar to *A*. This made it necessary to set each hole twice, whereas by combining *A* and *B* in one tool the job could be done in one operation. Cutter *B* is fed by the machine until it has cut through the plate, the feed being released and reamer *A* finishing the job, being fed by hand since this is quicker than machine feed.



Combination Cutter and Reamer Saves Time on Tube Sheet Holes

The tool, illustrated, is made of Double Mushet high-speed steel. Cutting section *B* has 4 flutes with a spiral of 1 in. in 12 in. right-hand, giving the cutter a rapid cutting action. The reaming section *A* is cut 10 flutes, left-hand spiral to prevent the reamer from seizing and leaving a rough hole. The reamer has a recess ¼ in. wide and 1/16 in. deep between *A* and *B* to allow any cuttings to escape from the cutting section. Section *A* has a taper of 3 in. in 12 in. for a distance of 7/16 in. and then paralleled cutting edges ⅞ in. long to finish the hole to the correct size. A round filleted shoulder at the top removes the sharp edges of the tube sheet holes and prevents the copper ferrules from being cut in the process of beading or expanding. The tool is detachable from its spindle which is turned down to 1 1/16 in. in diameter and threaded 12 threads per inch. This threaded end of the spindle turns into the threaded cavity in the cutter. The use of a heavy oil on the threads enables cutters to be readily removed so that the operator may use any number of cutters on one spindle. The spindle is made with a No. 5 Morse taper shank.

Angularities in Young Valve Gear

By Harry Cornell
Louisville, Ky.

THE difference in the elevation of the center lines of cylinders and driving wheels introduces a unique and interesting angularity in the Young valve gear, as the following resume of the gear shows. Referring to Fig. 1, the gear is shown with the link blocks in mid position, the left crosshead pin P_1 being at the forward extremity of its travel while the right crosshead pin P is a little distance back of the mid point of its travel due to the oblique position of the right main rod.

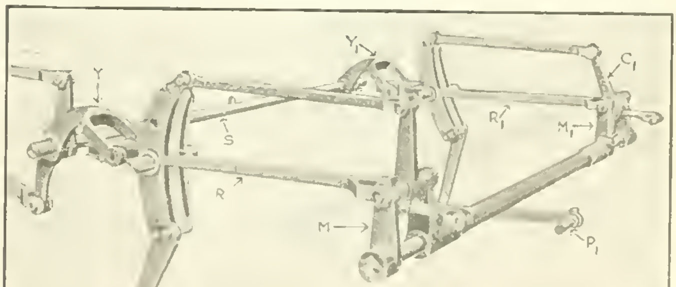


Fig. 1—Young Locomotive Valve Gear with Link Blocks in Mid Position

As Fig. 1 represents a gear for a locomotive wherein the right crank leads the left crank 90 deg., assuming the cranks to be moving clockwise, the back end of the right radius rod R is positioned above the center of oscillation of the right link while the back end of the left radius rod R_1 is below the center of oscillation of the left link, and these relative positions of the radius rods are possible because the bell crank Y is a free working fit on the reverse shaft S while the arm Y_1 is keyed to the reverse shaft.

As the arrangement shown in Fig. 1 is for actuating piston valves with inside admission, the left combination lever C_1 is shown in position appropriate to having caused the left valve to move from its mid position a distance equal to the steam lap, plus the steam lead for the front port of left cylinder. It is evident that the motion of one valve in addition to lap and lead is derived from the crosshead on the opposite side of the engine through the medium of two rockers, M and M_1, keyed to the same shaft.

Fig. 2, which shows in skeleton form the constituent elements of the Young valve gear in different positions and which was constructed on the assumption that the axis of the cylinder and the center of the driving wheel are at a common level, shows three positions V of the combination lever; the full heavy line for front dead center, the dash line for back dead center, and at the light full line for neutral position of the valve. (In Fig. 2, those parts of the gear found on the right side of the engine are indicated by heavy lines while the light lines indicate those on the left side.) The union link, indicated in three positions as 111, is of a length equal to the distance FG and is common to the two sides of the engine when the centers of the cylinder and driving wheel are at the same level.

On American locomotives, as a rule, the cylinder center line is higher than the center line of the driving wheels, frequently as much as 4 in. The distance, indicated in Fig. 2 as main rod error, is not, therefore, the same on the two sides of the locomotive. The union link, designated as 111 in Fig. 2, has a greater length on the left side than on the right for the reason that with the engine moving ahead, the crank moves through less than 180 deg. as the piston and crosshead move from the front dead center to the back dead center and more than 180 deg. as the piston and crosshead move from the back dead center to the front dead center. From this cause we find in effect that when the left crosshead and crank are on the front dead center, the right crosshead is farther back of mid-stroke position than is the left crosshead when the right crosshead is on the back dead center.

This simply means that the distance from F, which indicates the foot of the link with the latter in central position, to G, the position of the crosshead pin, is greater on the left side of the engine than on the right side. Consequently, we must assign to the two union links two different proportions; i.e., assign to the left union link a greater length than to the right union link.

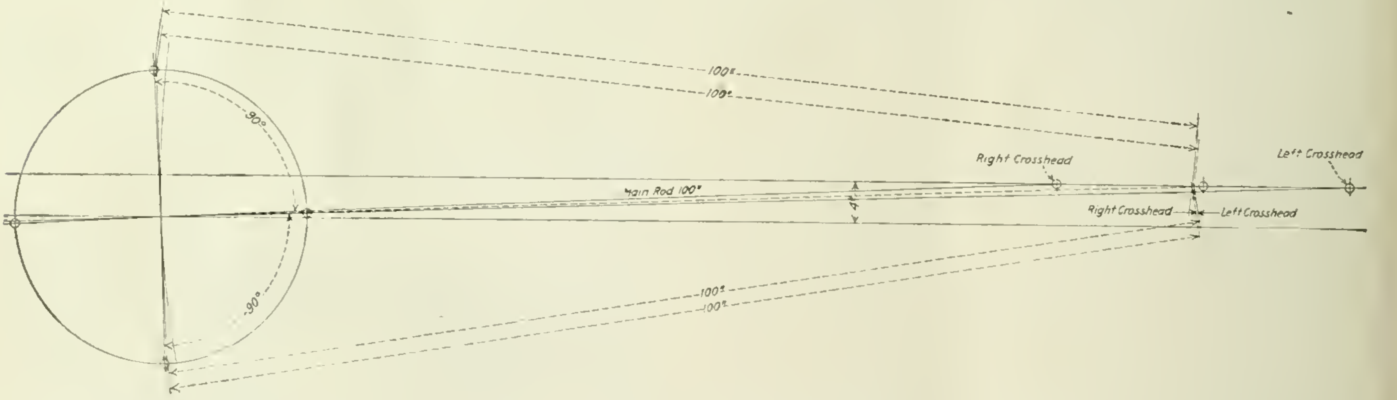


Fig. 3—Drawing Showing Irregularity Under Extreme Conditions With Main Rod Only 100 In. Long and Cylinder Centers 4 In. Above Driving Wheel Centers

The crank and crosshead diagram, illustrated in Fig. 3, is furnished by the courtesy of O. W. Young and will aid in visualizing the facts mentioned in the immediately preceding paragraphs. Referring to Fig. 3 it should be noted that with the left crosshead at the position for forward dead center, the right crosshead is about ⅛ in. further back from its central position than is the left crosshead when the right crosshead is at position for back dead center. In other words the error in crosshead position is about ⅛ in. under extreme conditions.

* * *

Editor's Note.—These irregularities in the Young valve gear, while of interest in connection with valve setting, are so slight as to be practically negligible, according to O. W. Young, designer of the gear, provided wheel centers are taken as directed. These directions provide for taking each wheel center by locating the opposite crosshead the specified amount (dependent on main rod angularity) back of mid stroke. Concerning this subject, Mr. Young has the following to say: "If, as is usual, the center line of the cylinders is somewhat higher than the center line of driving axles, and dead centers are taken on the wheels, as is customary, then in order to obtain absolutely constant lead for all cut-offs, forward and backward motions, the union link would need to be of different lengths for front and back dead centers, which is a mechanical impossibility.

"If the center line of cylinders were 8 in. or 10 in. higher than the center line of driving axles, it would be difficult to so proportion the union links as to produce symmetrical valve movement, particularly in lead openings, but because the cylinder center line is usually only from 1 in. to 3 in. higher than the center line of driving axles, the union link can be adjusted for length to suit either front or back dead wheel center, without causing an appreciable error in valve movement beyond slight irregularity in lead at one port.

"If the union link length is determined by taking wheel centers according to directions, errors in lead are too slight to be measurable unless the differences in height between center lines of cylinders and driving axles exceed 4 in."

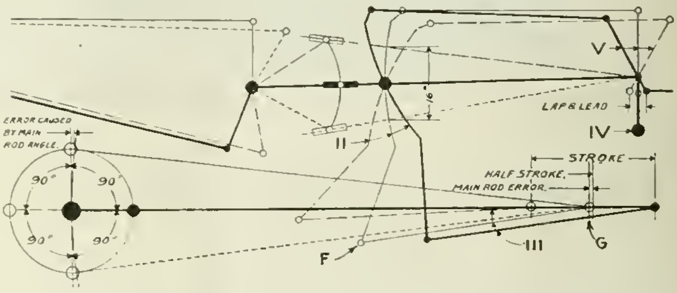
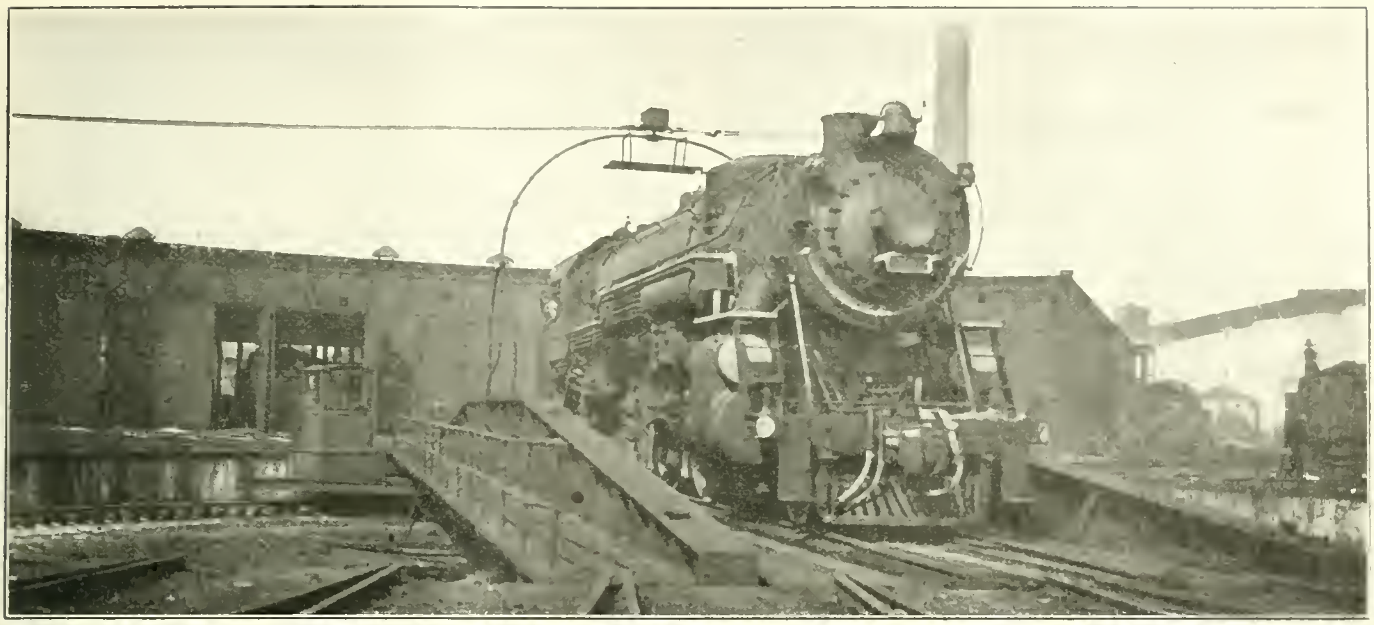


Fig. 2—Diagram in Which Heavy Lines Show Right, and Light Lines Left, Side of Young Valve Gear



Electrical Turntable Drive, Insures Ample Power and Reliability

A Mechanical Man's Views on Engine Terminal Design and Operation*

By L. K. Silcox

General Superintendent of Motive Power, Chicago, Milwaukee & St. Paul, Chicago

FROM the statistics compiled for all railroads in the United States, it has been determined that in every 24 hours, the average serviceable locomotive is used a little less than 8 hours in actual road service. This figure gives no consideration to the fact that the average annual locomotive service days range from 300 to 330 days out of the 365 days of the year, or only about 80 per cent. Therefore, of the total complement of locomotives owned, approximately 80 per cent are serviceable throughout the year and of the 80 per cent serviceable, only 33⅓ per cent of the actual hours in service are utilized so that the net amount of service obtained is only approximately 28 per cent of the total.

Therefore, since the engine is in service an average of only eight hours out of each 24, the inference is that the remaining 16 hours are consumed at the terminals in conditioning the engine for another trip and holding it awaiting call. It would appear that these 16 hours represent a tremendous waste of time and that earnest endeavor should be made to recover it for revenue service. However, consideration should be given to the fact that a certain amount of this time is absolutely necessary to prepare the engine for service.

Four Operations to Be Considered

The circular chart shows the distribution of the 24 hours of the average serviceable locomotive day. From reports of enginehouse performance, it has been determined that the average serviceable locomotive is turned approximately 1.4 times in every 24 hours from which information, it can be assumed that the average time required to turn an engine is about 11½ hours. For this reason the 16 hours of terminal detentions have been divided on the chart and 11½ hours indicated as representing one complete engine turning with the remaining 4½ hours considered as a portion of the next turning. An analysis of the various operations constituting an engine turning in the usual sequence of their occurrence indicates a grouping into four main divisions. These divisions, with the average approximate time element of each, are as follows:

Movement of the engine from the train to the engine terminal	¾	hour
Roundhouse care and ordinary repairs	8	hours
Extraordinary repairs and awaiting call	2	hours
Movement from outbound track to train	¾	hour

The first division represents the time consumed in releasing the engine from road service and in delivering it to the engine terminal, or in other words, what is usually termed outside hostling. The time element of this division is a function of the terminal layout and will depend upon the relative location of the engine terminal with respect to the train yard and the track arrangement leading into the engine terminal.

The several operations constituting the second division, when taken in their usual sequence average approximately as follows:

A.—Removing supplies, outside inspection, and knocking fires	1	hour
B.—Movement from cinder pit into roundhouse stall	¼	hour
C.—Inspecting, repairing, cooling down, and washing boilers and tanks	2½	hours
D.—Wiping, completing repairs and filling boilers	2½	hours
E.—Building fires and steaming up	1	hour
F.—Movement from roundhouse to outbound track, taking coal, water, sand, and supplies en route	¾	hour
Total	8	hours

The third division is necessary to provide a period for overlapping to take care of extra repairs and to compensate for slow operations at points where sufficient facilities are not available for the prompt turning of power. It also allows for the margin of time between when the engine is ready and when actually put into service. This division, therefore, bears a joint responsibility of the mechanical and transportation departments, as these detentions are the function of the speed of terminal performance and the utilization of power.

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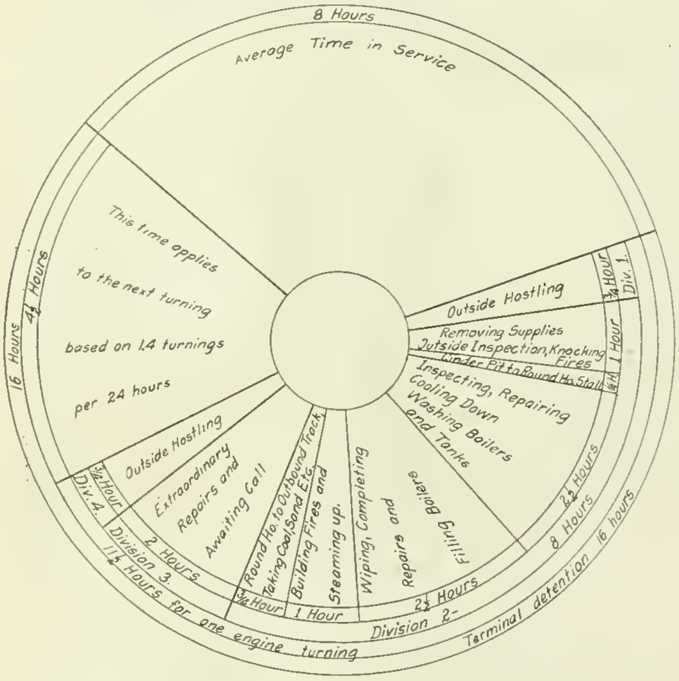
*From a paper presented March 13, 1923, before the Western Society of Engineers, Chicago, Ill.

The fourth division represents approximately the average time consumed in handling the engine by the engine crew or an outside hostler from the engine terminal to the train yard after the engine has received coal, water, sand, and supplies. As with the first division, the time element of this is also dependent upon the location of the terminal and the track layout leading from the terminal to the yard.

Thus a medium of measure is established for comparison. However, it cannot be applied literally, for it represents a collective result and should be made by grouping terminals either by divisions or districts. This becomes apparent when considering supplementary roundhouses where no machine shop facilities are available as against the major terminal which is well-equipped for making heavy repairs. The former merely constitutes a turn around point where the engine is turned and provisioned, while at the latter, the attention received will be more extensive and will include repairs so that it would not be fair to compare the one with the other merely on the time element basis. The combined result of the two, however, could be compared equitably with the results as indicated on the chart.


8 Hours
Average Time in Service
This time applies to the next turning based on 1.4 turnings per 24 hours
16 Hours
4½ Hours
Outside Hostling
¾ Hour
Div. 1.
Removing Supplies
Outside Inspection, Knocking Fires
Cinder Pit to Round Ho. Stall
1 Hour
¼ H.
Inspecting, Repairing Cooling Down Washing Boilers and Tanks
Wiping, Completing Repairs and Filling Boilers
2½ Hours
2½ Hours
8 Hours
Division 2-
Terminal detention 16 hours
Steaming up.
Building Fires and
1 Hour
Round Ho. to Outbound Track Taking Coal, Sand Etc.
½ Hour
Extraordinary Repairs and Awaiting Call
2 Hours
Division 3.
Outside Hostling
¾ Hour
Div. 4.
11½ Hours for one engine turning

Distribution of the 24 Hours of the Day for the Average Serviceable Locomotive

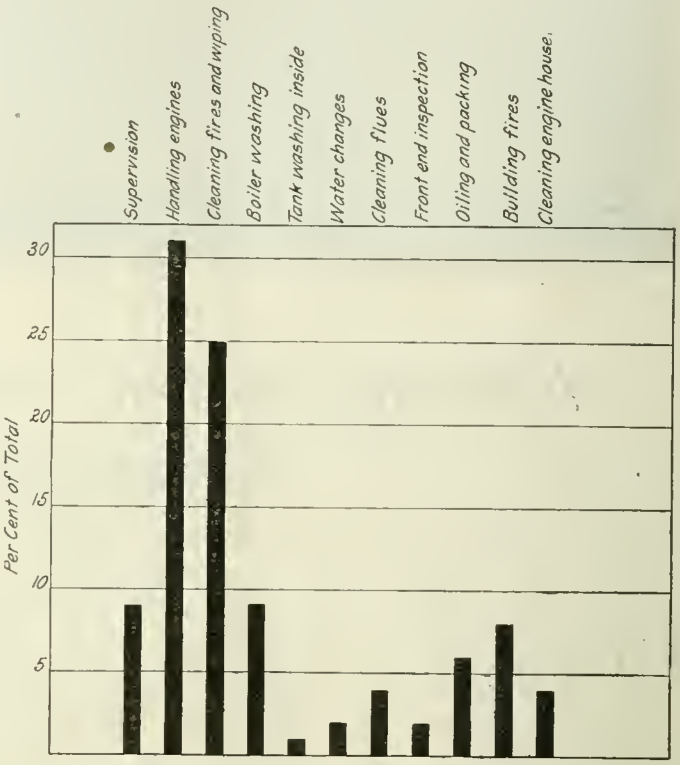
There are four fundamental factors relating to the proportion of time in service and out of service:

1. Mileage and time between terminals.
2. Demand for power.
3. Terminal layout and the location with relation to the train yard.
4. Facilities for conditioning engines for service.

Length of Engine District a Factor

From observations made of the performance on various railroads, especially when making a study of enginehouse expense, it appears that there are various basic elements which affect such performance, among which can be considered the average miles between engine terminals. A study of eight carriers reveals that the average distance between terminals ranges from 57 to 114 miles. It is found that each cost varies inversely with the miles between the terminals. In other words, the greater the distance between terminals, the less is the cost of turning engines per train mile. Too much stress cannot be placed upon the location and spacing of engine terminals. In the spacing terminals, however, consideration should be given to mileage and time as affecting the scheduling of train crews, as otherwise any gain made in the saving of enginehouse expense may be offset by overtime incurred by the train crews.

These studies also indicate that there is a great variation in the frequency of turning engines. This depends upon the distribution of power according to the demand, the amount of power owned in proportion to the volume of traffic, and most important of all, the frequency of terminals. When there is a large number of power units, but a great frequency of terminals, short runs will prevail, whereas if the runs are longer the number of service hours per day will increase, the dead time at terminals will be reduced, and the gross ton miles will increase with a consequent increase of earning power per locomotive. The spacing of terminals has an effect on the serviceable hours per day, but this should not imply an advocacy of unnecessarily long runs or the skipping of terminals, but rather the providing of a rearrangement that will give a more uniform distribution of terminals so as to reduce the amount of terminal handling to a minimum consistent with the volume of traffic.

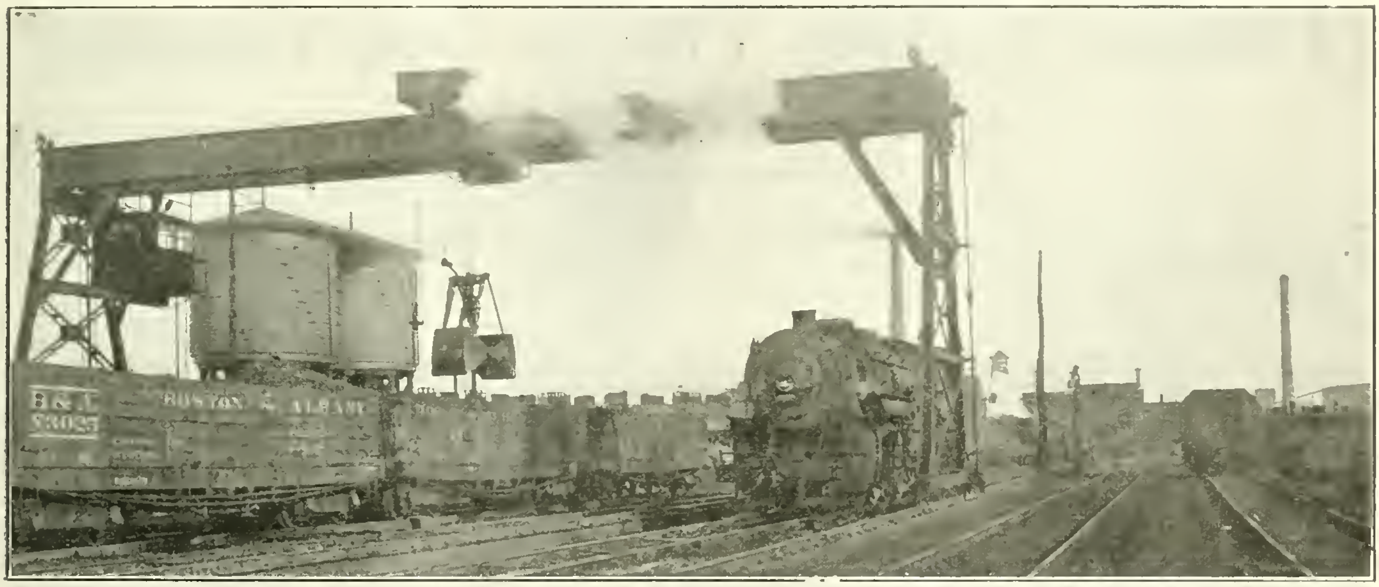


Relative Labor Costs of Various Operations in Engine House Expense

The question of margin of power is also very vital and must be considered before any step is taken at any one terminal to improve it out of proportion to the neighboring terminals. As an illustration, there may be an engine terminal where there are from 20 to 22 engines in the house at all times with an average of only eight departures and eight arrivals in the 24-hour period. In such a case, the dead time proportion of the 24 hours would be very large and would require a relatively small force to operate the terminal and possibly permit the use of two instead of three shifts. On the other hand, there may be an engine terminal with only 12 engines in the house at all times and with an average of 10 arrivals and 10 departures every 24 hours. Here operation would be more intensive, requiring a relatively large force, possibly three shifts, and with facilities which would permit the turning of power in less than 8 hours so as to be in a position to overcome any emergency.

The relative location of the terminal with respect to the yard and depot is a factor affecting Divisions 1 and 4 of the chart. If the terminal is close so that the engine may be uncoupled from the train and delivered directly to the engine terminal, only a few minutes will be involved, but if it is a long distance away or the movement involves complicated switching, the time loss becomes a large item.

To the mechanical man, the engine terminal is a facility, or in other words, it is merely a tool with which to perform a specific operation in detail. It is a double-edged tool as there are two functions to perform. The first is the ordinary handling and care of the individual locomotive in the roundhouse, and the other is repairs, both lighter classified and running. In the well-ordered performance of locomotives, it is necessary to divide the maintenance into running and classified repairs. The running repairs must of necessity be made in the roundhouses. It has been the usual practice to do the classified repairs in the back shops, but there is an increasing tendency to do the lighter classified repairs as well as the running repairs in the roundhouses in order to get a more intensive use of the power. It is the custom among some carriers to assign a certain mileage for a locomotive to perform between classified repairs, and in order to operate locomotives at a minimum cost per mile, for all classes of repairs, it is necessary to obtain a consistent balance between the cost of classified repairs and repairs made in the roundhouses. The manner in which roundhouses are equipped with repair facilities determines the balance.



Modern Ash-Handling Facilities Relieve Congestion at a Prominent New England Terminal

It is the practice on many lines to send locomotives to the back shop only when in need of heavy boiler repairs, taking care of all other work as due in the roundhouses. It is a function of the roundhouse, therefore, to obtain from the locomotive a specified performance in mileage and time, and to see that every engine leaves the terminal in proper condition to insure a successful trip.

Much of the Repair Work Is Done at the Roundhouse

The roundhouses usually perform maintenance work on locomotives to the extent of approximately 40 to 50 per cent of the total cost of repairs and should, therefore, be equipped with this in mind. Any ratio ranging from 60 per cent for classified repairs to 40 per cent for running repairs on the one hand or from 50 per cent for classified repairs to 50 per cent for running repairs on the other hand would seem practical. The ratio between the cost of repairs done in roundhouse and back shop depends largely upon the policy pursued with respect to the amount of work expected from the roundhouses.

As was mentioned at the beginning of this paper, the average locomotive produces annually from 300 to 330 serviceable days out of the 365 days of the year. The opportunity for producing higher efficiency in serviceable days per year obtains from the ability to keep the locomotive within the jurisdiction of the local man and this can best be done by providing him a well-selected supply of standard repair parts and materials, and with ample facilities with which to make prompt replacements and repairs when due, thus eliminating delays occasioned in waiting for parts and materials from the main shops, or in transporting the engine itself to the main shops for repairs.

It is more difficult to maintain the larger units of power that now predominate than it was to care for the smaller engines that were in use in the past. The modern engine is heavier and more complicated, and requires more consistent and frequent mechanical attention. The various parts of the locomotive are larger and heavier and cannot be repaired quickly, if adequate facilities are not at hand with which to handle them. Generally speaking, the increase in the capacity and extent of facilities in roundhouses has not kept pace with the increase in number and size of power units, and until this is brought to a proper balance, it cannot be expected that the full serviceability of the modern power will be attained. A modern locomotive represents a large capital investment and idle hours are of a relatively greater loss than in previous years.

In order to illustrate the general situation on a large railroad system, it is necessary to know just how the various divisions range as to the volume and density of traffic. This forms the knowledge necessary to understand the proper assignment of power to divisions after considering track gradients and curvature, and other operating features. A high performance in car miles per day is not obtained by train speed, but by the promptness with which trains are broken up, assembled, and moved through terminals. A terminal should be prepared to handle without delay any reassignment of power for seasonal loading or other reasons. Improved engine facilities should be made with consideration of the general situation, strengthening the weaker points first and thereby building up to a higher general efficiency.

There is no such thing as an ideal engine terminal, or an ideal terminal operation. From the very poorest to the very best they are a compromise. There are so many circumscribed elements affecting each point that no matter whether it was built up by gradual expansion or is constructed new, the final layout will always reveal some undesirable features. Financial stringency will retard development and restrict new construction. Precedent hampers relocation of existing facilities. A good labor market often overbalances other advantages and designates a location that is geographically or otherwise improper. So we must compromise and use to the best advantage what we have and that which we can obtain.

We are confronted with the problem of not only creating modern terminals in new locations but of overcoming a situation that has developed gradually with the growth of the railway property. Terminals constructed in new locations can easily be equipped with all the proper and modern facilities required for economical and prompt handling of power, but it is more difficult to rearrange existing facilities than to construct new ones and it is this feature of the work which will require the attention of railroad managements for many years to come.

To illustrate the importance of improving engine terminal facilities and relocating them to reduce the time element per engine turned and the frequency of turnings: The average cost of turning power is now approximately $6 to $8 per engine turning and the average number of turns is 1.4 per serviceable locomotive day. A revision of facilities that, by reducing the time element of turning, would produce a reduction of 50 cents per engine turned and reduce the frequency of turning 0.1 turning per day (say from 1.4 to 1.3), will accomplish an annual economy on a complement of 2,000 locomotives to the extent of approximately $650,000, an amount that would pay interest at 5 per cent on $13,000,000. Such an appropriation, properly distributed over the system, would provide for a great many time-saving features which, if utilized advantageously, would produce large returns on the investment and at the same time recover many serviceable locomotive hours to revenue service.

What the mechanical department expects from the locomotive terminal is to derive from it a medium by which locomotives may be cared for and maintained properly, promptly and cheaply, and from which locomotives may be consistently delivered to the transportation department with the result that the serviceable hours per locomotive per day and the serviceable days per locomotive per year may be increased to a maximum.

European Grinding Practice Being Extended

A Description of Grinding Machines and Methods of Proven Value in Foreign Repair Shops

IT has been apparent for several years that railroad men in Great Britain and on the Continent have a deeper appreciation of the value and possibilities of grinding than most of their brothers on this side of the Atlantic. At least this is the unavoidable conclusion of anyone who has studied the number of different grinding operations carried out abroad. In its issue of June 1922 the *Railway Mechanical Engineer* published an article describing certain grinding practices in English railway shops and since that time, important advances have been made both in the more general use of grinding methods and the improvement and development of grinding machines.

Practically a complete line of grinding machines is now being made, for example, by the Churchill Machine Tool Company, Ltd., London, England. The extent to which these machines have been developed for railroad shop work will be more or less of a surprise to American railroad men, many of whom are accustomed to nothing more advanced than

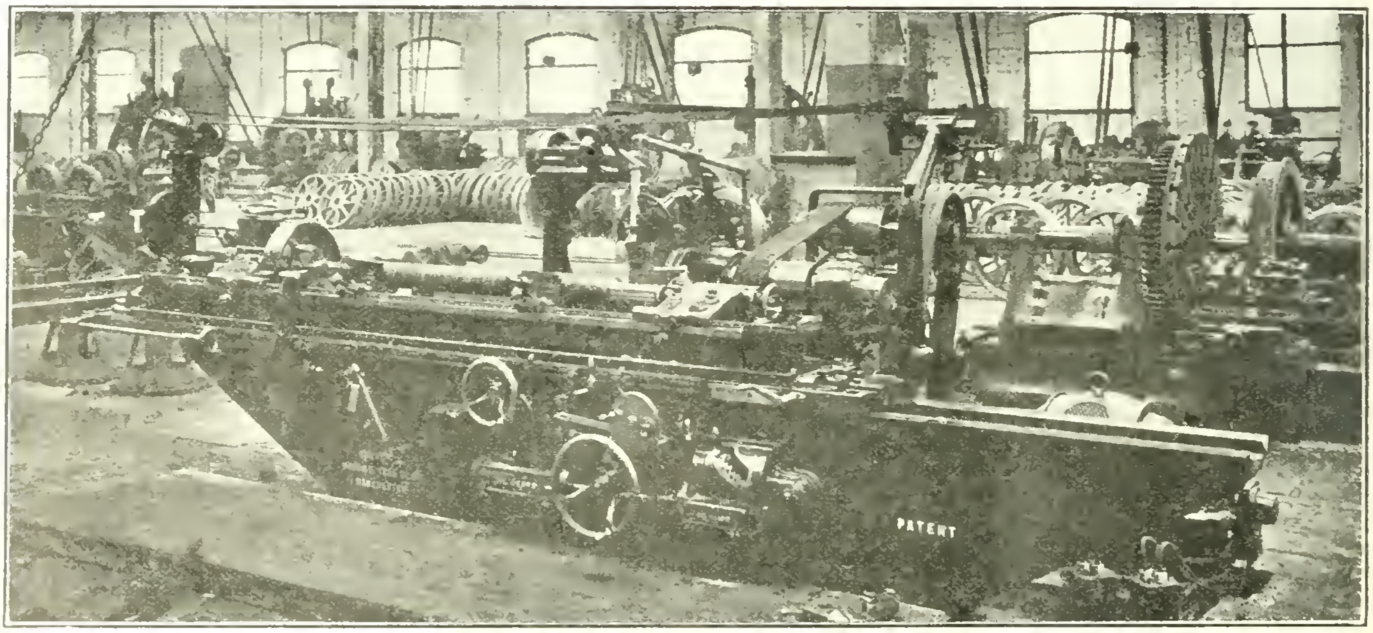


Fig. 1—Grinding Car Axle Journals on a 16-in. by 96-in. Churchill Plain Grinder in a Belgian Car Shop

a piston rod grinder. The following list will give some idea of the work handled on these machines:

Type of Grinding Machine	Locomotive Part Ground
16-in. by 96-in. plain grinder	Axle fits and journals.
Other plain cylindrical grinders	Miscellaneous parts.
Vertical spindle radius and bole grinder	Links and holes.
Car wheel bore grinder	Car wheel bores.
Vertical spindle surface grinder	Guides, rods, etc.
Plain grinder for pins	Motion work pins.
Portable valve bushing grinder	Valve chamber bushings.
Horn cheek grinder	Frame pedestal jaws.
Double vertical spindle grinder	Main and side rods.
Horizontal spindle link grinder	Links and other parts.
Turret head grinder	Miscellaneous grinding
Internal grinders	Air compressor cylinders.
Horizontal spindle grinder	Misc. surface grinding.
Rotary surface grinder	Packing rings, dies, etc
Tool room grinder	Shop tools.

In addition, plans are definitely under way and tentative drawings have been made of machines to grind driving axle journals with the wheels mounted and crank pins also mounted.

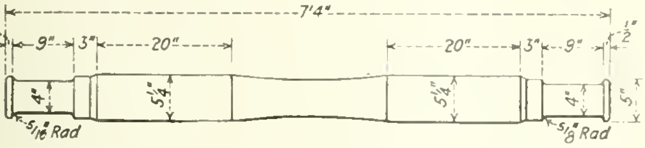


Fig. 2—Journals and Wheel Fits Are Ground at One Setting

While it is realized that some of these machines would require changes in design and especially size to take care of the relatively larger parts of American locomotives, these alterations in many cases would be slight and with standard machines, such as surface grinders, plain cylindrical grinders, and internal grinders, no alterations would be necessary. The following description of some of the grinding machines and methods used in foreign railway shops is given in the hope that it will lead to a better appreciation of the possibilities of grinding by American railroad shopmen.

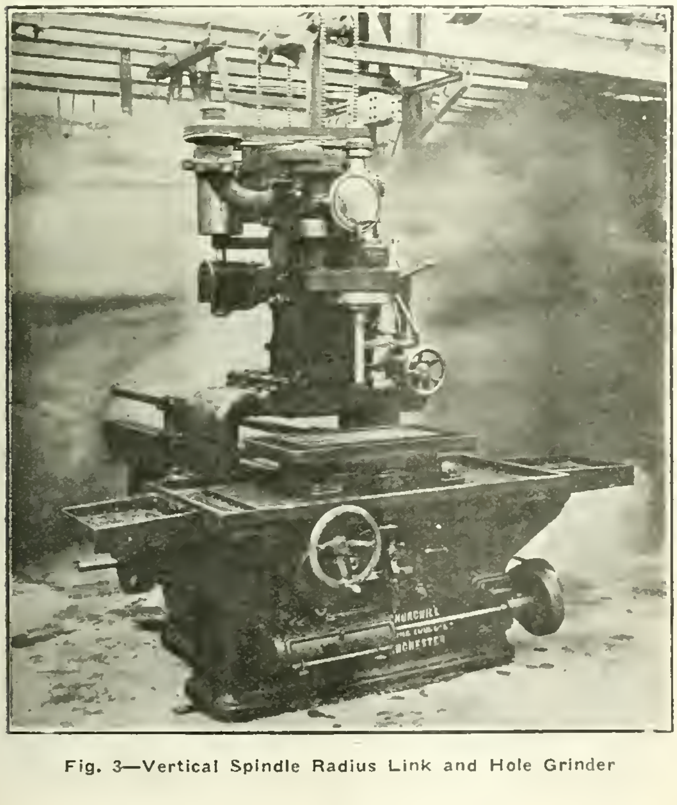


Fig. 3—Vertical Spindle Radius Link and Hole Grinder

Wheel Seats and Journals Ground

The practice of grinding journals has been thoroughly tested out with favorable results as regards accuracy, finish and length of operation. The ground journals give superior service to those finished by other methods and, in addition, only enough material is removed at each grinding to true the journal, thus greatly increasing its effective life before it becomes worn and ground down to the limiting diameter. Fig. 1 illustrates a 16-in. by 96-in. plain grinding machine installed in one of the largest Belgian car shops. This machine is equipped with an axle positioning device provided to take care of the varied depths of center holes in the ends of the axles, it being essential that all axle journal center distances be maintained a standard length. The machine is arranged for self-contained motor drive, all motions being obtained from a direct-coupled motor at the rear of the machine, the work being rotated by an endless belt and with the speed varied through the gear box shown on the workhead at the left.

The car axle, illustrated in Fig. 2, is of the type ground on this machine, and while the 4-in. by 9-in. journal is small for American practice, the machine could grind a much larger journal just as readily. The journal and wheel seat on each end of the axle are ground in 35 min., the journal fillets being formed by the rounded corners of the grinding wheel. The wheel seats are ground because this gives a uniform, accurate control of finish and diameter which insures uniform mounting pressures and, therefore, less trouble from loose wheels.

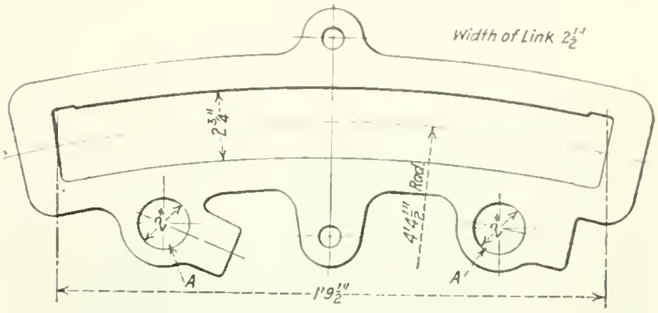


Fig. 4—Common Type of Link Ground on Machine Shown in Fig. 3

A Versatile Grinding Machine

The grinder, illustrated in Fig. 3, is particularly interesting because, while designed primarily for grinding the radius of links, the spindle has been provided with a planetary motion so that the link pin holes can be ground at the same setting. Moreover, with the table stationary, any small internal grinding job can be done on this machine and it is quite certain to be in continuous use. Relatively small shops, for example, which might not feel justified in buying a machine especially to grind the few links required for its

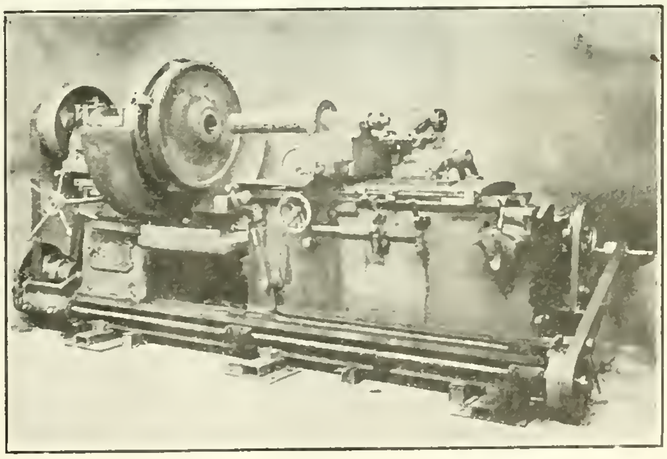


Fig. 5—Grinding Car Wheel Bore in Belgian Car Shop

monthly output of locomotives, would probably be interested in this machine because of its possible use for other work.

Fig. 4, shows the common type of Stephenson link finished on this radius link-grinding machine, .015 in. being removed from the width of the slot in 40 min. The two link pin holes *A* are ground in 5 min. each.

Grinding Car Wheel Bores

It is obviously of little avail to grind the wheel seats on an axle and then apply a car wheel having a rough bore. The old argument of greater accuracy and a more uniform, smooth finish applies in this case, and in the Belgian car shops referred to, the management has followed the only consistent course possible by arranging to grind car wheel bores. The machine illustrated in Fig. 5, is used for this purpose. This is a large powerful machine, the chuck in which the car wheel is applied having a capacity to swing 48-in. The wheel bores are ground by means of the rigid, accurately alined spindle which has a planetary motion. This grinder is provided with wet grinding equipment and maintains the standard size of bores to within very close limits of accuracy. Car wheel bores are ground in 18 min. each, actual grinding time. The diameter of the hole illustrated is 5⅞-in., its length being 7-in. From .015 in. to .018 in. of metal is removed from the diameter by grinding.

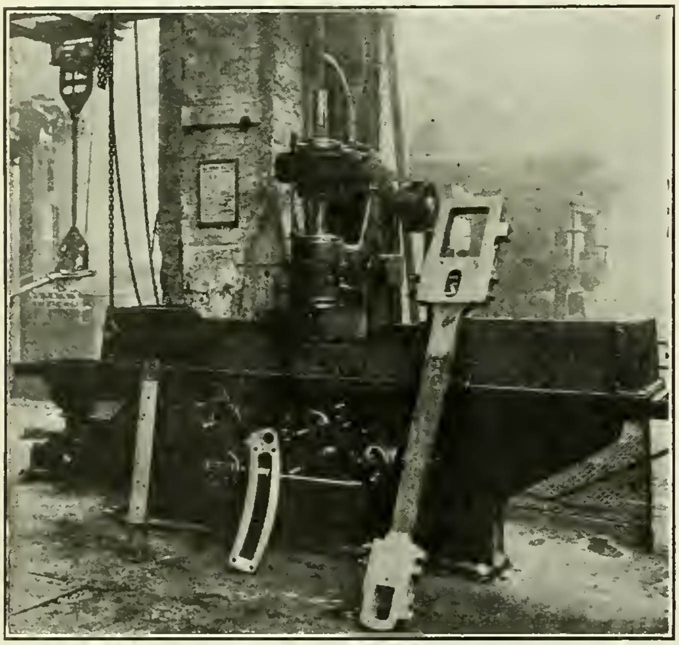


Fig. 6—Vertical Spindle Surface Grinder Installed at Ashford Works of Southeastern & Chatham

Vertical Spindle Surface Grinder

Surface grinding practice is not essentially different in this country than in England, but there is this much to be said in favor of English practice. The grinders are made in quite a number of different sizes and, as a rule, each English shop will have several of these sizes so that it is not necessary to grind small work on a large machine, as frequently happens in this country. The machine illustrated in Fig. 6 is a 16-in. by 72-in. grinder adapted to grind guides, links and rods, such as shown in the illustration. This machine is installed at the Ashford works of the Southeastern & Chatham.

Referring to Fig. 7, the guide illustrated is one of a pair ground as follows: Two guides are ground at the same time, the first operation consisting of grinding the 5½-in. face the full length, about .040 in. of stock is removed in 35 min. The second operation consists of grinding the 5½-in. face 10-in. long, .04 in. of stock being removed in 10 min. The third operation consists of grinding the sides of two of the guides the full length, taking 15 min. The guides are then turned over and brought to the correct width by grinding the two opposite sides the full length. This operation may take 12 min., in which case the total time for the two guide bars is 72 min., or 36 min. a piece. Many other parts can be ground on this machine which is equipped with a magnetic chuck when necessary. Slide valves, false valve seats, steam chests and steam chest covers are also ground to advantage on this machine with important savings over the old method of planing.

Motion Work Pins

In spite of the fact that one or two American roads have gone ahead with the work of standardizing motion pins and bushings and made arrangements for grinding these parts, the English are, on the whole, ahead of us in this respect. Fig. 8 illustrates a close-up view of a powerful 14-in. plain grinding machine fitted with a 5½-in. wheel for work on motion pins. Where motion pins and short shafts have to be produced in quantities, this method provides an accurate and ultra rapid means of sizing.

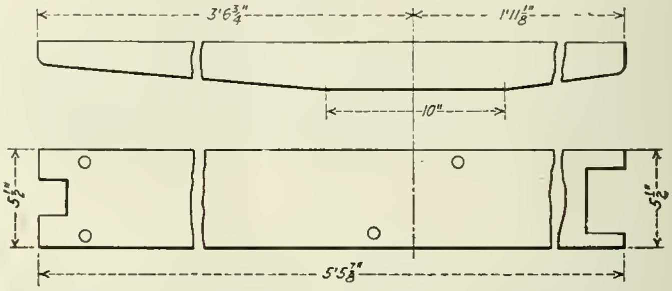


Fig. 7—A Heavy Guide or "Motion Bar" Finished by Grinding

For certain work, this machine is fitted with a grinding wheel 8¼ in. wide. The pin shown at *A* (Fig. 9), for example, is ground with an 8¼-in. wheel in 1 min., .041 in. being removed from the diameter with a limit of .0005 in.

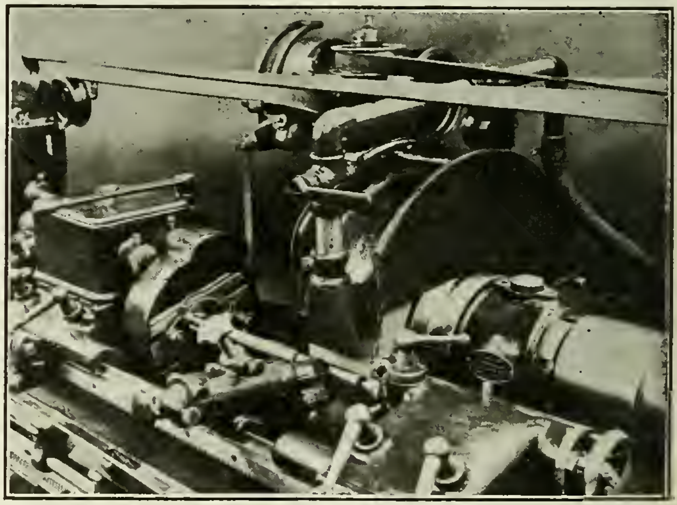


Fig. 8—Plain Grinder with 5½-in. Wheel Grinding Motion Pins

The pin, illustrated at *B*, is finished by removing .032 in. from the diameter, the limit in this case also being .0005 in. and the time, 1 min. Pin *C* is a case-hardened pin, the surfaces indicated being finished by grinding in 3 min., using a wheel with a 2 in. face. Motion pin *D* is finished by grinding on three surfaces in 1 min. Pin *E*, also case-hardened, is finished by removing .015 in. from the diameter by grinding in 1 min. A grinding wheel, having a 4½-in. face, is used.

From Fig. 9 a good idea can be obtained of the types of motion pins suitable to be ground and while all may not agree that it is necessary to grind the taper fit, there is no question that in important shops where a considerable number of valve gears and motion parts are repaired, the pins should be standardized, ground to a fit in their respective bushings, and carried in stock. The volume of pin and bushing work in some shops is extremely large and there is a possibility of real economy by making pins and bushings in quantity on automatic, or semi-automatic machines. The pin fits in the bushings can be ground, thus securing accurate, smooth bearings, and enough material can be left on the taper pin surfaces and outsides of the bushings so that the units will fit with slight additional machining, any standard link or motion bar.

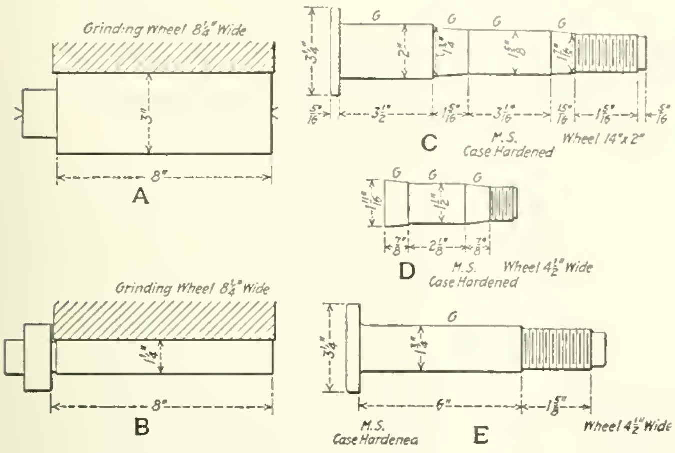


Fig. 9—Showing Several Types of Motion Work Pins as Ground

The quality of the bearing surface is improved by grinding, as would be expected, and an important feature of this method is the increased pin and bushing life. It is well known, for example, that a case-hardened pin put into a case-hardened bushing with a scaly surface and allowed to run shows excessive wear for the first few months, after which there is an undue amount of play at the connection. This is practically eliminated by grinding, because in this case both the pin and bushing are smooth, accurate, cylindrical surfaces, fitted with just the required amount of play. Such a bearing, properly lubricated, is bound to last for a long time without appreciable signs of wear.

Determination of Boiler Operating Factors

Part II

Method of Calculating Combined Efficiency of Boiler, Furnace and Grate—Operating Charts Verify Points

By D. C. Hess
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[*The first part of this article was published in the March issue of the Railway Mechanical Engineer, being devoted to a discussion of methods of determining essential factors in the economical operation of boiler rooms. Test results, together with typical performance curves and 24-hour* CO_2 *charts were included in Part I.*—The Editors.]

THE principal final product of complete combustion of fuel is carbon dioxide (CO_2). In order to obtain high CO_2 the most important factors to take into consideration are:

First, keep the fuel bed in good condition; that is, prevent the formation of holes in the fire. Maintain the correct thickness and contour of the fuel bed.

Second, eliminate all air leaks in the boiler walls.

Third, maintain as nearly as possible a balanced draft or a slight vacuum in the combustion chamber. Avoid bottling up the gases which would cause a pressure in the furnace. Such a pressure would be very destructive to the brickwork and stoker parts. One type of baffle graduates the cross section of the flue gas passage, so that the velocity of the gas will be uniform throughout the boiler and also eliminate any dead pockets where there is no circulation of gas.

Importance of High CO_2

Fig. 6 is a calculated curve based on the CO_2 per cent by volume at flue gas temperatures of 400 deg. F., 500 deg. F., and 600 deg. F., with no carbon monoxide. Theoretically, perfect combustion of pure carbon will give 20.7 per cent of CO_2 in the flue gases. However, perfect combustion is not possible in boiler room practice.

Referring now to Fig. 6, suppose the flue gases analyze six per cent CO_2 and that by decreasing the amount of excess air and giving careful attention to the fuel bed, the CO_2 is increased to 15 per cent. A glance at the curves shows that the relative fuel loss has been reduced from 40 per cent to 17, which amounts to a fuel saving of 10 to 12 per cent.

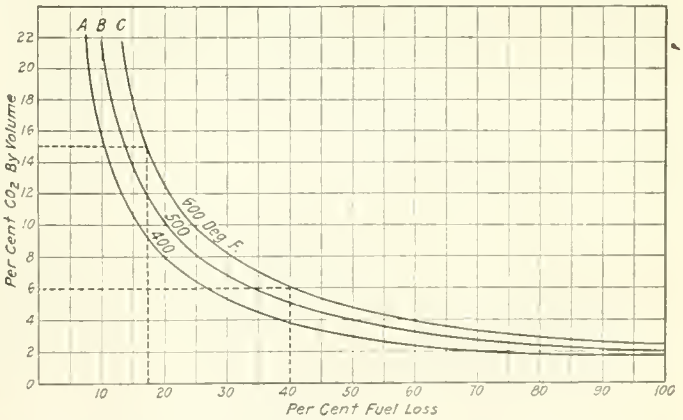

Fig. 6—Calculated CO_2 Curves Based on the Per Cent CO_2 by Volume at Flue Gas Temperatures of 400 deg. F., 500 deg. F., and 600 deg. F., with no Carbon Monoxide Present. Shows Fuel Saving by Increasing the CO_2 Values

Determining Combined Efficiency

The general definition of the efficiency of an apparatus is the ratio of the energy developed by the apparatus to the energy available for its use.

The efficiencies of the different parts of a boiler installation and of the installation as a whole are defined in so many ways that there is frequently confusion. The following definitions are recommended.

What is ordinarily called the efficiency of the boiler is in reality the combined efficiency of the boiler, furnace and grate, and is the heat absorbed per pound of fuel divided by the heating value per pound of fuel. The value obtained will be approximately the same whether the efficiency is based on dry fuel or fuel as fired. All the fuel is not burned; some of it goes through the grates or is dumped out with the ash while cleaning the fire. It is obviously unfair to charge this loss to the boiler. On the other hand, the boiler user must pay for it and is justified in charging it against the furnace.

The combined efficiency can be expressed as

$$E = W (h + L + sS - f) \div DH$$

Where W = lb. of water evaporated in a unit of time.
D = lb. of coal fired in a unit of time.
s = .48 = specific heat of steam.
h = heat of liquid at steam pressure.
L = latent heat.
S = deg. supt.
$h + L + sS$ = heat in one lb. of steam as delivered by boiler.
f = heat in one lb. of water as received by boiler.
H = heat value of one pound of coal in B.t.u. as fired.

The numerator of the above fraction equals 970.4 Q, where Q is the factor of evaporation.

Specimen Heat Balance

A typical heat balance worked out according to the above formula is given below:

The calculations are made as follows:

24-hour test of 2,400-hp. boiler, operated at 137 per cent of rating.

Coal as fired: 76.87 per cent carbon; 5.31 per cent hydrogen; 7.19 per cent ash; 1.80 per cent moisture; 13,810 B.t.u. per lb.

Dry coal = 98.2 per cent of coal fired.

Dry coal basis: 78.30 per cent carbon; 7.32 per cent ash; 5.41 per cent hydrogen; 1.83 per cent moisture; 14,090 B.t.u. per lb.

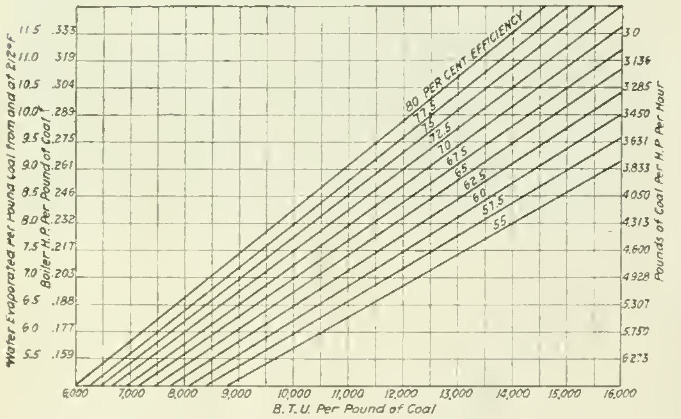

Fig. 7—Combined Boiler Efficiency Curves Based on Pounds of Water Evaporated from and at 212 deg. F. per Lb. of Coal of Various B. t. u. Values

Coal fired 246,000 lb. = 241,500 lb. dry coal.

Refuse produced 21,375 lb. = 8.88 per cent of dry coal.

Carbon in refuse = 8.88 — 7.32 = 1.56 per cent dry coal.

This statement assumes that all of the ash is in the refuse.

Flue gas analysis: 14.6 per cent CO_2, 0.36 per cent CO, and 3.30 per cent O_2. CO is seldom found in the products of combustion, but if produced it is treated as follows in the heat balance.

Water evaporated, 2,480,000 lb., steam pressure 160 lb. gage, superheat 100 deg. = 1,254 B.t.u. per lb. above 32 deg. F.

Average temperatures: feedwater 220 deg. F., flue gas 560 deg. F., room 72 deg. F., air 63 per cent saturated.

Heat Balance Calculations

		B.t.u. per lb. dry coal	Per cent of total heat
1.	Heat absorbed by boilers: 2,480,000 (1,254 — (220 — 32)) ÷ 241,500.......	10,960	77.79
2.	Heat lost hy evaporation of moisture in coal: 0.0183 (212 — 72 + 970 + 0.47 (560 — 212))....	23	0.16
3.	Heat lost in steam from hydrogen in coal: 9 × 0.0541 × (212 — 72 + 970 + 0.47 (560 — 212))	609	4.32
4.	Heat lost in dry flue gases: Air = 3.036 (0.7830 — 0.0156) (1 — 0.1460 — 0.0036 — 0.0330) ÷ (0.1460 + 0.0036) = 12.45 lb. per lb. uf dry coal. Gases 12.45 + (1 — 0.0888) = 13.36 lb. per lb. dry coal. Loss = 0.24 × 13.36 (560 — 72)................	1,565	11.10
5.	Heat lost in unburnt CO = (0.7830 × 10,150 × 0.0036) ÷ (0.1460 + 0.0036) = ...	193	1.37
6.	Heat lost in combustible refuse = 14,600 × 0.0156 =	246	1.75
7.	Heat lost in heating moisture in air = 63 per cent at 72 deg. F. = 0.0168 × 0.63 = 0.0105 lb. per lb. of air (0.0105 × 12.45 × 0.46 (560 — 72) =	29	0.21
8.	Unaccounted for (radiation, unburned bydrocarbon, errors of observation) by difference = ...	465	3.30
	Total	14,090	100.00

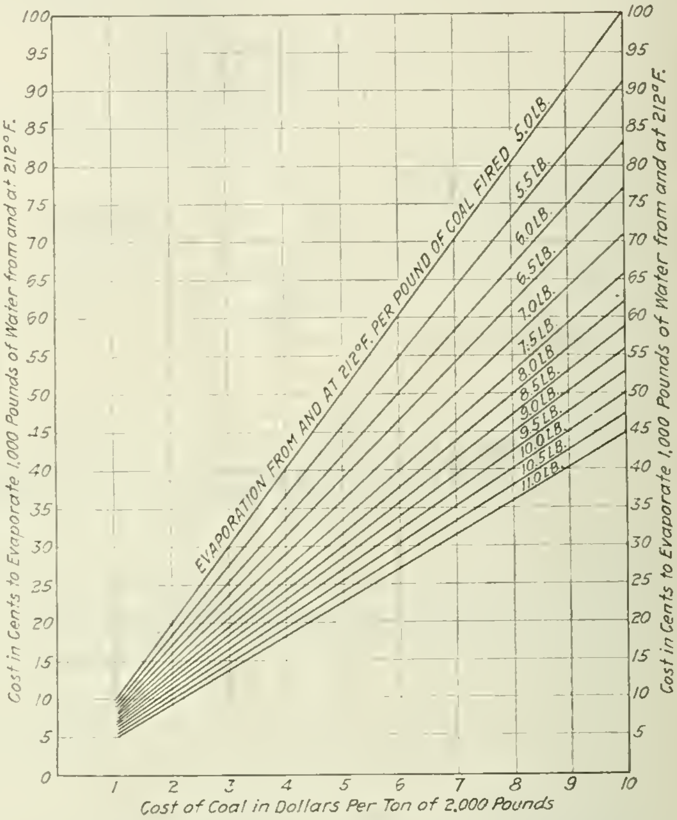

Fig. 8—Cost of Steam Based on the Pounds of Water Evaporated from and at 212 deg. F. per Lb. of Coal Fired

Fig. 7 is a set of curves showing combined efficiencies based on pounds of water evaporated from and at 212 deg. F. per pound of coal at various B.t.u. values. These curves also give the boiler horsepower per pound of coal and pounds of coal per horsepower per hour.

Cost of Steam Curves

Fig. 8 is a set of curves showing the cost of steam based on the pounds of water evaporated from and at 212 deg. F. per pound of coal fired. The column at the left shows the cost in cents to evaporate 1,000 lb. of water which is plotted against the cost of coal in dollars per ton of 2,000 lb.

"The Three Graces"

After you have made a thorough study of your boiler room conditions and heat balance, you will no doubt come to a final conclusion that the economical operation of your boiler plant narrows down to three things.

First, maintaining high CO_2. This means good combustion of the fuel. This is accomplished by keeping the proper ratio between the fuel feed and air supply, good fuel bed conditions and careful attention to the operation of the stokers and boilers.

Second, keeping the flue gas temperature as low as possible. That is, absorb all the heat possible from the furnace gases before they reach the breeching.

Third, reducing the combustible in the refuse as low as possible. This signifies good operation on the part of the fireman who should control the fuel bed conditions so that a minimum amount of carbon is dumped with the ash.

These three items are the main factors in boiler room operation from an economy standpoint.

Triple Valve Piston Press

By J. D. Flinner

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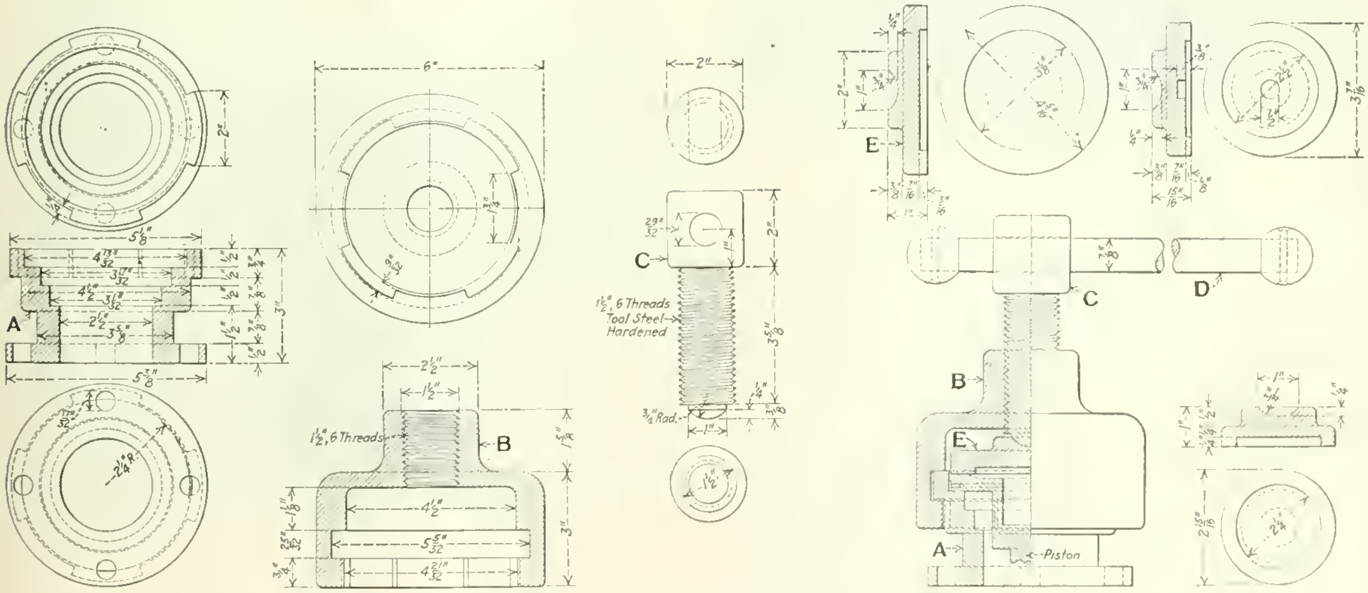
A SMALL hand press, designed to close the piston ring grooves of triple valves, control valves, or distributing valves, is illustrated in the drawing below. In time piston ring grooves wear, and without some means of closing them the pistons must of necessity be scrapped. By using this press, which is bolted to the air brake bench and operated by hand, the piston ring grooves can with a little practice be closed just the right amount for the application of new rings.

In operation, the piston with the oversized groove is placed in base *A* resting on whichever one of the three seats it fits. (The old piston ring is left in the groove to prevent compressing the groove too much.) The proper die, in this case *E*, is then placed on, the piston and cover *B* applied. By giving the cover an eighth of a turn, it is locked in place and cannot come off when pressure is put on the die by means of screw *C* operated by handle *D*. The piston should be turned slightly with each squeeze of the press to assure a uniform closure of the groove and with a little practice grooves can be closed just the right amount. Die *E* is used for the equalizing and release pistons of P. C. control valves. The 3 7/16-in. die at the right is used for all 3½-in. pistons, and the 2 15/16-in. die for New York triple pistons having projections which extend into the die recess.

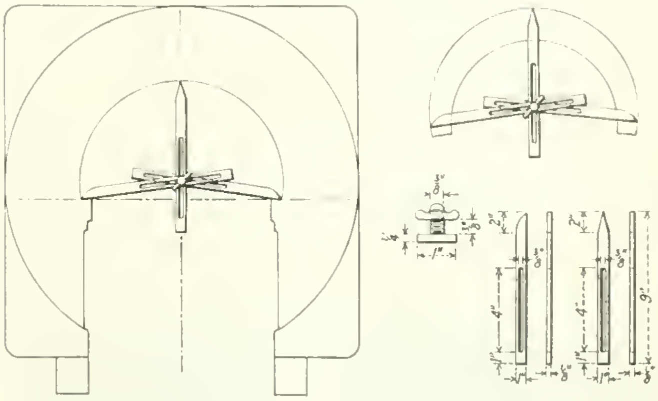
Referring to the detailed drawing of base *A* the 4 13/32-in. diameter seat is used for release pistons and equalizing pistons of P. C. control valves. The 3 17/32-in. diameter seat is used for K1, K2, H1, H2, P1 and P2 Westinghouse triple valve pistons; also for F1, GN1, GN2, K5 and K6 New York triple valve pistons. In general, any of the quick-action triple pistons can be closed on this 3 17/32-in. seat. The plain triple pistons can be closed on the 3 1/32-in. seat.



Piston Ring Grooves in Three Sizes of Triple Valves Can Be Readily Closed in This Simple Press

Driving Box Gage

A GAGE, designed to measure the crown brass fit in driving boxes, is shown in the illustration. This gage can be made with little expense of ⅛-in. boiler steel, cut and filed to the dimensions shown in the drawing. The three parts of the gage are adjustable on each other, being held together by a thumb screw as indicated.



Simple Gage for Measuring Driving Box Crown Brass Fit

The use of this gage, like others of similar type, will save many steps and much lifting when laying out driving box brasses preliminary to machining them for the fit in the driving box. Without some sort of a gage this operation involves placing the brass on top of the box as near as possible in the correct position and scribing the shape of the box on the lower end of the brass. With this gage, the method is to set the gage as shown at the left in the illustration, transferring the marks to the brass as shown at the right. This eliminates a lot of extra handling of the heavy brasses and permits accurate fits to be rapidly made.

Simple Devices Facilitate Machine Work

Description of Several Simple Devices and Methods for Increasing Machine Shop Production

By J. Robert Phelps
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THE output of the machine shop of the Atchison, Topeka & Santa Fe at San Bernardino, Cal., as a whole, is greatly affected by a number of jigs, fixtures and simple methods devised for speeding up certain operations and enabling others to be handled more easily. The following devices and comparatively simple methods have proved their value in expediting machine shop work.

Boring Mill Fixtures

One of the most awkward locomotive parts to set up on a boring mill is the back cylinder head with its one or more massive projecting lugs to which the guides are bolted. These lugs, or guide blocks, are cast solid on the back head so that extra high chuck jaws are required to hold the head while being turned to fit the cylinder and bored for the piston rod. This job can be handled much more readily by means of the special jaws illustrated in Fig. 1 than by other arrangements. Blocking up under the regular jaws is unsatisfactory because it takes time and does not hold the cylinder heads firmly.

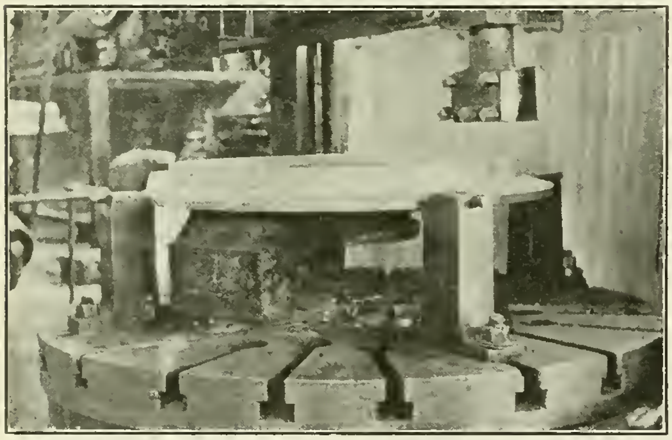


Fig. 1—Extension Jaws Hold Back Cylinder Head for Machining

Referring to the illustration, the general design of the jaws is evident. They consist of three substantial forged rectangular posts, provided with drilled projections at the bottom for bolting to the boring mill table and each having a shoulder at the top to support the cylinder head. Set screws provide for centering the cylinder head and holding it firmly while machining.

Fig. 2 shows the tool head of a boring mill to which a 1½-in. strip *A* has been welded, forming an additional support for the cutting tool and allowing the tool to be set out far enough so that chips can clear the front part of the head. The tool is still supported close to the heel, enabling heavy cuts to be taken without vibration, or excessive stress on the tool.

Holding Steam Pipe Casings

It was formerly the practice at San Bernardino to bolt steam pipe casings to a piece of boiler steel bent to conform to the radius of casings preparatory to machining. By using the method illustrated in Fig. 3, two casings can be handled at the same time. They are simply bolted together and set on the boring mill table, being reversed and recentered when one end has been machined. After the boring mill work is completed, the casings are left bolted together and sent to the drill press for drilling where the same arrangement is found convenient.

In using this method, the first machine work done on the casings is to drill the holes in the curved, or radius flanges so that the casings can be bolted together. The rest of the machine work is done with the casings bolted together.

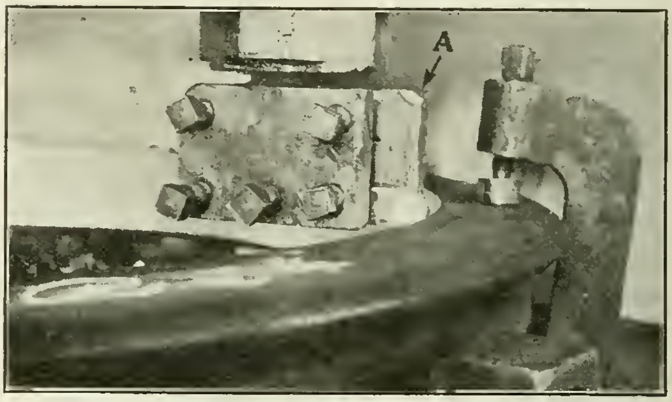


Fig. 2—Additional Support Provided for Back of Boring Mill Tool

Jack for Leveling Rods

A handy and cheaply made jack for use on wooden rod horses is illustrated in Fig. 4. It consists of a 1¼-in. by 16-in. stud to which is electric welded the ¾-in. by 1½-in. by 12-in. strip *S* supporting the rod. Vertical adjustment is provided by a 1¼-in. nut to which ¾-in. handle *H* is attached by electric welding. The use of this device is clear from the illustration which shows one end of a side rod, the other being on a machine ready for boring. The end shown is raised to the proper height by simply turning handle *H* and the nut to which it is welded. This method is more convenient than using blocking, and the handle, being

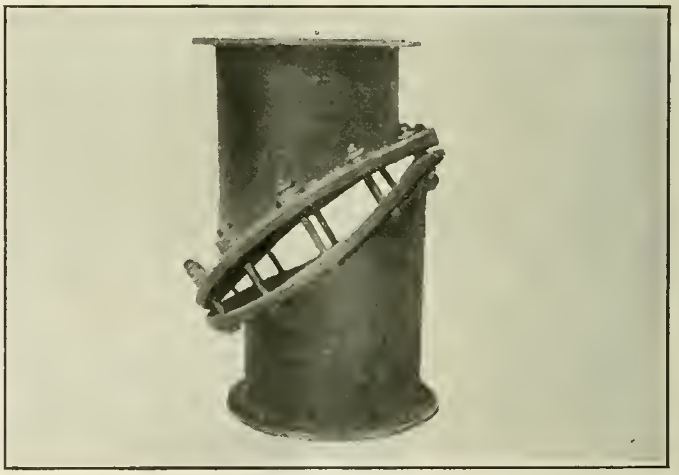


Fig. 3—Two Steam Pipe Casings Are Bolted Together for Boring and Drilling

permanently attached to the nut, is also a convenience. If a wrench is used, it frequently requires both hands and the undivided attention of the operator, whereas with this arrangement the operator can be watching the level on the rod and turn the handle without looking at it.

Adjustment of Slotter Stroke

The figures shown in the following table are stamped on a copper plate and attached to the slotter in the shop at San Bernardino. By having this plate to help him, the machinist can set the stroke to exactly the right length he wants on first trial. He can do it quickly and be sure of it. There is often a tendency on the part of a man operating a machine to get the stroke fairly close and let it cut air above and below the work. While it is realized that the later type of slotters have a stroke indicator, there are many slotters in use where a plate, similar to the one described, will, over a period of weeks or months, prove extremely valuable in increasing slotter production.

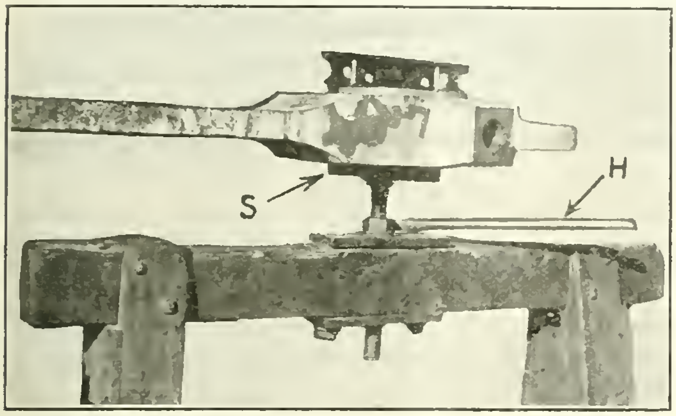


Fig. 4—A Convenient Leveling Jack for the Rod Job

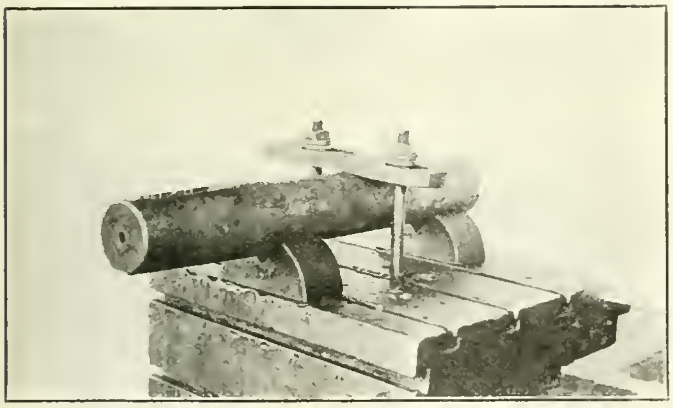


Fig. 5—Mandrel for Use in Drilling Crosshead Keyways

Plate for Indicating the Slotter Stroke

Stroke	Distance from Dovetail block to edge of wheel
1 in.	5¾ in.
1½ in.	5½ in.
2 in.	5¼ in.
2½ in.	5 in.
3 in.	4¾ in.
3½ in.	4½ in.
4 in.	4¼ in.
4½ in.	4 in.
5 in.	3¾ in.
5½ in.	3½ in.
6 in.	3¼ in.
.....	.....
9 in.	1¾ in.
9½ in.	1½ in.
10 in.	1¼ in.
10½ in.	1 in.
11 in.	¾ in.
11½ in.	½ in.
12 in.	¼ in.
12½ in.	0 in.

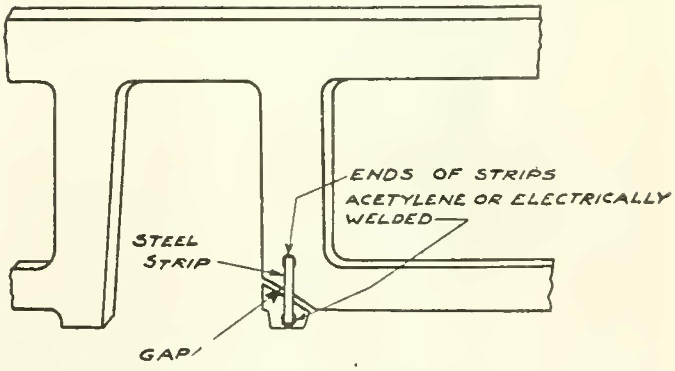
Machining Crosshead Keyways

While it is realized that the correct method of machining crosshead keyways is by milling with an end or side mill, there are many small shops not provided with equipment for handling the work in this way, and roundhouses in particular are not infrequently called on to replace a broken crosshead with a new one in which the keyway has not been machined.

In cases of this kind, the keyway must be drilled and afterwards filed by hand, the question of setting up and holding the crosshead for drilling being something of a problem. A convenient method of holding the crosshead is by means of an old piston rod cut off and clamped to the drill press table as illustrated in Fig. 5. The keyway in this old rod is enlarged sufficiently to clear the drill. A crosshead can then be applied to the mandrel at the proper angle and the keyway drilled without difficulty. The arrangement of V-blocks and clamp is rigid and holds the crosshead firmly.

Risers and Vents for Vertical Frame Welds

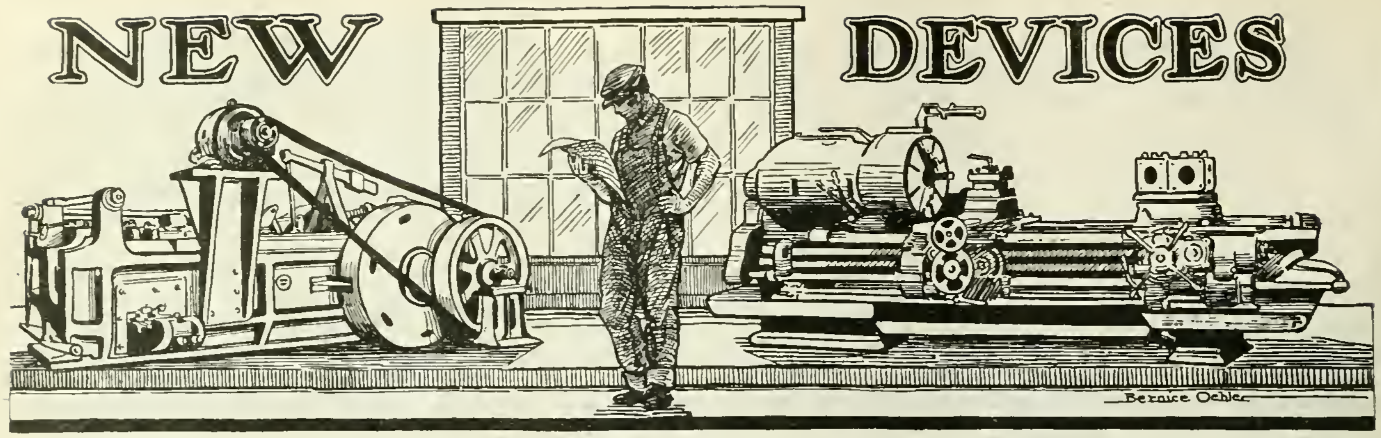
In welding a fracture in a vertical locomotive frame member with Thermit, it has not been found advisable to place any risers directly against the frame at the upper edge of the collar because this reservoir of heat so close to the frame is likely to melt away the section above the weld. When the risers are placed ¼ in. or more down from the top edge of the collar, on the other hand, it is evident that there will be a pocket above the level of the base of the riser in which air will be trapped when the mold is being rapidly filled with steel.



Method of Aligning Broken Head of Frame Preparatory to Thermit Welding

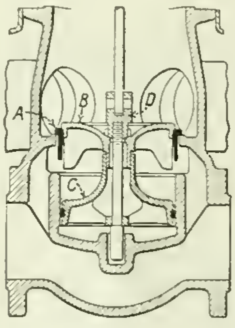
It is therefore important that this extreme top edge of the collar all the way around the section should be completely vented to the top of the mold so as to allow the air to escape freely as the mold is filling. It is advisable to lay in, alongside of the frame, thin wooden shims, 1/16 in. to ⅛ in. thick, which are withdrawn after the mold is rammed and, therefore, completely vent the top edge of this collar all the way around. It is true that this space will be filled with steel but the fin will be so small that it will chill against the frame and not weld to it and therefore, can be readily chipped off upon completion of the weld.

When repairing the fractured heels of frame legs, by Thermit welding, the broken part is held in correct alinement by two 6-in. by 1-in. strips, one laid flush against each side of the frame as indicated in the illustration. About ½ in. of the ends of these strips are welded to the surface of the two parts by means of the oxyacetylene torch or the electric arc.

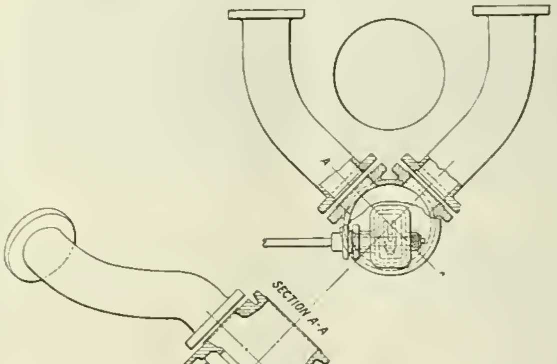


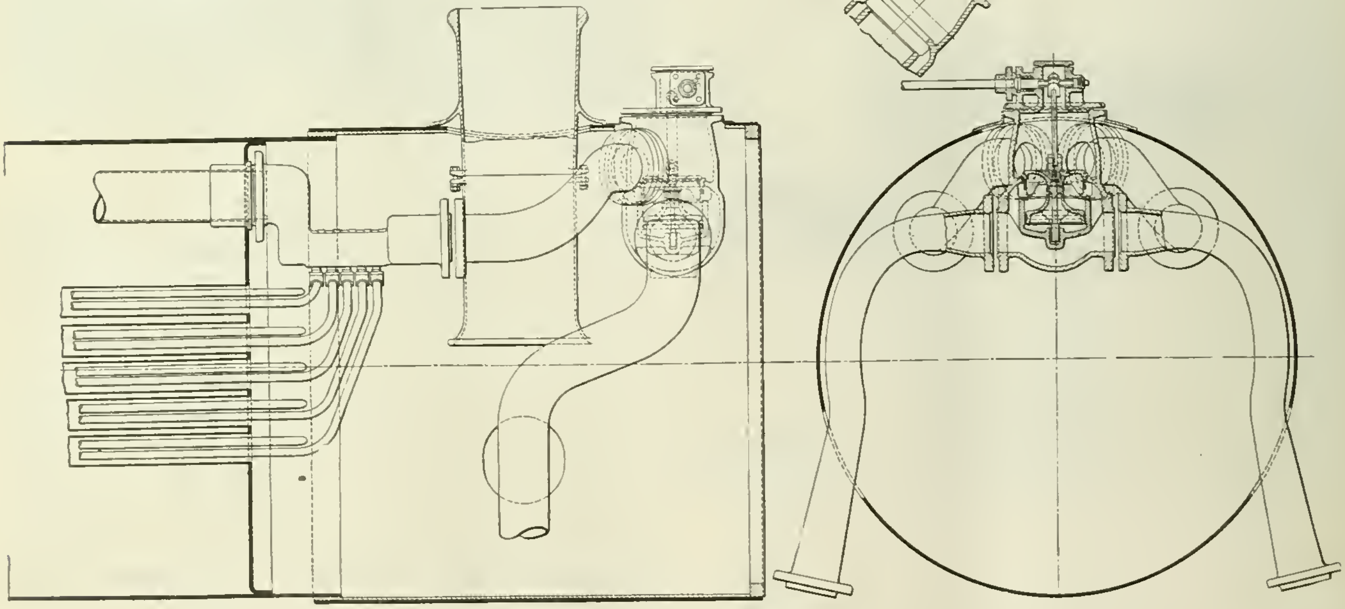
Front-End Locomotive Throttle Valve

THE Chambers throttle valve, manufactured by the Bradford Draft Gear Company, New York, has been applied to a great many modern locomotives as a saturated steam valve located in the dome. This valve has now been redesigned to make it applicable as a front-end throttle, using superheated steam. The new design, which is illustrated in the drawing, differs in a number of details from the earlier types. The connections from the throttle lever to the valve are carried outside the boiler, the throttle rod connecting to an arm on a rotating shaft which enters the throttle box cover through a steam-tight packing. A forked arm secured to the square inner end of the shaft is connected to the valve stem and lifts the pilot valve and the main throttle.



Cross-Section Through Valve





Chambers Throttle Designed for Superheated Steam

The throttle box has two steam inlets from the superheater header entering from the rear at right angles to each other and leading to the top of the valve. The outlets to the cylinders are placed on each side at the bottom of the throttle box. This arrangement keeps all the steam pipes entirely inside the front-end. The throttle box is supported by the steam pipes, the joints between the front-end and the throttle box being sealed with a pressed angle. The throttle valve is readily accessible by removing the throttle box cover.

It is a well-known fact that castings when exposed to high temperatures warp and distort. These temperature strains make it difficult to keep throttle valves tight with high pressure steam and especially if it is superheated. The design of the Chambers valve has been worked out carefully to eliminate the effect of these distortions so that the valve will remain tight in spite of warping in the throttle box. The way in which this is accomplished will be evident by an examination of the drawing. It will be noted that the ring seat *A* rests on the throttle box with a flat joint and has a slight clearance in the bore of the box. If the throttle box warps so that the bore is eccentric it still will not affect the tightness of the joints between the box and the ring seat. The main valve *B* rests on a beveled face on the ring seat. When steam is shut off there is no balancing pressure beneath this valve and the force of the boiler pressure acting upon its surface presses it tightly into the ring seat. The ring seat is of relatively light cross section and the force on the main valve is sufficient to cause the seat to conform to the shape of the main valve, thus making a tight joint in spite of any slight distortion in the valve.

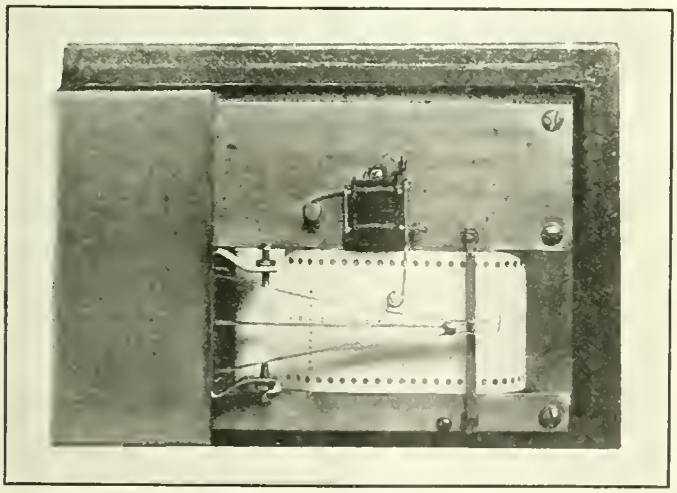
The balancing force on the main valve is secured by the action of the balancing piston *C* which is always tight in the balancing chamber and for that reason the valve is not subject to the troubles due to difference in expansion between the valve and the throttle box which are found with double seated throttle valves. Locomotives with superheaters and a throttle in the dome have a considerable volume of steam space between the throttle valve and the cylinders. When the throttle is opened this space must be filled with steam before the locomotive will start and when the throttle is closed this steam continues to expand so that the locomotive does not stop at once. This sluggishness in responding to the movement of the throttle makes it difficult to handle a locomotive especially on a slippery rail. When a locomotive throttle valve is placed in the front-end, the volume of the steam passages between the throttle and the cylinders is decreased, making the locomotive more prompt in responding to the movement of the throttle.

Superheated steam flows at a higher velocity than saturated steam and for these reasons the fine graduation of the throttle valve opening secured with the Chambers valve is of special importance. The first opening of the throttle is through the pilot valve *D* which permits steam to pass through the center of the main valve to the cavity under the balance piston. A slight amount of steam will flow through the relief opening in the balance piston but this is negligible. When the main valve is lifted from its seat, a small annular passage is opened between the valve and the ring seat. The next steam passage to be opened is a series of 24, ¼-in. holes around the valve skirt. Raising the valve still further gradually opens the passage between the wings on the main valve and the ring seat until the full cross-sectional area of the steam passages is attained.

The Bradford Draft Gear Company favors the use of throttle valves located in the front-end because this arrangement permits the use of superheated steam in the auxiliaries and enables the steam supply to be taken from a large opening at the topmost point of the dome, thus insuring the driest possible steam, the maximum superheat, and consequently the maximum economy in the use of fuel.

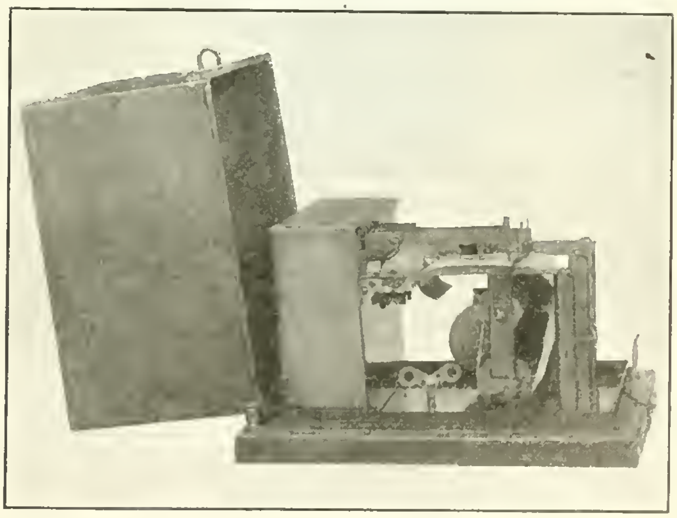
Impact Recorder and Pilferage Detector

An instrument for use in box cars, which serves the double function of recording rough handling and detecting the time at which cars have been entered for pilfering, has recently been developed by the Impact Recorder Company, Burlington, Ia. The impact recorder operates on the inertia principle. The time when the car is entered is recorded electrically by connections attached to the car door. Both records are made on the same tape.



Top View of the Impact Recorded with the Cover Removed

The instrument is equipped with a Seth Thomas No. 10, eight day recording clock movement, which carries a paper tape under the two recording pencils at the rate of one inch an hour. The impact recorder consists of a pencil barrel with provision for inserting and adjusting the lead, which is located at the free end of a flat leaf spring that normally moves in a horizontal plane. The movement of the pencil is restrained by two other flat leaf springs, each of which resist the movement of the pencil from one side of the center line of the paper tape. Each of these springs is prevented from following the pencil across the center line by a stop pin set in a bar which extends across the tape just outside of the pencil. The instrument is calibrated by means of the set screw adjustments on the restraining springs, shown in the top view of the instrument, which, once set, are arranged to be permanent.



Side View of the Instrument

The instrument case is placed in the car with the springs at right angles to its longitudinal center line. The inertia of the pencil causes it to move laterally whenever the car is subjected to a sudden change of velocity. The pencil draws a lateral line across the paper, which is calibrated to read directly in miles per hour. A velocity scale is printed on the tape, one for each 12 hours on the one o'clock line. Dots across the paper at each of the other 11 hours, correspond with the above scale reading.

In order that the tape may be readily set to correspond with the time at which the instrument is started, the driving drum is loosely mounted on the shaft. After the paper has been set and suitably marked with the date and a. m. or p. m., the cylinder is clamped to the shaft by tightening the thumb nut on the end of the shaft, shown in the side view of the instrument.

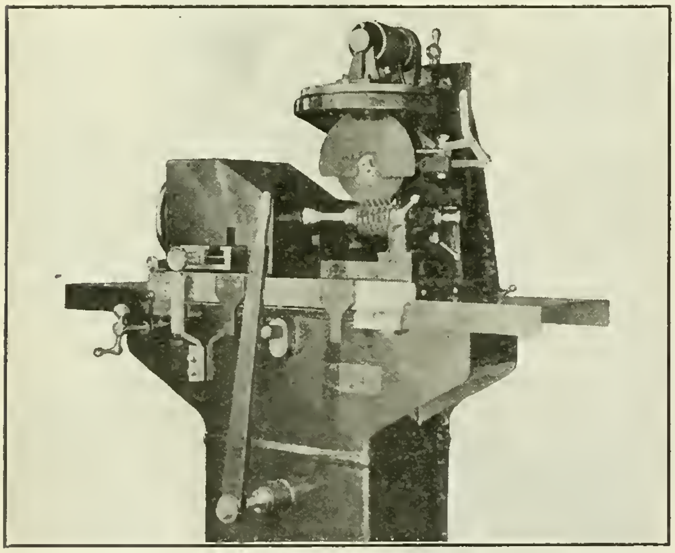
The pilferage detector consists of a buzzer magnet and armature, placed so that the armature extends laterally across the instrument. The outer end carries a pencil which rests on the paper. In order to avoid interference with the pencil of the impact recorder this pencil has been set forward on the scale so that it reads one hour later than the impact recorder. The record is therefore subject to a simple correction by the subtraction of one hour from the scale reading.

The metal box at the end of the instrument contains two dry cells which furnish the energy for the operation of the buzzer. The circuit is completed by wires carried outside the instrument. From binding posts provided for that purpose they are carried to open circuit connections either on the door post or door plate. The circuit is momentarily closed by a spring attached to the door whenever the door is opened or closed. The vibration of the buzzer armature produces a distinct record on the tape.

The weights of the parts of the instrument acting under inertia are so light that it can be used to measure vertical as well as horizontal impact. To measure vertical impact the instrument is placed on its side, in which position the weight of the pencil is not great enough to overcome the resistance of the restraining spring.

Semi-Automatic Hob Grinding Machine

To meet the demand for a hob-grinding machine for hobs with straight and right- and left-hand helical flutes not over 4 in. in diameter by 5 in. long, the Harris Engineering Company, Bridgeport, Conn., has brought out the No. 5 semi-automatic hob-grinding machine illustrated. All working parts are positively protected from emery dust. The table is operated on ball-bearing rollers, making the action very sensitive and enabling the operator to actually feel the wheel as it sharpens the hob teeth.



Harris Hob Grinder of Improved Design

An important improvement has been made in the method of transmitting a rotary motion during the travel of the table in order to grind hobs having right- or left-hand helical flutes. A lever pivoted in the center with ball bearings at each end is connected to the work spindle by a steel tape wound upon a drum. By changing the angle at which this ball-bearing lever operates, a positive helical motion is generated during the travel of the table.

The index plates are of heat-treated chrome-nickel steel, accurately cut from a master plate. They are double, one plate being used for indexing and the other plate for escapement. The escapement pawl is provided with an adjustment to take up wear. By being so designed, the wear all comes upon the escapement plate and there is no wear on the set for indexing, thus maintaining its original accuracy. The indexing mechanism is semi-automatic and can only operate at the end of the return stroke, thus preventing any damage to the wheel or hob by accidental indexing in the middle of a stroke. Indexes are changed in 60 seconds by merely unscrewing the hand wheel. The wheel spindle is driven by an endless open belt without twists, turns or idler pulleys. The largest wheel used is 7 in. in diameter. The wheel head and column are so designed as to have the center of the wheel swivel on the center line of the table and to give maximum strength and minimum overhang. The wheel spindle is carried in large bronze bearings of oil well type construction, is dust proof and has an especially designed device for taking up thrust and wear. The diamond truing device is built in the head, is always in position and may be used when the machine is in operation without disturbing the work.

This machine may be set at will to grind undercut hobs or cutters and to give them so-called top rake as well as to grind them in the ordinary way with radial face. The feed of the hob against the wheel is rotative and is obtained through a small handwheel, turned by the operator's left hand after each complete revolution of the hob on the work spindle.

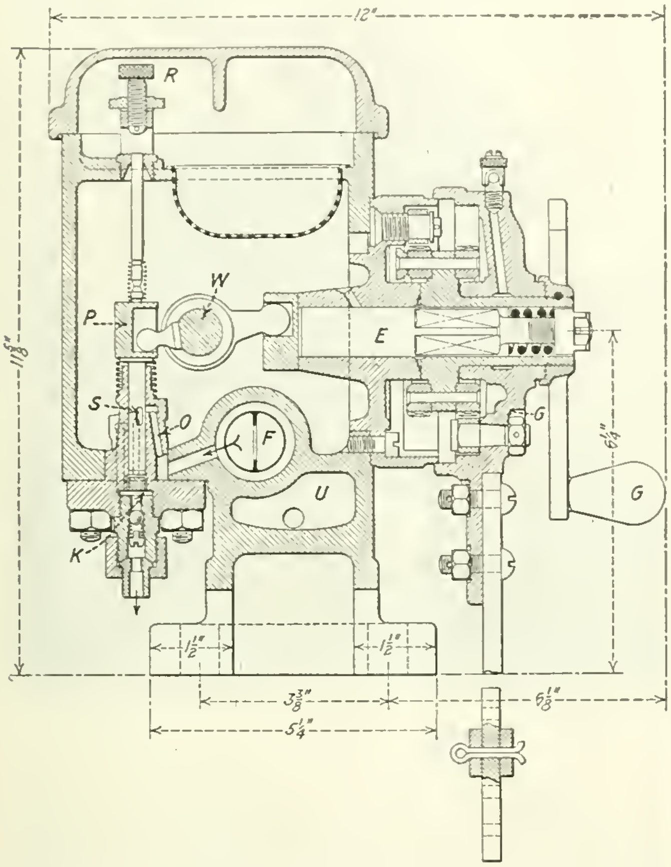
The machine is furnished with countershaft drive or individual motor drive. With motor drive, the motor is mounted on the top of the machine on a special pedestal provided with means for taking up all belt slack. This machine is usually equipped for dry grinding, but can also be provided with pump and piping for wet grinding.

Valveless Mechanical Locomotive Lubricator

The type DV mechanical locomotive lubricator, illustrated, is made by the Nathan Manufacturing Company, New York City. It is a development of the Friedman lubricator, of which more than 60,000 have been applied to European locomotives. This lubricator is valveless, the operation of its working pistons or plungers being independent of the action of check valves. Inside the oil reservoir there is a separate valveless pump for each feed.

This pump, consisting of a plunger which in its highest and lowest position automatically opens and closes the oil inlet opening and oil outlet opening through a turning movement of the plunger, eliminates the necessity of all suction and discharge valves.

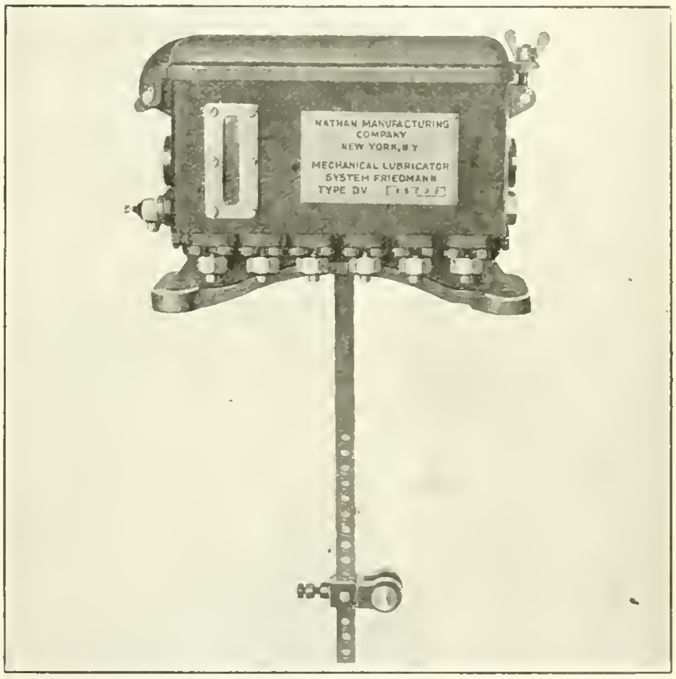
The operating movement of the mechanical lubricator is taken from some point on the motion work of the engine where the stroke is fairly constant, so that the set movement of the lubricator will not be influenced by variations in cut-off of the engine. A useful auxiliary of this device is an indicator which shows at a glance whether the oil pipes are filled with oil at the proper pressure and if not, the trouble can be located.



Cross-Sectional View Showing Operating Parts of Nathan Valveless Mechanical Lubricator

The Nathan mechanical lubricator may be obtained with two forms of terminal check, one for use when the oil is being delivered to the steam pipes and the other for applications in which the oil is delivered into the cylinders. The lubricator is simple in operation requiring little attention. The engine crew and roundhouse men have only to keep it filled with oil. The correct rate of oil feed is permanently set by the mechanical department. The engine starts the lubricator and the engine stops it.

The operation of this lubricator will be evident from the drawing. The crank disc on the end of the ratchet shaft *E* contains a circular hole which receives the ball end of the rocker arm attached to the shaft *W*, so that as the ratchet shaft rotates the vertical component of the circular motion of the hole causes the shaft *W* to oscillate while the horizontal component causes the shaft to slide back and forth. These oscillating and reciprocating motions are definite since the arm is rigidly attached to the shaft *W*. These two motions are utilized to operate the plungers for pumping and for the control of admission and discharge of oil. Each plunger is operated by a small arm rigidly attached to the shaft *W* acting on a cross head-like extension of the plunger *P* which is provided with an elongated slot. The upward motion of the plunger is effected by means of a spring below the cross head, and downward motion is effected by the small arm attached to the shaft *W* coming in contact with the bottom of the slot in the cross head. The turning movement of the plunger causes a groove *S* in the plunger to make connection from the plunger cylinder to the suction chamber *O* at the up-stroke and with the discharge chamber *K* on the down-stroke. The up-and-down motion of the plunger may be observed through the small chamber below the regulating screws, an extension rod being attached for that purpose to the top of the plunger.



Nathan Type D V Valveless Mechanical Lubricator

High-Production Automatic Milling Machine

The No. 33 automatic milling machine, illustrated, is a new product of the Brown & Sharpe Manufacturing Company, Providence, R. I., primarily designed for the automatic milling of duplicate parts in large quantities. The machine has many structural features and improvements over those of the ordinary manufacturing type. The ways are exceptionally wide and heavy; the automatic oiling system designed to be efficient, effective and thorough; and the controls are entirely within the machine.

A unique feature is the automatic control of the spindle and table. Adjustable dogs at the front and rear of the table make the control of the table and spindle entirely automatic. The available movements include a variable feed, constant fast travel and stop for the table, start and stop and right and left-hand rotation for the spindle. The table and spindle may be operated independently of each other and these movements may or may not be intermittent in either or both directions and may take place one or more times. The spindle may be stopped when the table is on its return travel, thus eliminating the possibility of marring the work. The spindle reverse allows the use of two sets of cutters with teeth facing in opposite directions so that one set may be in operation with either direction of table traverse. A constant fast travel and a slow variable feed of the table in either direction are automatically controlled by the table dogs. The machine can be set and the dogs will operate the table independently of the spindle.

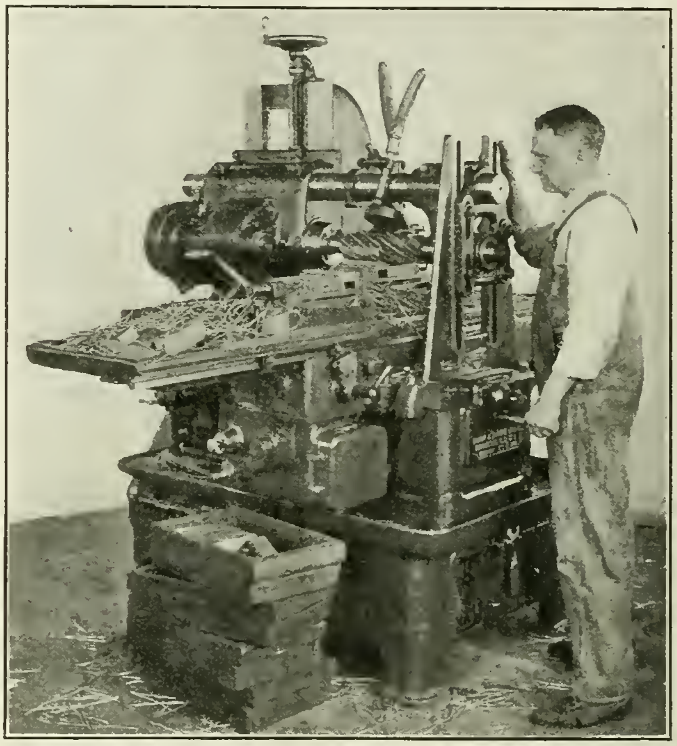
All the automatic operations of the machine are performed through the medium of the adjustable table dogs and four different styles of dogs are necessary to operate all the automatic movements of the machine. However, for ordinary milling operations, two or three of the types are usually sufficient. The spindle can be set to start, stop or reverse automatically, or it can be set to run continuously in either direction.

Although the automatic control of the spindle and table is by means of the table dogs, the same result may be obtained by hand by means of the two controlling levers conveniently located on the front of the saddle. If the loading time of a piece exceeds the cutting time, the table is set to stop for the safety of the operator. Under these conditions the machine is semi-automatic in operation, the hand control levers being employed in place of the dogs.

The manipulation of these controlling levers is extremely simple and the ease and rapidity with which they may be operated in some cases gives faster operation than when the machine is fully automatically controlled. The hand control levers also permit the operation of the machine as a plain milling machine, accomplishing within its capacity all that of an ordinary plain milling machine. The constant speed type of drive permits the machine to be driven by belt direct from the main shaft or counter shaft to the single driving pulley. This pulley runs at a constant speed and is mounted on the main driving shaft.

An important feature of the constant speed type of drive is the complete separation of the spindle speeds and table feeds, permitting any combination of the two within the capacity of the machine. Variations of the spindle speeds are obtained through change gears giving twelve changes of speeds in geometrical progression from 22 to 180 r.p.m. in either direction. The table feeds are positive and are entirely independent of the spindle speeds. There are eighteen changes ranging in practically geometric progression from .38 in. to 24.54 in. per min. This provides a range per revolution of the spindle of .002 in. to .136 in. for small mills, and .017 in. to 1.115 in. for large mills.

This machine is exceptionally well adapted to a motor drive as provision is made for neatly enclosing a constant speed motor in a chamber within the base. The cutting lubricant is pumped to the work from a large tank cast in the base. Two nozzles are provided and, therefore, if two cutters are used, each has ample cutting lubricant at all times. Provision is made for cutting off the supply to either or both nozzles if it is not needed.


New Brown & Sharpe No. 33 Automatic Milling Machine

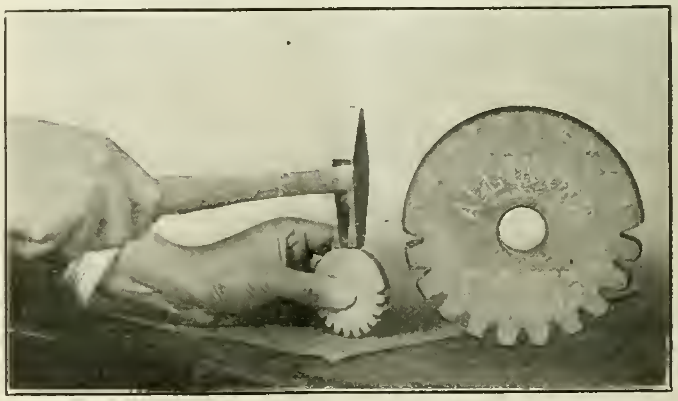
The machine has a longitudinal feed of 34 in., transverse adjustment of 5¼ in., and vertical adjustment of spindle, 15 in. The hole through the spindle is 13/16 in., the spindle having a No. 11 taper hole. Constant speed drive at 350 r.p.m. is recommended. The working surface is 52 in. by 12½ in. There are 3 T-slots, ⅝ in. wide. The net weight is 7,200 lb.

All-In-One Steel Figures Save Time

An ingenious arrangement of steel figures, with important advantages over the individual steel figures or letters commonly used, is shown in the illustration and has been placed on the market recently by Marburg Bros., Inc., New York. The method of using these figures is plainly shown at the left in the illustration and a close-up view at the right. The figures are cut around one-half of the circumference as indicated.

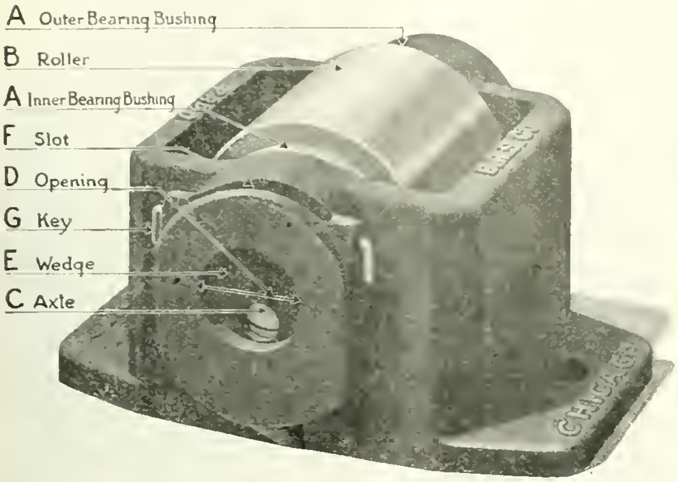
Many obvious advantages result from this arrangement including in the first place the saving of a large amount of time formerly spent hunting for the correct individual figures. The All-In-One is more convenient to handle, with less danger of smashed fingers, and vertical figures or letters are produced with ease. In addition, the speed of stamping is greatly increased and the figures never get upside down. Shattering is prevented and the general appearance of the lettering is improved. There are no individual figures to be lost or disarranged.

The All-In-One can be furnished for metal, wood, or leather in seven sizes from 1/16 in. to ⅜ in. In case alphabets are desired they can be furnished on three discs.


View Showing Method of Using All-In-One Steel Figures

Paragon Continuous Roller Side Bearing

A CONTINUOUS roller side bearing, the housing of which is protected against wear from the roller axle bearings, has been placed on the market by the Burry Railway Supply Company, Chicago. The bearing is known as the Paragon frictionless side bearing and is designed for use on passenger equipment.



The Housing of the Paragon Roller Side Bearing is Protected from Wear by Removable Axle Bushings

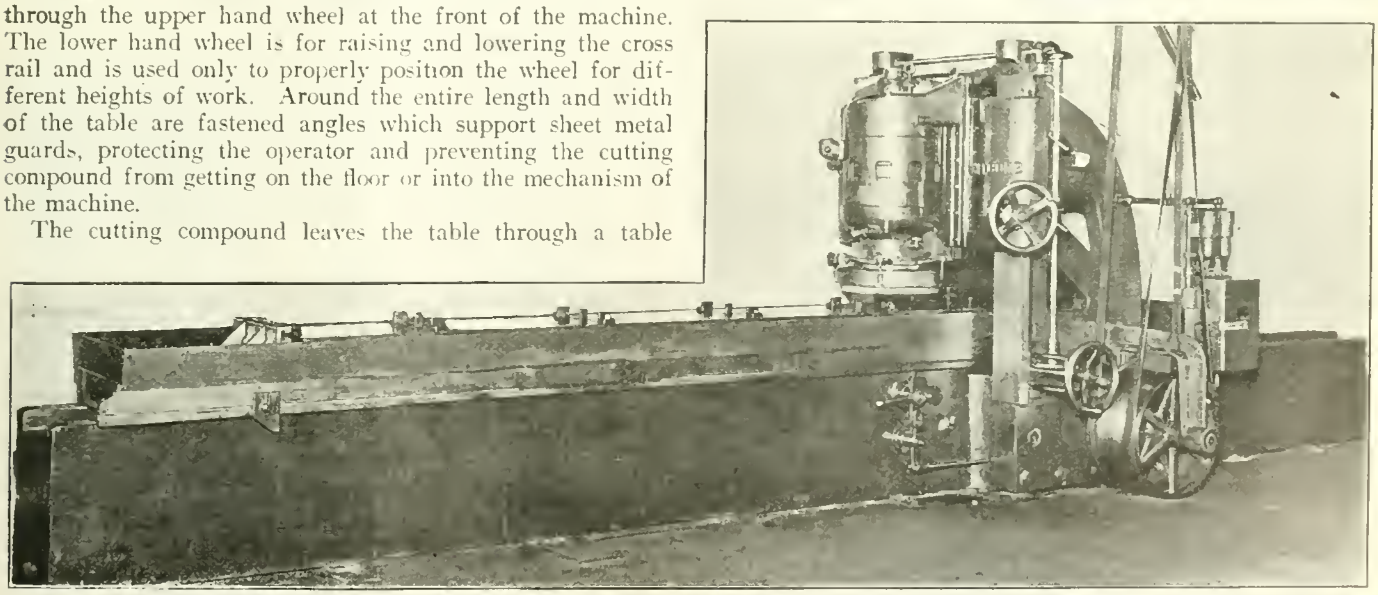
The roller is not of the trunnion type. It revolves on a removable axle which is inserted through one end of the housing and is held in place by a wedge and key which are located in the inner end of the housing. The housing is protected from destruction from the rapid wearing out of the axle bearings by the insertion of interchangeable bushings, shown at *A* in the illustration. In assembling the bearings these bushings are inserted in the housing from the inside and are provided with chafing flanges which bear against the inside faces of the housing. The lower half of the bushings and the pockets in the housing are semi-hexagon in form, thus preventing the bushings from turning in the housing, and the bearing area of the hexagonal surfaces is large enough to protect the housing against cutting out from the pressure on the bearing. The thickness of the metal in the lower half of the bushing has been made great enough to insure a considerable length of service before renewal becomes necessary.

In assembling this side bearing the bushings are first slipped into the pockets in the housing. The roller *B* is then inserted between them, thus locking them in place, and the axle *C* is inserted through the opening *D* in the inner end of the housing. The outer end of the housing is closed, thus preventing the axle from slipping through, and a thin wedge *E*, inserted in the slot *F* at the inner end of the housing, closes the opening through which the axle is inserted. The wedge is locked in place by the insertion of the wire pin *G*.

The bearing bushings are easily renewed without removing the housing from the bolster and renewal of these bushings restores the bearing to its original condition. While intended primarily for application to the truck bolster, the Paragon side bearing may be inverted if desired and applied to the body bolster.

Planer-Type Surface Grinding Machine

THE new grinding machine illustrated consists of the bed, table and housings of a 36-in. heavy duty planer with a special cross rail, on which is mounted a self-contained 25-hp. motor-driven grinder head, carrying a 20-in. wheel. The vertical movement of the head is obtained through the upper hand wheel at the front of the machine. The lower hand wheel is for raising and lowering the cross rail and is used only to properly position the wheel for different heights of work. Around the entire length and width of the table are fastened angles which support sheet metal guards, protecting the operator and preventing the cutting compound from getting on the floor or into the mechanism of the machine.



Reed-Prentice 36-In. Planer-Type Surface Grinder Driven by Self-Contained 25-Hp. Motor

The cutting compound leaves the table through a table spout, and flows through metal troughs to receiving and supply tanks, located in the floor. The cutting compound is delivered to the wheel from a pump in the supply tank through two 1-in. pipes, one to the inside of wheel, the other to the outside.

The work is held by six magnetic chucks with a magnetic surface of $14\frac{1}{8}$ in. by $19\frac{3}{4}$ in. A cast-iron spacer between each chuck insures the work being supported its entire length against the thrust of the wheel. On the cast-iron spacers are mounted side guides and spacers, and at one end a work "bunter' is provided. These are necessary in case the electric current to the chucks should be shut off while the wheel was traveling over the work.

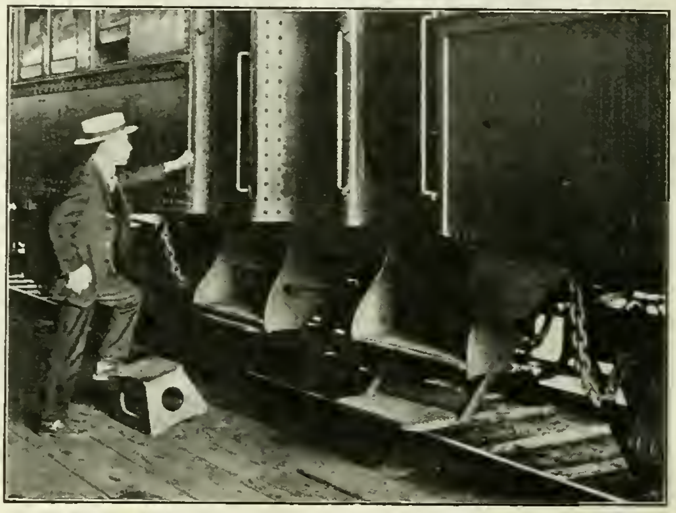
The machine will grind work 19¾ in. wide by 15 ft. long and 10 in. high above the magnetic chucks. The machine is equipped with a two-speed countershaft for driving the table, and the two speeds provide for roughing and finishing cuts. The roughing cuts are taken at a table speed of 30 ft. per min., the wheel cutting both on the forward and return strokes. The finishing cuts are taken at a speed to suit requirements.

Although this machine was designed for grinding cast-iron channels, and is longer than ordinarily used in railroad shops, it can be used for finishing rods and other long parts. It can also be obtained in shorter bed lengths for grinding locomotive guides and other parts. The machine is made by the Reed-Prentice Company, Worcester, Mass.

Extension Coach Step Prevents Accidents

IN 1916 the Duluth, Missabe & Northern began the equipment of its coaches with an extensible coach step the patents on which were secured and are owned by John T. Rodenbur, a conductor on that road. This device, which was illustrated and described in the *Railway Mechanical Engineer* for March, 1917, page 163, has been in general service on the passenger equipment of the Duluth, Missabe & Northern for more than six years. In that time the railroad has not had a personal injury to a passenger caused while getting on or off a train. The illustration, which shows the extensible step both in the operating position and drawn up closely under the bottom fixed step, suggests the type of accident which the step prevents. Prior to the general application of this device, which is known as the Rod-En-Bur extensible step, several personal injury suits had been filed against the railroad as the result of accidents caused by passengers slipping off the step box or tipping it over. The latter type of accident was the more common.

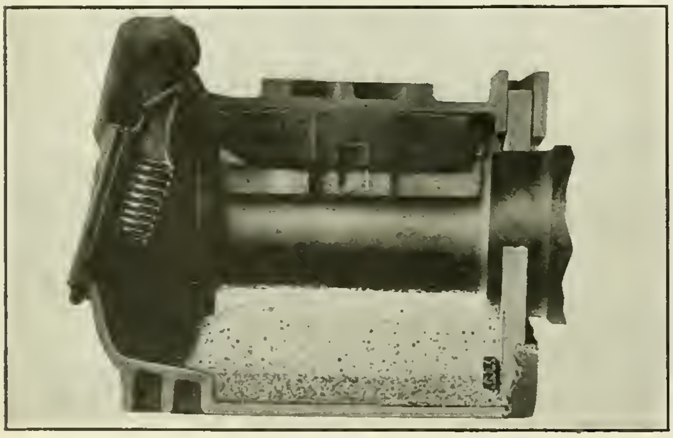
The step is of simple construction and is easily operated by a lever in the end of the vestibule. The guides in which the side bars of the extensible step operate are fitted with roller bearings. A simple interlocking device makes it impossible to lower the step while the vestibule trap door is closed and makes it necessary to raise the step before the vestibule side door or trap door can be closed. The original cost of applying the step under conditions as of 1916 was approximately $50 per car. Once installed, the device requires no lubrication or adjustment and during the six years of general service on the Duluth, Missabe & Northern there is reported to have been practically no expenditure for maintenance chargeable directly to this step.



The Rod-En-Bur Safety Coach Step Renders Effective Service on the Duluth, Missabe & Northern

Journal Box Designed to Save Waste and Oil

THE waste an oil retaining features of the journal box illustrated are of special interest. This box is made by the National Malleable Castings Company, Cleveland, Ohio, and the features mentioned are obtained by means of a retaining wall or shoulder on the floor of the box directly underneath the end of the journal, and an oil port through the inner dust guard wall, as indicated in the illustration.



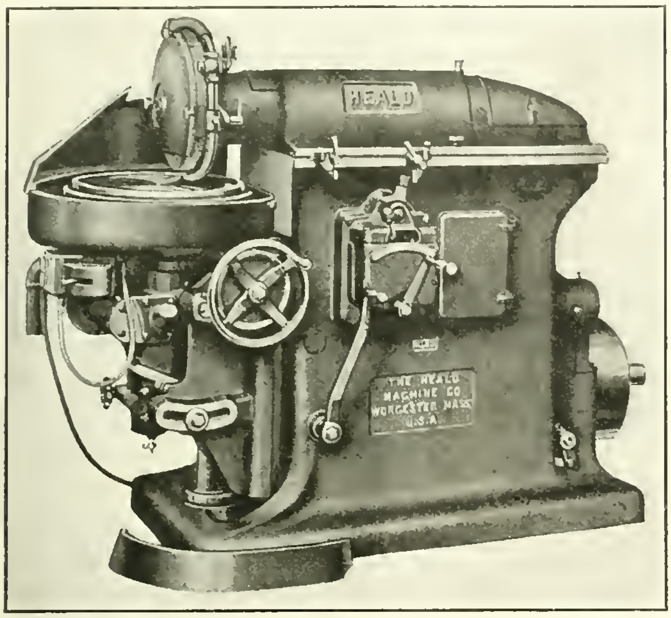
National Journal Box with Waste and Oil Retaining Features

The retaining wall prevents the waste from working forward into the front of the box and serves as an oil gage to show the inspector when he has supplied the right amount of oil. The oil port in the inner dust guard wall allows the oil which accumulates in the dust guard pocket to return to the waste at the bottom of the box and be used again. These features tend to eliminate the liability of hot boxes with the resultant loss of time and cost of repairs.

It is common practice to apply a plug and waste between the end of the journal and the front of the box to prevent the waste working forward and leaving the back of the journal without any waste contact. The arrangement shown, which is known as the Tatum-Zell entirely eliminates this front plug, as the collar of the journal and the shoulder in the floor of the box retains the waste in position. With this front plug eliminated the oiler can readily see the amount of oil contained in the box. The above features also result in a saving of oil since the amount available in the box can be determined at a glance. Attention is also called to the large and powerful coil spring which insures positive closing of the journal box cover. This is a special feature of the National coil spring journal box, the entire design of which has been developed along practical lines suggested by actual service requirements.

Powerful Rotary Surface Grinding Machine

THE most rigid and powerful rotary surface grinder yet produced by the Heald Machine Company, Worcester, Mass., is its No. 25 model illustrated. While designed for big production and grinding parts from the rough to a smooth concentric finish, this machine is of a relatively inexpensive type, having the further advantages of low wheel maintenance cost, provision for quickly changing grinding wheels, and small power consumption compared to work done.



Heald No. 25 Rotary Surface Grinding Machine

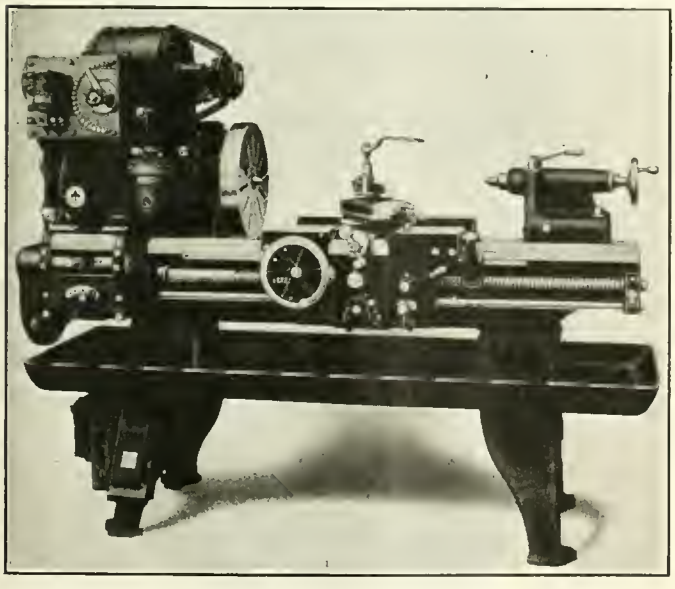
This machine is provided with a quick return wheel slide, hydraulically driven by oil, enabling the operator to get any speed desired. Operation of an auxiliary speed valve also enables a slow forward travel and a quick return to be obtained, when it is not desired to have the same speed on both the forward and backward strokes. With the slow forward travel it is possible to remove a large amount of stock with very slight wheel wear while the quick return immediately moves the wheel back into position for a second cut or new work.

The chuck is mounted on a spindle, supported by oil submerged bearings housed in the chuck bracket. This bracket can be raised and lowered by a hand wheel and can be tipped for concave and convex grinding. Special top plates can be furnished suitable for odd shaped work. The wheel is mounted on a chrome vanadium steel spindle, carried in an adjustable bronze bearing at the front and in S. K. F. ball bearings at the rear end. The grinding wheel cuts on the periphery which tends to provide long wheel life. Wheel changes can be made in three minutes.

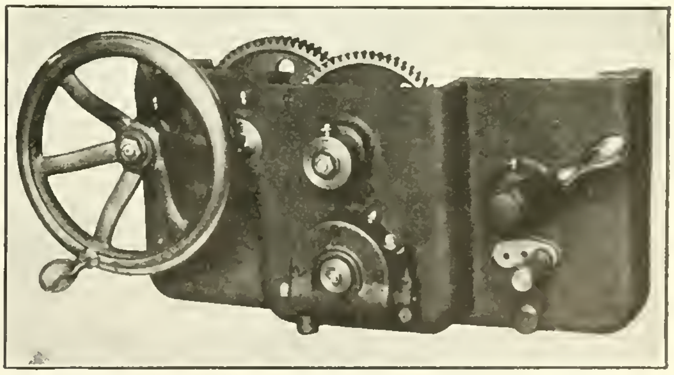
The main drive shaft at the rear of the machine is mounted on ball bearings and may be driven directly from the main line or motor. This machine is furnished with any one of three sizes of magnetic chucks, 8 in., 12 in., or 16 in. in diameter. Automatic vertical feed for the chuck can be provided if desired. The water equipment includes the pump, tank, water guard and connections. The maximum swing with the 16-in. chuck is 20 in. inside the water pan. The vertical adjustment of the chuck is 7⅞ in. The machine will grind concave 5 deg. and convex 15 deg. Tight and loose pulleys 15 in. in diameter with a 5½-in. face, running at a speed of 550 r.p.m., are required. For motor drive a 10-to 15-hp. motor is recommended, running at a speed of from 850 to 1,200 r.p.m. depending upon conditions.

Variable-Speed Geared Motor-Driven Lathe

THE variable-speed geared motor-driven lathe, illustrated, is one of several models of heavy duty lathes recently put on the market by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. These lathes, made in 13-in. and 15-in. sizes, can be supplied with 3-step cone, double friction back gear head, or single pulley drive geared back. Motor drive can also be provided. Besides the wide variety of modern drives offered, these lathes have other distinctive features including a new one-piece box section apron with positive tooth feed clutch, improved heavy duty carriage and a bed with ample strength for the duty imposed on it. The lathes are of exceptionally rigid design, embodying high power, convenience of operation and accuracy.



Le Blond 15-In. Lathe with Driving Motor on Headstock



One-Piece Box Section Apron with Positive Tooth Feed Clutch

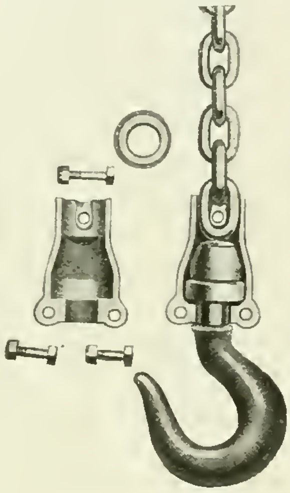
With motor drive, two types are offered including belted motor drive for constant speed motors and variable speed geared motor drive, as illustrated, for direct current variable speed motors. In this arrangement the lathe is equipped with automatic controllers embodying a dynamic brake. The motor is mounted on top of the headstock and the drive is through a motor pinion and intermediate gear to the broad faced gear that replaces the driving pulley. In this construction the first series of gear changes in the headstock are omitted, the speeds being obtained electrically. On lathes with beds 6 ft. or shorter, the clutch-operating lever is also eliminated, the spindle being controlled by the lever on the electric starting box. This lever controls both the forward and reverse rotation of the spindle and in the "off" position applies the dynamic brake bringing the spindle to an instant stop. On lathes with beds longer than 6 ft. apron motor control is supplied instead of apron mechanical control. When more convenient the motor can be mounted on an adjustable motor plate attached to the leg of the lathe and driving through an endless double leather belt to the driving pulley.

In the 15-in. size the swing over the shears is 16¼ in. and over the carriage 11¼ in. Nine forward spindle speeds are available from 20 to 350 r.p.m. (geared head lathe). There are 32 feeds from 12 to 184 per inch. Thirty-two threads from 3 to 46 per inch can be cut. The lathe weighs, in the 6-ft. length, ready to ship, 2,015 lb.

Chain Hoist Lower Hook Swivel

A NEW style of ball bearing swivel hook connection for the ends of hoisting chains has been developed by the Wright Manufacturing Company, Lisbon, Ohio, as illustrated. This swivel eliminates the necessity of pulling and tugging at the load to get it into the desired position. Ease of swiveling permits heavy loads to be turned on this hook by a small expenditure of energy.

In construction the hook connection is practically indestructible, with a large drop forged housing enclosing the entire bearing and chain connection. The housing is split its entire length, being clamped together by three steel bolts, held by castellated nuts. The top bolt passes through the lower chain link but only acts as a reinforcement to the connections and clamp for the housing as the load on the hoist hook is supported by bosses forged in each half of the housings, these bosses meeting each other inside the lower chain link so that the hook is held on an area of forged steel equal to the clearance on the inside of the chain link. The two lower bolts of the connection serve only as housing clamps.



Ball Bearing Swivel Hook

The lower ball race rests on a shoulder at the bottom of the housing. The upper race rests on the top of the large capacity balls which easily accommodate any overload hung on the hook. The straight shank of the hook passes up through the lower part of the housing and the inside of the ball races and is retained in place by a washer and extra large nut screwed and riveted to the threaded end of the shank. The ball bearings are thoroughly lubricated so as to insure easy frictionless action and to overcome all difficulty in positioning heavy loads. The new Wright swivel hook should prove of special value in railroad shops because of the large number of such hooks used on cranes and hoists in the various shop departments, many of the hooks now in use being home-made and inferior as regards safety and ability to swivel easily under heavy loads.

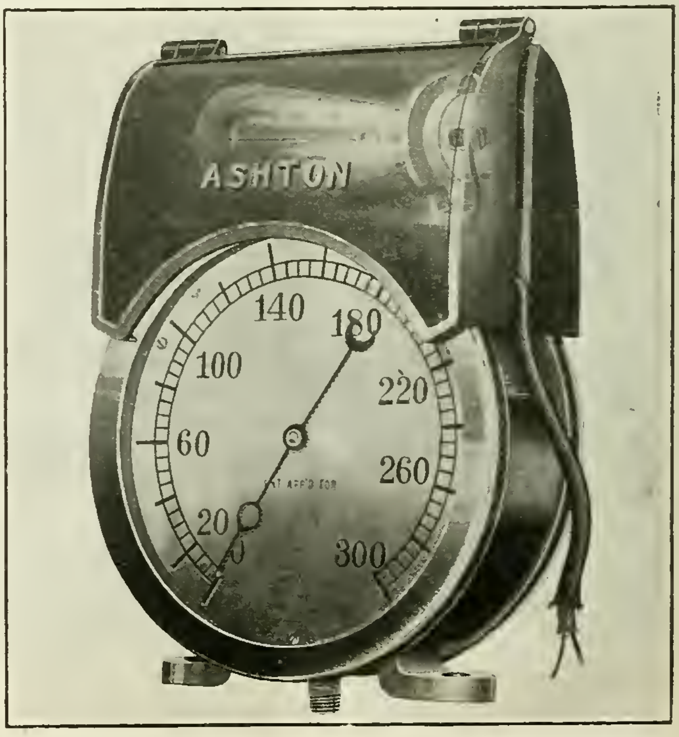
Double Dial Locomotive Steam Gage

THE double dial locomotive steam gage, illustrated, is a recent development of the Ashton Valve Company, Boston, Mass. It is particularly designed for use on large oil-burning locomotives and locomotives having large fireboxes with boiler heads extending back into the cabs, requiring two steam gages, one visible to the engineman on one side of the cab, and one for the benefit of the fireman on the other side.

The gage is constructed with two hands and also two dials which are opposite and parallel to each other. The hands work clockwise on one dial and contraclockwise on the other.

Illumination for both dials is provided in the practical and compact manner illustrated. The particular advantage of this gage is in eliminating the necessity of two gages which take up valuable space in the cab and require duplicate piping.

The gage housing is self-contained and is equipped with an A. R. A. standard receptacle for lamp bulbs, substantially fastened to the top of the gage. The arrangement is such that light is reflected downward on the two dials in such a manner as not to interfere with the vision of the engineman. The dials are finished either silvered or black, as specified, and are regularly graduated to 300 lb. or 400 lb. These gages are made only in the 3¾-in. dial size, being contained in dust-proof brass, or iron cases, with threaded valve brass rings and having ¼-in. standard pipe thread connections. If desired, gages are furnished without the light attachment.



Double Dial Steam Gage with Electric Light Shown in Phantom

GENERAL NEWS

Group insurance, life, accident and health, is to be provided for the shopmen, said to number 10,000, on the Great Northern Railway by the Metropolitan Life Insurance Company, of New York City. The scheme is similar to group insurance arrangements on other roads, but it is said that the shopmen's brotherhood deals directly with the insurance company, the railroad company not being a party to the contract.

Employees of the Philadelphia & Reading in Philadelphia have been invited by the management to attend a series of noon meetings in the Young Men's Christian Association to listen to short addresses on railroad work, the purpose being to acquaint the employees of each department with the work done in other departments. The first subject dealt with was company welfare work; other subjects include fuel; materials and supplies, disbursement and conservation; freight traffic; movement of trains, the personal touch; what is done with the railroad's dollar; what is involved in a locomotive; light railway operation on the Western front in the War; creating travel.

2,000 Cars to Be Built in Chile

The Chilean government has decided to place an order for 2,000 steel freight cars to be built in Chile, according to Commerce Reports.

The Southern's Expenditures for Equipment

New cars and locomotives costing $17,000,000 have been ordered recently by the Southern Railway. This is in addition to equipment costing $13,000,000 purchased in 1922, making a total outlay of $30,000,000 for equipment by the Southern Railway in two years.

New Officers of Pacific Railway Club

The Pacific Railway Club of San Francisco, Cal., has elected the following officers to serve during 1923: President, F. S. Foote, professor of railroad engineering, University of California; vice-presidents, J. N. Clark, chief fuel supervisor, Southern Pacific, and J. M. Yount, master mechanic, Market Street Railway; treasurer, R. G. Harmon, chief clerk, Western Pacific—Denver & Rio Grande Western; secretary, W. S. Wollner, general safety agent, Northwestern Pacific; governors, G. W. Rear (Southern Pacific), C. E. Norton (Southern Pacific), D. Wood (Southern Pacific) and G. H. Harris (San Francisco-Oakland Terminal).

Questionnaire on Freight Cars

The American Railway Association has recently sent out Circular No. 2350 requesting from the railroads information regarding freight cars owned, the original cost and the cost of maintenance for the year 1922. The first part of the circular is arranged for a report of the average number of cars maintained and the total charges for repairs, retirements, depreciation and taxes. In the second part of the circular the equipment is separated according to type and each type is sub-divided into groups according to capacity. Data is requested under each of these divisions covering the number of cars owned, the original cost of cars, the number of cars destroyed and acquired, the average age of cars and the total number of car-years represented in each group.

The Pennsylvania's Equipment Orders

New equipment ordered by the Pennsylvania to be placed in service this year—some of it already being delivered—involves an expenditure of more than $57,000,000. In order to handle its share of the country's growing business—normally about 11 per cent of the freight and 17 per cent of the passenger traffic of the nation the company is making large additions to its present car and locomotive capacity.

Since the first of this year, the Pennsylvania has ordered 500 new steam locomotives, for delivery this year in time to be of service when business ordinarily reaches its maximum activity in the fall. In addition to those locomotives, deliveries have been completed on the 100 heavy freight locomotives ordered last August. Final deliveries are now being made on 250 passenger cars ordered last year and 15 passenger locomotives being built at the company's Altoona Works. Three new and improved electrical locomotives and 100 caboose cars are also under construction.

Last fall an order for twenty new all-steel dining cars was completed at Altoona Works. About the same time work was started on an important addition to the company's coal carrying capacity by changing 50-ton trucks to 70-ton trucks under about 10,000 coal cars. This change increases the capacity of these cars by approximately 31 per cent.

Biggest Testing Machine in the World

A crushing force equal to the weight of fifty loaded coal cars of a hundred tons each can be exerted by the largest testing machine in the world, which is now being installed at the Bureau of Standards. This machine has been in use for several years at the branch laboratory in Pittsburgh and has recently been moved to the main laboratory in Chevy Chase, a suburb of Washington, D. C.

This machine has two massive heads, one set in a concrete foundation beneath the laboratory floor, the other supported on four steel screws, each over a foot in diameter, and two stories high. The upper head may be set at any height by turning the nuts on the screws by means of an electric motor.

The specimen to be tested is placed in the machine by an electric crane capable of lifting twenty tons. The upper head is brought down until it rests on the specimen and the load applied by a huge hydraulic jack built into the lower head. The piston of this jack, on which the specimen rests, is lifted by oil forced into the cylinder under a pressure of 5,000 lb. per sq. in. by a motor-driven pump.

This testing machine will be used mainly for investigating the strength of long columns such as are used in bridges and buildings.

Continuous Brakes in France

The Conseil Superieur des Chemins de Fer has at length decided the much-vexed question of what type of continuous brake is to be favored for freight trains. The technical commission, appointed a year ago, reported in favor of the Westinghouse, but the three experts charged later by the Minister of Public Works with the task of further examining the merits of the three rival systems, Westinghouse, Clayton-Hardy and Lipkowski, came to the conclusion that more trials should be made, especially with a view to considering the advantages of the Clayton-Hardy. The council then handed over the question to another commission, whose report came up before it a short time ago.

The council unanimously adopted its conclusions, but as to what these conclusions are there is no official statement. It would be safe to guess, however, that they favor the Westinghouse brake, and that the French Government will accordingly recommend its adoption by the Powers signatory to the Berne Convention. Whether it will be adopted as the unique international brake, however, is another matter. The extensive application of the Kunze-Knorr system in Germany and elsewhere, despite the treaty of Versailles, does not bar the way to use of the Westinghouse in other countries, since both are air-brakes and can be employed indifferently without inconvenience to international freight traffic. Incidentally, it is learned that the German Government's offer to install the Kunze-Knorr brake on the French railways as part of the reparations' payment has been refused. The Supreme Railway Council, in endorsing the conclusions of its commission, stipulated that all apparatus for the French railways should be manufactured in France.

The Railway Motor Finance Corporation

The Railway Motor Finance Corporation has been organized under the laws of Illinois, for the purpose of assisting member lines of the American Short Line Railroad Association, and others, in the purchase and operation of railway passenger and express motor cars. Plans have been formulated whereby prospective purchasers of motor cars may finance their needs on a lease purchase basis, paying approximately 25 per cent cash and the balance over a maximum period of four years.

The corporation was organized following the receipt of answers to questionnaires sent to the entire membership of the Short Line Association. Since the total outlay for motor cars by any one road is insufficient to justify a separate car trust, it was necessary to organize a corporation through which the motor car requirements of a large number of lines could be combined. The corporation held its first meeting in Washington on March 3, at which J. W. Cain, manager of purchases, was elected president; L. S. Cass, president of the Waterloo, Cedar Falls & Northern and A. C. Moore, vice-president of the Chicago Railway Equipment Company, were elected vice-presidents and A. M. Fornwald was elected secretary and treasurer. In addition, Bird M. Robinson, president of the American Short Line Railroad Association; Ben B. Cain, vice-president and general counsel, T. F. Whittelsey, secretary and treasurer, and F. J. Lisman were elected directors. The principal office of the corporation will be at 616 Railway Exchange, Chicago, Ill.

N. Y. C. Ordered to Pay Hourly Instead of Piece Rates Retroactive to 1921

Shop employees of the New York Central who have been on piece work schedules since November, 1921, must be paid on an hourly basis under the terms of a decision handed down by the Railroad Labor Board on March 22. The board's ruling also provided that the employees affected should be compensated for the period of time that they were paid on piece work schedules at a wage rate "the average of which shall not be less than the hourly rates established by the decision of the board relating to such employment."

This ruling upholds the contention of representatives of the shopmen involved, who contended that the piece work schedule was introduced without proper negotiation and that the Transportation Act had consequently been violated. The Board held that the piece work schedules were not in conformity with the Transportation Act "because the employees were deprived of the right to negotiate such an agreement through their duly authorized representatives."

Economical Gasoline Rail Car on Middletown & Union

The Middletown & Union, a road 15 miles long, serving a farming district with four small villages, has obtained excellent operating results from a gasoline motor passenger car. This car, furnished by J. Blaine Worcester, Middletown, N. Y., was built around a Gramm-Bernstein 3-ton truck chassis, with a special frame. The light weight is 8,700 lb., which is equivalent to 281 lb. for each of the 31 passengers for which seats are provided.

The power is furnished by a Hinkley engine, with four 4¼ in. by 5½ in. cylinders. It is governor-controlled at a speed between 1,250 and 1,300 r. p. m., which corresponds to a piston speed of 1,200 ft. per min. The maximum speed of the car in full gear is 29 m. p. h.

The front truck is of the four-wheel type, while the drive is on the two-wheel trailing axle. The steering wheel has been converted into a brake-wheel controlling the brakes on the front truck, while a service foot-brake and an emergency lever-brake act on the rear wheels and wheel drum, respectively. There is also an electric brake, which employs a small motor, driven by current from a storage battery to rotate a screw and thus apply the brakes.

In November, 1922, the car made 107 round trips of 30 miles each, during which time the gasoline consumption was 251 gallons, or almost 13 miles to a gallon. The passengers carried during the month totaled 2,179. In December, when there was considerable snow and sleet, the gasoline consumption was at the rate of a gallon for each 10 miles run. The consumption of engine oil is from three to four gallons a month.

MEETINGS AND CONVENTIONS

Traveling Engineers to Discuss Train Control

Automatic train control will be one of the topics discussed at the next annual meeting of the Traveling Engineers' Association. The committee on this topic has recently issued a questionnaire requesting information regarding the devices in service, number of engines equipped, length of time device has been in service, the cost of installation and maintenance, and objectionable and desirable features as developed in service.

American Welding Society

At the annual meeting to be held at the Engineering Societies' building, New York, April 24-27, 1923, the following subjects will be considered: Training of operators; Resistance welding; Electric arc welding; Welding of storage tanks; Developments in welding field; Specifications for steel to be welded, and Gas welding.

American Foundrymen's Association

At the annual convention to be held at Cleveland Auditorium, Cleveland, Ohio, April 30-May 3, 1923, the following subjects will be discussed: Industrial education and training of apprentices; Pattern practice; Phosphorus and sulphur in steel; Molding sand research; Steel castings; Grey iron castings; Heat treatment of ferrous castings; Corrosion of metals; Malleable castings; Nonferrous castings; Refractories; Coal and coke; and Metallography. In addition, there will be joint reports of the American Foundrymen's Association and the American Society for Testing Materials on the following subjects: Car wheels, Cast iron pipe, Soil pipe and General castings.

Central Railway Club

Until recently the Central Railway Club has held bi-monthly meetings. Three months ago it decided to hold monthly meetings during the season, every other meeting, however, being in the nature of a topical discussion or open forum, without a formal paper. At the meeting on Thursday evening, April 12, 1923, at the Hotel Iroquois, Buffalo, at eight o'clock, the following topics will be discussed:

1. Errors in billing.
2. Preparation of cars for flour and grain loading.
3. Is it preferable to provide an outside inspection pit where locomotives can be inspected and minor repairs such as tightening, etc., be done previous to placing locomotives in engine house?

Master Boiler Makers' Association

At the fourteenth annual convention to be held at Hotel Tuller, Detroit, Mich., May 22-25, 1923, committee reports will be presented on the following subjects: Are Combustion chamber boilers as easy to maintain as straight standard firebox, Henry J. Raps; Finished material (boiler plates) should be sound and free from cracks, surface flaws and laminations, and no hammer dressing, patching, burning or electric welding allowed, Charles P. Patrick; Best methods of detecting defective boiler sheets, John J. Keogh; Hammer testing of staybolts, J. A. Holder; Standard method of applying flues, Albert F. Stiglmeier; Is the use of automatic stokers injurious to firebox sheets, H. A. Bell; Care of water tube stationary boilers, J. J. Davey; Steam leaks and bad effects on boiler plate, D. A. Lucas; Life of the superheater tubes and safe-ends, J. P. Malley; Experience with electric weld heater, John W. Holt.

Railroad Session at Spring Meeting of A. S. M. E.

During the Spring Meeting of the American Society of Mechanical Engineers, which this year is being held at Montreal, Quebec, the Railroad Session will be held on Tuesday morning, May 29, 1923.

Papers of more than ordinary interest at the present time are being prepared and will be presented. One paper entitled, "Construction of Steel Frame Box Cars by the Jig Method," is to be presented by H. R. Naylor, assistant works manager, Canadian Pacific, Angus shops, Montreal, Quebec. The paper will be descriptive of the modern methods employed at this shop and fully detail the jig method of car construction which marks a definite step forward in the building of railway cars. The author has done a great deal in the development of this method and is fully qualified to present the topic.

The paper on Railroad Motor Cars by C. E. Brooks, chief of motive power of the Canadian National Railways, Toronto, Ont., promises to be of more than ordinary interest. The Canadian National Railways have tested out a large number of cars of this character and experiences with, and qualifications of, various designs will be given.

Fuel Association Organizing Local Chapters

Periodical meetings in the principal railroad centers to stimulate interest in fuel matters is one of the activities recently undertaken by the International Railway Fuel Association. In December, 1922, President J. N. Clark, acting upon authority of the Executive Committee, requested members in some of the larger railroad centers to organize district chapters. This work is now being carried forward and the District of Columbia Chapter, which was organized on January 10, 1923, has already held two meetings. The subjects discussed by this chapter included: Forms of Fuel Contracts; Practicability of Fuel Purchase on Specification Basis; Methods of Fuel distribution by Direct Consignment from Mines to Coaling Station and Otherwise, and Supervision of Locomotive Operation. The Chicago District Chapter held a meeting on March 12 at which W. E. Dunham, assistant superintendent motive power and machinery of the Chicago & North Western, presented a paper on Cold Weather Practices as Related to Fuel Conservation. Each section will be allowed to work out its own program for the discussion of problems of local and general interest. It is thought that by holding informal meetings each thirty or sixty days, the members will be able to carry out the objects of the organization to better advantage and promote the best methods for fuel economy in their own territory.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, May 1 to 4 inclusive.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting, Chicago, beginning June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923. Annual meeting, Hotel Sherman, Chicago, May 15, 16 and 17, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., beginning June 25, 1923.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting April 10. Paper on The Legal Department of the Railway and Its Functions will be presented by E. B. Flintoft, assistant general solicitor, Canadian Pacific, Montreal, Canada.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G Crawford, 702 East Fifty-first St., Chicago, Ill. Next meeting, May 21-24, 1923, Cleveland, Ohio.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Annual convention, Hotel Fuller, Detroit, Mich., May 22 to 25 inclusive, 1923.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting April 10. Annual entertainment, Copley-Plaza Hotel.

New York Railway Club.—H. D. Vought, 26 Cortlandt St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago.

SUPPLY TRADE NOTES

Joseph T. Ryerson & Son, Chicago, have taken over the Cincinnati Iron and Steel Company, Cincinnati, Ohio.

C. R. Lewis, general manager of sales of the Standard Forgings Company, Chicago, has been appointed vice-president.

B. L. Worden, has been elected director and vice-president of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

A. C. Goodale has been appointed branch manager of the Cutler-Hammer Manufacturing Company, with headquarters at Detroit, Mich.

R. E. Janney, consulting engineer of the coupler department of the American Steel Foundries, Chicago, died on March 2 in Chicago.

W. C. Irwin has been appointed southwestern sales manager for the Union Railway Equipment Company, with headquarters at St. Louis, Mo.

Columbus K. Lassiter, president of the Consolidated Machine Tool Corporation of America, New York City, and formerly vice-president in charge of manufacturing of the American Locomotive Company, died from a sudden heart attack while driving his automobile in New York City on March 3. He had served also the Bausch Machine Tool Company, Springfield, Mass., as a controller, and was a director of many other corporations. Mr. Lassiter was born in Suffolk, Va., and was 57 years of age at the time of his death. He served with the American Locomotive Company for 29 years at Richmond, Schenectady and New York. His first position with this company was that of timekeeper at Richmond and he was promoted until he became general mechanical superintendent. About nine years ago he was elected vice-president in charge of all manufacturing, from which position he resigned on July 1, 1922, to become president of the Consolidated Machine Tool Corporation of America which he was instrumental in organizing. He served as president of the Consolidated Machine Tool Corporation up to the time of his death. Mr. Lassiter was the patentee of a number of machine tool and railroad appliances, chief of which was staybolt machinery now in general use in most of the railroad shops in this country.

Columbus K. Lassiter

Edwin Henry Benners, an inventor of railway appliances and formerly a manufacturer of lubricating oils, died on March 9 at Elizabeth, N. J.

The Reliance Manufacturing Company, Massillon, Ohio, has opened a district sales office in the Fullerton building, St. Louis, Mo., in charge of A. C. Rule.

A. S. Littlefield, western sales agent of the Loraine Steel Company, with headquarters at Chicago, died on March 4 from heart trouble at his home in Chicago.

The Walter A. Zelnicker Supply Company, St. Louis, Mo., has removed from 325 Locust street to new offices in the Chamber of Commerce building, 511 Locust street.

C. A. Dunn, formerly sales representative of The Prime Manufacturing Company, has been appointed manager of sales of The Weldless Tube Company, Wooster, Ohio.

C. S. Sale, since 1918 assistant to the president of the Railway Car Manufacturers' Association, New York City, has resigned to accept an appointment with the American Car & Foundry Company, 165 Broadway, New York City.

The Production Engineering Corporation, Canastota, N. Y., has been incorporated to take over the business of the Marvin & Casler Company, Canastota. This corporation will continue to manufacture and sell the Casler tools for machine shops.

The Union Asbestos & Rubber Company has moved its factory to 351 East Ohio street, Chicago. The general office of the company will be located at the factory and the present offices at 231 South Wells street will be retained as the sales offices of the organization.

Lawrence F. Whitney has joined the New England sales organization of the Reading Iron Company, Reading, Pa. Mr. Whitney will assist the district sales manager for New England. He will be located in the company's district office at 161 Devonshire street, Boston, Mass.

H. J. Titus, until recently with the American Locomotive Company, at Paterson, N. J., and George H. Zouck, until recently mechanical engineer with W. H. Marshall, have joined the Franklin Railway Supply Company, Inc., New York, as assistant engineers in its engineering department.

A. A. Taylor

A. A. Taylor, manager of the railroad division of Fairbanks, Morse & Co., with headquarters at Chicago, has resigned to become vice-president and general manager of the Locomotive Firebox Company, manufacturer of Nicholson thermic syphon, with the same headquarters. Mr. Taylor was born at Yates City, Ill., on December 3, 1869, and entered railway service in the office of the vice-president of the Chicago, Burlington & Quincy at Chicago, in 1887. In 1889, he entered the employ of Westinghouse, Church, Kerr & Company, Chicago, in the stoker department, where he remained until 1891, when he entered the sales department of the Morden Frog & Crossing Company, Chicago. From 1896 to 1899, he was employed by the Cable Piano Company, Chicago, and on February 1, 1899, he entered the employ of Fairbanks, Morse & Co., Chicago, as a salesman in the railroad department in the territory east of the Mississippi river and south of the Ohio river. In 1906, he was promoted to manager of that part of the railroad department operating from Chicago, with headquarters at Chicago. In September, 1915, he was promoted to manager of the railroad division including the construction department, in charge of all railroad business in the United States and foreign countries, which position he held up to the time of his resignation. Mr. Taylor has been active in railway supply association work, having served as a director of the National Railway Appliances Association for the last three years.

Edwin L. King has been appointed district sales manager for the Reading Steel Casting Company, Inc., Reading, Pa.; Pratt & Cady Company, division Reading Valve and Fittings Company, division, Bridgeport, Conn., with headquarters at 208 South La Salle street, Chicago, Ill., to succeed M. L. Chase, resigned.

L. R. Phillips has been appointed district sales manager of the Detroit Seamless Steel Tubes Company, Detroit, Mich., and has established an office in Chicago. For the past 20 years Mr. Phillips has been associated with the National Tube Company, 17 of which were with the Chicago office, and the latter three with its St. Louis office.

The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, manufacturers of high-pressure hydraulic presses, pumps, valves, accumulators and intensifiers, has increased its capitalization from $260,000 to $1,200,000. The company's plant will be extended soon by the addition of a new office building, an extension to the erecting shop, wood and pattern department, and the addition of new machines in the machine shop and pattern department.

The Tennessee Coal, Iron & Railroad Company has leased the plant of the Clearfield Steel Company, Birmingham, Ala., heretofore occupied by the Chickasaw Shipbuilding & Car Company, and will use it for the manufacture of railroad cars. It will be known as the Clearfield Car Works of the Tennessee Coal, Iron & Railroad Company.

W. E. Brumble

W. E. Brumble, manager of the Southeastern territory of the Nathan Manufacturing Company, New York, died at his home in Baltimore, Md., on March 2. Mr. Brumble was born at Renovo, Pa., on April 8, 1871. He began railway work as a messenger for the Northern Central in March, 1885, and subsequently served consecutively as yard clerk and fireman. In May, 1894, he was appointed an engineman on the Norfolk & Western and in October, 1901, he entered the services of the Seaboard Air Line as road foreman of engines. He was later promoted to trainmaster of the first division with headquarters at Richmond, Va. From October, 1903, until October, 1916, he was with the Galena Signal Oil Company at Richmond, as mechanical expert, leaving that company to enter the services of the Nathan Manufacturing Company as manager of its Southeastern territory, the position he held at the time of his death.

E. F. Chaffee

Edward F. Chaffee, manager of the railroad department of the O. M. Edwards Company, Inc., Syracuse, N. Y., has been elected a vice-president of that company. Mr. Chaffee has been identified with railroad and allied industries since his boyhood. Eighteen years ago he went with the Edwards Company from the New York Central, where he had charge of the passenger car shops at West Albany. His first work for the Edwards Company was in the capacity of eastern sales representative. Six years later he was promoted to manager of the company's railroad department.

The Sykes Company, with headquarters at Kenosha, Wis., has been organized for the manufacture and sale of gasoline driven rail equipment. The personnel of the new organization includes: C. E. Sykes, Ardmore, Okla., president; C. S. Lynch, Ardmore, Okla., secretary and treasurer; A. M. Russell, Kenosha, Wis., vice-president, formerly president and organizer of the Russell Company, Kenosha, Wis.; J. A. Hennan, Ardmore, Okla.; M. T. Winther, Kenosha, Wis., president of Winther Motors, Inc., and formerly vice-president of the Russell Company; Ray Koehler, formerly chief engineer of the Winther Motors, Inc.; J. F. Sattley, formerly general manager of the central region of the Russell Company, and C. A. Sattley, formerly general manager of the eastern region of the Russell Company.

H. F. Mattern has been appointed sales manager of the Reading Iron Company, Reading, Pa., to succeed E. F. Mishler, whose death occurred on December 11, 1922. Mr. Mattern joined the

Reading Iron Company in 1911 as a salesman, and was given the New England and southern territories to cover. In 1919 he was appointed assistant sales manager.

The Gibb Instrument Company, Bay City, Mich., has taken over, under exclusive license, the manufacture and sale of the automatic and semi-automatic electric arc welding machines developed and heretofore manufactured by the Fred Pabst Company, of Milwaukee, Wis., under various letters patent, and have contracted to act as selling agent for the Pabst line of patented covered electrodes.

Walter C. Doering has resigned as vice-president of the Southern Wheel Company, St. Louis, Mo., to engage in the railway supply business in St. Louis. Among the concerns that Mr. Doering will represent are the American Brake Shoe & Foundry Company, New York; the Bradford Draft Gear Company and the Republic Railway Equipment Company, Chicago. His offices will be located in the Railway Exchange building, St. Louis, Mo.

R. W. Williams

R. W. Williams has been appointed southwestern district manager for both the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company, with headquarters at St. Louis, Mo., and has also been elected a vice-president of the American Brake Company. Mr. Williams has been connected with the Westinghouse Air Brake Company since April 1, 1902, when he went to Wilmerding as secretary to John F. Miller, now vice-chairman of the board of directors. Mr. Williams was born in Renovo, Pa., in 1878. He attended public school in Williamsport, Pa., and graduated from high school with the class of 1897. He immediately entered the employ of the Pennsylvania Railroad, serving in the freight and maintenance of way departments at Williamsport until he went to the Air Brake Company. After serving in the general offices at Wilmerding for seven years, he was transferred to the southeastern district office in Pittsburgh. In 1910 he went to the Cincinnati office, and two years later was appointed representative and assigned to the Atlanta office. He returned to the Pittsburgh office in September, 1920.

Owing to the Cleveland Discount Company having gone into receivership, the Sharon Pressed Steel Company, which was being financed by them, went into voluntary receivership on February 26, in the United States District Court, Pittsburgh. The court has authorized the operation of the plant under W. L. David and Donald Thompson, receivers, who have appointed A. E. Swan, former vice-president and general manager of the Sharon Pressed Steel Company, their agent and attorney.

The Central Steel Company of Massillon, Ohio, manufacturers of alloy steel products for the automotive industry has decided to enlarge its field of activities, by the addition of special alloy steels for railroad service, such as axles, springs and reciprocating parts of locomotives. This department will be under the direction of Irving H. Jones, director of railroad development with office in the Peoples Gas Building, Chicago. Mr. Jones was formerly sales engineer with Joseph T. Ryerson & Son.

Broderick Haskell, Jr., has joined the service staff of the Franklin Railway Supply Company, Inc., New York, as special engineer in connection with the locomotive booster. A. F. Zinkan, who had been for 22 years with the New York Central, much of the time as inspector of locomotive construction, has joined the inspection department of the Franklin Railway Supply Company, Inc., and C. G. Shafer, road foreman of engines of the Southern Railway, is now a service engineer with the Franklin Railway Supply Company. Mr. Shafer's headquarters in his new position are at Memphis, Tenn. C. C. Clabaugh, formerly gang foreman in the Collinwood, Ohio, shops of the New York Central, has been appointed inspector at the plant of the Lima Locomotive Works.

TRADE PUBLICATIONS

Welding and Cutting Apparatus.—The Alexander Milburn Company, Baltimore, Md., has recently issued catalogue No. 1122 illustrating its line of welding and cutting apparatus. A price list is also included.

Zeolite Water Softeners.—Water softeners in which zeolite is used to remove every trace of lime and magnesia are described in Bulletin 509 recently issued by the Graver Corporation, East Chicago, Ind. The chemistry of Zeolite water softening is described as well as the details of operation of the Graver Zeolite softener.

Portable Woodworking Machinery.—The Oliver Machinery Company, Grand Rapids, Mich., has issued Bulletin No. 7 descriptive of its line of portable woodworking machinery, which includes motor-driven saw benches, band saws, hand planers and jointers, motor-driven disk sanders, oscillating spindle sanders, oilstone tool grinders, etc.

Electric Motors.—A pamphlet giving instructions for ordering and adjusting repair parts of single-phase motors has recently been issued by the Wagner Electric Corporation, St. Louis, Mo. The causes which may result in the motor failing to start, the brushes failing to release on full load, etc., are explained and instructions are given for correcting these conditions.

Electric Cranes.—A carefully prepared, 32-page booklet has just been issued by the Whiting Corporation, Harvey, Ill., devoted to the operation and maintenance of Whiting electric cranes. This booklet includes lists of parts together with cuts and diagrams making it easy for the user to order repair parts. A list of valuable "don'ts" for crane operators is given on the last page.

Oxy-Acetylene Outfits.—The Air Reduction Sales Company, New York, has issued two booklets describing and illustrating its line of oxy-acetylene welding and cutting apparatus and equipment, together with its tube welding machines and acetylene generators. The bulletins devote some attention to the history of these subjects, and the use of equipment, and designate the field for which each type of apparatus listed is especially adapted:

Coaling and Cinder Plants.—A bulletin has been issued by the Roberts & Schaefer Company, Chicago, describing a one-man operated plant which this company has recently developed to perform the dual functions of coaling locomotives and handling cinders The bulletin is illustrated with line drawings and photographs showing the plant in elevation and plan, as well as sectional views illustrating its general appearance and operation.

Combusco Ash Conveyor.—The Combustion Engineering Corporation, New York, has issued a large size, 12-page, illustrated booklet descriptive of a new type of ash conveyor for power plant and other uses. The text describes the various phases of its operation such as the automatic removal of ashes, the prevention of dust and fumes, the quenching, the maintenance of an air seal in the combustion chamber, etc., while the photographs illustrate numerous sections of typical installations.

Tools for Boiler Making.—The J. Faessler Manufacturing Company, Moberly, Mo., has issued catalogue No. 36 containing a complete descriptive list of all tools produced by this company. Details of roller flue and tube expanders, sectional beading expanders, flue cutters, patch bolt counter-sinking tools, etc., are contained in the catalogue, in each case illustrations, tables of sizes and price lists being included. The company also maintains a department for designing tools for special requirements and difficult tube installations.

Welding and Cutting Apparatus.—A piece parts catalogue of 15 pages has recently been issued by the Torchweld Equipment Company, Chicago, in which is illustrated and listed a complete line of welding and cutting torches and their parts, gas pressure regulators and gages. The parts shown in the catalogue are for minor repairs, which ordinarily can be made by the user, and to facilitate ordering, each part listed in the catalogue is clearly identified both by part, number and name. Assembled torches are illustrated by sectional drawing with key numbers showing the location of the listed parts.

EQUIPMENT AND SHOPS

Locomotive Orders

THE ATLANTIC COAST LINE has ordered 50 locomotives from the Baldwin Locomotive Works.

THE SEABOARD AIR LINE has ordered 20, 2-8-2 type locomotives from the American Locomotive Company.

THE PHILADELPHIA & READING has ordered 25, 2-8-0 type locomotives from the Baldwin Locomotive Works.

THE CHILEAN STATE RAILWAYS have ordered 25, 2-8-2 type locomotives from the Baldwin Locomotive Works.

THE ELGIN, JOLIET & EASTERN has ordered 10, 2-8-2 type locomotives from the American Locomotive Company.

THE SOUTHERN has ordered 50, 2-8-2 type locomotives and 16, 4-6-2 type locomotives from the American Locomotive Company.

THE GREAT NORTHERN has ordered 28, 2-10-2 type locomotives and 30, 4-8-2 type locomotives from the Baldwin Locomotive Works.

THE BOSTON & MAINE has ordered 10, 2-10-2 type locomotives and 10, 4-6-2 type locomotives from the American Locomotive Company.

THE NEW YORK CENTRAL has ordered for the Pittsburgh & Lake Erie 10, 2-8-2 type locomotives from the American Locomotive Company.

THE LOUISVILLE & NASHVILLE has ordered 30, 2-8-2 type locomotives and 6, 4-6-2 type locomotives from the American Locomotive Company.

THE NEW YORK, NEW HAVEN & HARTFORD has ordered 10, 4-8-2 type and 5, 0-8-0 switching locomotives from the American Locomotive Company.

THE SOUTHERN PACIFIC has ordered 34, 2-10-2 type, and 6, 4-6-2 type, from the Baldwin Locomotive Works, and the 10, 4-8-2 type from the American Locomotive Company.

THE BALTIMORE & OHIO has ordered 25, 2-10-2 type locomotives from the Lima Locomotive Works and 50, 2-10-2 type locomotives from the Baldwin Locomotive Works.

Freight Car Orders

THE MERCHANTS DISPATCH will build 1,500 refrigerator cars in its own shops.

THE CAMBRIA & INDIANA has ordered 1,000, 55-ton hopper cars from the Cambria Steel Company.

THE SKELLY OIL COMPANY has ordered 50, 8,000 gal. capacity tank cars from the Standard Tank Car Company.

THE UNIVERSAL PORTLAND CEMENT COMPANY has ordered 300 all-steel box cars from the American Car & Foundry Company.

THE MIDLAND REFINING COMPANY has ordered 100, 50-ton, 10,000 gal. capacity tank cars from the Standard Tank Car Company.

THE REPUBLIC IRON & STEEL COMPANY has ordered 50 flat bottom gondolas of 70 tons' capacity from the Standard Steel Car Company.

THE BUFFALO & SUSQUEHANNA has ordered 200 all-steel hopper car bodies of 55-tons' capacity, from the Buffalo Steel Car Company.

THE UNITED GAS IMPROVEMENT COMPANY, Philadelphia, Pa., has ordered 150 coal cars of 50 tons' capacity from the American Car & Foundry Co.

THE WHITE EAGLE OIL & REFINING CO., Wichita, Kan., has ordered 100 8,000-gal. capacity tank cars from the Pennsylvania Tank Car Company.

THE SEABOARD AIR LINE has ordered 1,000 box cars from the Pressed Steel Car Company, 800 gondola cars from the Standard Steel Car Company and 200 gondola cars from the Newport News Shipbuilding Corporation.

THE CHESAPEAKE & OHIO has ordered 1,000 hopper cars of 70 tons' capacity from the American Car & Foundry Co., and 1,000 from the Standard Steel Car Company.

THE HILLMAN COAL & COKE COMPANY has ordered 300 hopper cars of 70-tons' capacity from the Pressed Steel Car Company. These are in addition to the previous order for 300 cars noted in the March *Railway Mechanical Engineer.*

THE ILLINOIS CENTRAL has ordered 1,000 automobile cars from the American Car & Foundry Company, 500 automobile cars from the Western Steel Car & Foundry Company and 500 automobile-furniture cars from the Mt. Vernon Car Manufacturing Company.

THE TEXAS COMPANY has ordered 200 tank cars of 8,000 gal. capacity from the Pennsylvania Tank Car Company, 50 tank cars of 8,000 gal. capacity from the Chicago Steel Company and 50 tank cars of 10,000 gal. capacity from the Standard Tank Car Company.

THE LOUISVILLE & NASHVILLE has ordered 6,000 hopper cars of 55 tons' capacity from the Pressed Steel Car Company, 1,000 ventilated box cars of 40 tons' capacity from the Mt. Vernon Car Manufacturing Company and 1,000 ventilated box cars of 40 tons' capacity from the Chickasaw Shipbuilding Company.

THE NEW YORK CENTRAL has ordered 100 Hart convertible ballast cars of 50 tons' capacity from the American Car & Foundry Company for use on the Michigan Central. The company also has placed orders for 4,000 cars as follows: To the Standard Steel Car Company 1,500 cars of 70 tons' capacity and 500 all-steel box cars of 50 tons' capacity; American Car & Foundry Company, 1,500 all-steel box cars of 50 tons' capacity, and the Pressed Steel Car Company, 500 cars of 70 tons' capacity.

THE SOUTHERN RAILWAY has ordered 1,365 composite hopper cars and 1,500 box cars from the American Car & Foundry Company; 1,500 composite hopper cars and 1,000 box cars from the Standard Steel Car Company; 570 box cars from the Mt. Vernon Car Manufacturing Company, and 2,000 coal cars from its Lenoir Car Works. All the box cars are 36 ft. long. An order has also been given for 200 stock cars to the Kilby Car & Foundry Company.

Passenger Car Orders

THE NEW YORK CENTRAL has ordered 6 coaches from the American Car & Foundry Company. These are for use on the Peoria & Eastern. An order has also been given to the Standard Steel Car Company for 8 combination baggage and mail cars for use on the Michigan Central and for 1 combination baggage and mail car for use on the Toledo & Ohio Central.

Machinery and Tools

THE UNION PACIFIC has placed an order for a 200-ton locomotive lifting crane.

THE WESTERN MARYLAND has ordered from Joseph T. Ryerson Son, Inc., a complete equipment for the repairing of locomotive flues.

THE PERE MARQUETTE has ordered one 200-ton, five 15-ton and two 10-ton electric traveling cranes for use in its shops at Grand Rapids, Mich., from the Shaw Crane Company.

THE ATCHISON, TOPEKA & SANTA FE is inquiring for one 16-in. by 8-ft. engine lathe, one 14-in. heavy duty slotting machine with longitudinal and cross feeds and circular table feed, two vertical high power 24-in. drilling machines with compound table and capacity to drill 4-in. holes in steel, also one 5-ft. plain heavy duty type motor driven radial drill.

THE NORFOLK & WESTERN is inquiring for a number of machine tools including the following: A four-spindle planer type milling machine; a slab milling machine; 24 in. vertical turret lathe; 600-ton double end car wheel press; 72 in. plain radial drill; 60 in. plain radial drill; 48 in. radial drill; 84 in. plain radial drill; 72 in. vertical boring mill; 48 in. car wheel borer; a standard double head, center drive, car axle lathe; 2½ in. hollow spindle turret lathe; four, 20 in. by 5 ft. center engine lathes with taper attachment; two, 24 in. by 6 ft. center heavy duty lathes with taper attachment; 24 in. heavy duty lathe with taper attachment; 48 in. by 10 ft. center heavy duty lathe; 2½ in. flat head turret lathe; 16 ft. sensitive drill press; 36 in. by 36 in. by 16 ft. two-head planer; 42 in. car wheel lathe; 36 in. vertical drill press; 15 in. by 18 in. drill slotter; 26 in. by 96 in. plain grinding machine; one internal grinding machine; a plain external cylindrical grinding machine, and a 32 in. Newton plank planer.

Shops and Terminals

Missouri, Kansas & Texas.—This company has awarded a contract to the Graver Corporation, Chicago, for the construction of 24 water treating plants along its lines.

Chicago & Eastern Illinois.—This company contemplates the construction of a new roundhouse and shop buildings at Evansville, Ind., to cost approximately $3,000,000.

Toledo, Peoria & Western.—This company has awarded a contract to the Ogle Construction Company, Chicago, for the construction of a 100-ton capacity frame coaling station at Fairbury, Ill.

Illinois Central.—This company contemplates the construction of a brick and steel car repair shop and other additions to the shop facilities of the Burnside shops at Chicago to cost approximately $3,000,000.

Missouri Pacific.—This company has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for the construction of a 15,000 gal. per hour capacity water treating plant at Benton, Mo.

Chicago, Rock Island and Pacific.—This company has awarded a contract to the J. A. Benson Construction Company, Des Moines, Iowa, for the construction of a 13-stall roundhouse at Valley Junction, Iowa.

Toledo Terminal Railway Company.—This company has awarded a contract to the Ogle Construction Co. for the erection of a 200-ton, two-track, reinforced concrete coaling and sanding station at Toledo, Ohio.

Chicago, Rock Island & Gulf.—This company has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for the construction of a 300-ton, 2-track coaling and sanding station at Amarillo, Texas.

New York Central.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 100-ton two track, reinforced concrete automatic electrically operated locomotive coaling station at North Judson, Ind.

Central of Georgia.—This company has awarded a contract to the Ogle Construction Company, Chicago, for the erection of a reinforced concrete electrically-operated coaling station which will provide for ground and overhead storage of 9,000 tons and 600 tons of coal, respectively, and the storage of 200 tons of wet sand and 35 tons of dry sand, at Macon, Ga.

St. Louis-San Francisco.—This company plans the construction of new shop buildings at St. Louis, Mo., and at East Thomas, Ala. Each group will be of concrete, brick and steel construction and will consist of a roundhouse, machine shop, power house, mill shop, car repair shop and storeroom. The cost of the new facilities will be approximately $500,000 at each place.

Atchison, Topeka & Santa Fe.—This company will construct extensions to the shop facilities at San Bernardino, Cal., at an approximate cost of $1,250,000. A portion of the work to cost $750,000 will be undertaken this year. Plans include also the rearrangement of the machine, boiler and paint shops. A 120-ft. turntable to cost approximately $60,000 will also be constructed.

St. Louis-San Francisco.—This company has awarded a contract to John M. Olsen, Springfield, Mo., for the construction of a mill shop building at Enid, Okla. This company has also awarded a contract to the Jarrett Construction Company, Springfield, Mo., for a four-stall addition to the roundhouse at West Tulsa, Okla., and a five-stall addition to the roundhouse at Ft. Scott, Kan.

Southern Pacific.—This company contemplates the construction of additional shop facilities at Los Angeles, Cal., to cost approximately $1,000,000. The buildings to be constructed include a car repair shop, a forge and blacksmith shop, a one-story boiler shop, a new locomotive house and related facilities. The company is now constructing an acetylene generator plant with a distributing system throughout the entire yards and has nearly completed a two-story oil house, 34 ft. by 86 ft., with a loading platform, 42 ft. by 100 ft.

PERSONAL MENTION

General

J. Hainen, assistant to the vice-president, mechanical, of the Southern, with headquarters at Washington, D. C., has resigned.

B. Perkins has been appointed fuel agent of the Kansas division of the Union Pacific, with headquarters at Armstrong, Kansas City, Kan.

C. E. Brooks, mechanical assistant in the locomotive department of the Canadian National, has been appointed chief of motive power with headquarters at Montreal.

E. A. Rauschart, master mechanic of the Montour railroad at Coraopolis, Pa., has been promoted to mechanical superintendent, the office of master mechanic having been abolished.

W. U. Appleton, general superintendent of rolling stock of the Canadian National, has been appointed general superintendent of the Atlantic region with headquarters at Moncton, N. B.

W. E. Barnes, master mechanic of the Canadian National at Moncton, N. B., has been appointed superintendent of motive power of the Atlantic region with the same headquarters.

W. G. Black, master mechanic of the New York, Chicago & St. Louis, with headquarters at Chicago, has been promoted to superintendent of motive power, with headquarters at Cleveland, Ohio, succeeding A. R. Ayers.

J. C. Garden, general superintendent of motive power and car department of the Grand Trunk with headquarters at Montreal, has been appointed general superintendent of motive power of the Central region of the Canadian National with headquarters at Toronto.

P. W. Kiefer, assistant engineer in the mechanical department of the New York Central, has been appointed to the new office of assistant engineer of rolling stock, with headquarters at New York. H. I. Wood, chief draftsman, has been appointed assistant engineer to succeed Mr. Kiefer.

C. F. Needham, assistant to the general superintendent of the motive power and car departments of the Grand Trunk, lines east of the Detroit and St. Clair rivers, has been appointed assistant to the general manager of the Central region of the Canadian National with headquarters at Toronto, Ont.

G. O'Connell has been appointed superintendent of work equipment of the Canadian National with headquarters at Toronto, Ont. W. H. Secord, supervisor of work equipment with headquarters at Toronto, has been promoted to assistant superintendent of work equipment with the same headquarters.

E. M. Sweetman, superintendent of motive power, lines west of the Southern with headquarters at Cincinnati, Ohio, has been transferred in a similar capacity to the lines east with headquarters at Charlotte, N. C., succeeding W. F. Kaderly, resigned. Frank Johnson, master mechanic at Ferguson, Ky., has been promoted to superintendent of motive power, lines west, succeeding Mr. Sweetman.

James E. Davenport has been appointed superintendent of fuel and locomotive performance of the New York Central with headquarters at Utica, N. Y., succeeding Robert Collett, who has resigned to enter the service of another company. Mr. Davenport was born on October 8, 1887, at Charlestown, W. Va., attended the Georgia School of Technology in 1908 and 1909 and entered railway service on August 1 of the latter year as a special apprentice in the mechanical department of the New York Central. In April, 1912, he was appointed enginehouse foreman and in June, 1914, was advanced to engineer in charge of a dynamometer car. In June, 1917, he was promoted to trainmaster of the Harlem division and in November, 1918, was transferred in a similar capacity to the Mohawk division. In June, 1920, he was appointed engineer of dynomometer tests and served in that capacity until the time of his recent appointment.

Robert Collett, whose appointment as fuel agent of the St. Louis-San Francisco was announced in the February *Railway Mechanical Engineer,* page 138, entered railway service in 1895 as a locomotive fireman for the St. Louis-San Francisco. Five years later he was promoted to locomotive engineman and in 1905 was appointed road foreman of engines. In 1909 he became superintendent of locomotive fuel service and held that position until 1914, when he resigned to become assistant manager of the railway lubricating department of the Pierce Oil Corporation, St. Louis, Mo. From July 1, 1918, to March 1, 1920, he was assistant manager of the fuel conservation section of the U. S. Railroad Administration in charge of fuel conservation in the Eastern region. Upon the return of the roads to private operation, he became superintendent of fuel and locomotive performance of the New York Central and held that position until he re-entered the service of the St. Louis-San Francisco, as noted above.

W. D. Robb, ranking vice-president of the Grand Trunk, has been appointed vice-president in charge of natural resources, developments and colonization of the Canadian National, with which the Grand Trunk has been recently consolidated. He was born on September 23, 1857, at Longueuil, Que., and was educated at Sherbrooke Academy, Sherbrooke, Que. He entered railway service in 1871 as an apprentice in the motive power department at Port Levi, Que. From 1874 to 1883 he was apprentice in the same department at Montreal. He then served for a few months as night roundhouse foreman at Port St. Charles and was then appointed foreman at Belleville, Ont. In 1897 he was appointed master mechanic at London, Ont., and eight months later was transferred in a similar capacity to Toronto. In 1901 and 1902 he served as acting superintendent of motive power at Montreal and from 1902 to 1917 as superintendent of motive power. In the latter year he was appointed vice-president in charge of motive power and car department and the following year was promoted to vice-president in charge of operation.

A. R. Ayers has been promoted to assistant general manager of the New York, Chicago & St. Louis. Mr. Ayers was born on October 26, 1878, at Toledo, Ohio. He was graduated from Cornell University in 1900, and then entered railway service as a special apprentice on the Lake Shore & Michigan Southern. He was made special inspector in 1903, and held this position for two years, when he was promoted to night enginehouse foreman. He was promoted to assistant general foreman of the Collinwood locomotive shops in 1906, and a year later was made superintendent of the shops at Elkhart, Ind. He was promoted to assistant superintendent of the Collinwood locomotive shops in 1908, and a year later to assistant master mechanic at Elkhart. He was appointed mechanical engineer in 1910, and held this position for one year when he was advanced to general mechanical engineer of the New York Central, lines west of Buffalo. In May, 1915, he was promoted to engineer of rolling stock, serving in this capacity until October, 1916, when he was appointed superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. He held this position at the time of his recent promotion to assistant general manager, with the same headquarters.

Master Mechanics and Road Foremen

T. C. Baldwin, superintendent of shops of the New York, Chicago & St. Louis, at Conneaut, Ohio, has been promoted to master mechanic, with headquarters at Chicago, succeeding Mr. Black.

George T. Strong has been appointed master mechanic on the New River division of the Virginian with headquarters at Princeton, W. Va., succeeding G. H. Langton, resigned. Frank Welboan has been appointed shop superintendent at Princeton.

C. S. Branch, superintendent in charge of operation of the Chicago, Peoria & St. Louis, with headquarters at Springfield, Ill., has been appointed master mechanic of the Chicago & Alton with headquarters at Bloomington, Ill., succeeding W. H. Kerchner, resigned.

J. A. Wilking, master mechanic of the Southern at Chattanooga, Tenn., has succeeded Mr. Johnson as master mechanic at Ferguson and L. C. Schults, general foreman at Danville, Ky., has been promoted to master mechanic at Chattanooga. J. J. Robinson, master mechanic at Alexandria, Va., and M. D. Stewart, master mechanic at Bristol, Va., have changed places.

A. G. Akans, road foreman of engines of the Southern with headquarters at Sheffield, Ala., has been transferred to Knoxville, Tenn., succeeding G. G. Shafer, who has resigned. J. P. Russell, road foreman of engines, with headquarters at Birmingham, Ala., has been transferred to Sheffield, succeeding Mr. Akans, J. Sims, road foreman of engines between Birmingham, Ala., and Columbus, Miss., with headquarters at Birmingham, has been transferred to the district between Birmingham and Atlanta, with the same headquarters. J. E. Hardy has been promoted to road foreman of engines, with headquarters at Birmingham, Ala., succeeding Mr. Sims.

Car Department

G. E. Smart, mechanical assistant in the car department of the Canadian National has been appointed chief of car equipment with headquarters at Montreal.

G. E. McCoy, master car builder of the Canadian National, with headquarters at Moncton, N. B., has been appointed superintendent of car equipment of the Atlantic region with the same headquarters.

J. Coleman, assistant to the general superintendent of the motive power and car departments of the Grand Trunk lines east of the Detroit and St. Clair rivers, with headquarters at Montreal, has been appointed general superintendent of the car department of the Canadian National, Central region, with headquarters at Toronto.

Purchasing and Stores

R. C. Vaughan, has been appointed director of purchases and stores of the Canadian National with headquarters at Montreal. Mr. Vaughan was born on December 1, 1883, at Toronto, Ont. He received a high school education and entered railway service in 1898 with the Canadian Pacific. He later left this company to go with the Grand Trunk. From 1903 to 1910 he was with various predecessors of the Canadian National in various departments. From 1910 to 1918 he was assistant to the third vice-president of the Canadian Northern. From 1918 to December, 1920, he was assistant to the president of the Canadian National. From the latter date until the time of his recent appointment he served as vice-president of purchases and stores.

R. C. Vaughan

W. A. Hopkins, supply agent of the Missouri Pacific with headquarters at St. Louis, has been promoted to general purchasing agent, with the same headquarters, succeeding C. A. How, deceased. L. P. Krampf has been appointed supply agent, with headquarters at St. Louis, succeeding Mr. Hopkins.

Obituary

C. A. How, general purchasing agent of the Missouri Pacific, died on March 5 at St. Louis, Mo. Mr. How was born in 1866 at Brooklyn, N. Y. He entered railway service in 1884, as a file clerk for the Union Pacific at Council Bluffs, Ia. A year later he entered the service of the Chicago, Burlington & Quincy at Omaha, Neb., as a clerk, being transferred a few years later to Plattsmouth, Neb., where he was promoted to chief clerk to the supply agent. He was promoted to supply agent in charge of the Hannibal and St. Joseph divisions in 1899, and was promoted to division superintendent in 1904. Later in that year he entered the service of a railway supply company, in which work he was engaged for one year, when he resigned and was appointed purchasing agent of the Wabash, with headquarters at St. Louis, Mo. He was appointed supply agent of the Missouri Pacific, with the same headquarters in 1910, and in 1911 was promoted to general purchasing agent with the same headquarters. During Federal control he served as chairman of the Regional Purchasing Committee of the Southwestern region, with headquarters at St. Louis, returning to his position as general purchasing agent of the Missouri Pacific at the expiration of Federal control.

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Erecting Shop Competition

The erecting shop competition, announced in the April issue of the *Railway Mechanical Engineer,* closes on June 1 so that the time is limited in which those interested in this subject can submit articles to be considered for the two prizes. Please remember two things: The articles will not be judged primarily on their literary merits; contributions not awarded the prizes but containing ideas of merit will be published and paid for at the regular space rates. In view of the importance of erecting shop work and the comparatively little which has been written on this subject, it is hoped that a number of comprehensive articles will be received. There is no railroad erecting shop which has *all* the best practices and probably also no shop but has at least *one* good practice. Tell us about that one. The only way to raise the general standard of erecting shop work is by exchanging ideas and information regarding these *best* practices, which is the purpose of the erecting shop competition. Will you help us? The prizes, as announced, will be fifty dollars and thirty-five dollars for the two best articles on erecting shop practice, received at the New York office on or before June 1.

The Railroads' Equipment Program

According to an estimate recently made by the Car Service Division of the American Railway Association, car loadings for the year 1923 will exceed those of any previous year and will tax the capacity of the railroads to the limit, especially during the autumn months when the peak of traffic usually occurs. It is generally recognized that the supply of equipment has not been increased in proportion to the growth of the country and that the physical condition of locomotives and cars has not been kept up to the desired standard. To make up the deficiency in facilities, the railroads have spent two hundred and forty-five million dollars for locomotives and cars in 1922, and in 1923 they plan to spend six hundred and seventy-five million dollars additional. This equipment will help the situation but it cannot entirely make up the shortage. The American Railway Association has recognized this condition, and at its last meeting on April 5, the executives recommended a definite policy for taking care of the heavy traffic which is anticipated in the fall. The recommendations which directly affect the mechanical department are that by October 1 bad-orders cars, which at present are about nine per cent of all the equipment, should be reduced to five per cent, and that locomotives awaiting repairs should be brought down from twenty-two per cent to fifteen per cent.

An examination of the records for the past few months shows that the mechanical department will have a difficult task to perform in accomplishing these results. With the heavy traffic that is being handled at present, equipment is being worn out practically as fast as it is repaired. During 1921 and the first half of 1922, the shops repaired about twenty-two thousand locomotives per month. Since the first of this year, they have turned out an average of about thirty-eight thousand locomotives monthly, but this has resulted in only a slight reduction of the percentage of unserviceable locomotives. From July, 1922, to January, 1923, bad-order freight cars were reduced from fifteen per cent to nine per cent, but there has been only a very slight reduction during the first three months of this year.

It seems evident that the shops will have to be worked to the limit of their capacity to bring about the necessary improvement in equipment conditions during the summer months. Some roads are already reporting a serious shortage of mechanics, and other methods than mere additions to the number of shop employees will have to be used to increase production. It is encouraging to note that a few roads have adopted programs for extensive additions to their shop facilities and if others would profit by their example, the difficulties experienced at present in maintaining locomotives and cars could soon be overcome.

In spite of the emphasis that has been placed on the necessity for adequate shops for taking care of modern rolling stock some roads apparently are still buying equipment without providing a corresponding increase in repair facilities. Such a policy will give temporary relief, but in the last analysis the railroads must turn out of their shops repaired cars and locomotives capable of making as many car-miles and locomotive-miles as are required to handle the business, or their equipment condition will deteriorate. In the interest of economical operation, the capacity of the shops should be brought up to the point where they will be able to do the necessary amount of repair work under normal conditions without resorting to periodical campaigns to bring down the percentage of bad-order equipment.

Car Department and Transportation Expenses

At the present time freight cars are in such great demand that most shops find it difficult to supply all the equipment needed by shippers. There is a strong temptation under such conditions to make less rigid inspection and to approve for loading cars that have minor defects. Sometimes it may be permissible to make a liberal interpretation of inspection rules, but car men should realize the extent to which they are responsible for transportation expenses and how much errors of judgment may cost the railroad. For example, during the year 1921 derailments and other accidents due to defects and failures of equipment cost the railroads over ten million dollars. Probably a large proportion of this could not have been avoided by the most careful inspection, but at the same time it emphasizes the losses that may occur if defects are passed by. Loss and damage to freight due to defective equipment is another large item of expense, the total loss in 1921 being likewise about ten million dollars. The defect which caused the greatest loss was leaks in roofs. Defective grain doors, water leaking in around doors, defective lining or siding and protruding nails and bolts were the other principal sources of loss.

Transferring loads is another item of transportation expense which the car department can help to minimize. Considerable reductions can sometimes be effected by repairing cars under load wherever possible, but in this case prevention of the cause of transferring is the most effective measure. Proper preparation of cars for the commodities they are to carry requires considerable care, but the savings to the railroad by eliminating labor charges for transferring and by expediting shipments make it well worth while to give this matter special attention.

Labor-Saving Machinery in Pattern Shops

The railroad pattern shop is often more or less neglected as regards machine equipment in spite of the fact that this department, in proportion to its size, affords as great an opportunity for economy by the use of labor-saving machinery as any other shop department. It frequently takes weeks to make some of the larger, more complicated patterns, whereas the time and cost of this work can be reduced often as much as fifty per cent if the pattern shop is equipped with such machines as the variety saw bench, power sanding machines, portable hand planers and jointers, and in particular the universal wood milling machine. The latter type of machine performs the same function for the pattern shop as the universal milling machine for the machine shop, being used for making wood, brass and soft metal patterns. It is well adapted for core box work, grooving, trenching, jointing, routing, surfacing, cutting segments of circles, etc. Core holes can be cut to a uniform depth and equally divided by the use of this machine in a fraction of the time formerly required. The universal dividing head provides means for quickly milling gear teeth exactly alike, uniformly spaced and with the proper allowance for draft.

In one case where thirty thousand dollars' worth of patterns had been destroyed in a fire, these patterns were restored in a short time during which a new wood milling machine more than paid for itself. One of these sets of locomotive patterns, which previously cost nearly thirteen hundred dollars to build, was made with the universal wood milling machine at a cost of slightly over six hundred dollars. One foreman pattern maker testifies that he can make a set of core boxes for a pair of locomotive steam pipes in fifteen hours, which, without the wood-milling machine, would require fifty to sixty hours. By having the foreman or assistant pattern shop foreman go over the drawings on every job and pick out the work that can be done on this machine, enough work will be found to keep it busy and pay a handsome return on this investment, even in relatively small shops where the importance of cutting down hand operations to the minimum is not always appreciated.

Fuel Oil-Burner Efficiency

It is a serious question if all, or even a majority, of railroad shop managements fully realize the relation of fuel oil-burner efficiency to successful furnace operation and the economical use of fuel. Exact figures as to the number of fuel oil furnaces of various types used in railroad shops in the United States are not available, but if they were, and the annual consumption of fuel oil for these furnaces could be determined, the importance of efficient burners would be apparent. Fuel losses of twenty-five per cent are readily possible in cases where burners of the wrong type are improperly installed or operated. Are your burners one hundred per cent efficient?

Under varying furnace conditions and requirements, oil burners must thoroughly atomize the fuel oil, mixing it with the right proportion of air. A burner suitable for use on one type of furnace may not be adaptable to another type. For forging, heating and welding furnaces, for example, a burner is required which will give the soft soaking heat needed for forging, or the reducing heat needed for welding; all air used for atomizing and for combustion must be under the absolute control of the operator. For heat treating, tempering, annealing, etc., the burner must be capable of adjustment to give finely-regulated, uniform temperatures, the burner highly atomizing the fuel and giving a short flame. For regenerative mechanical draft or stack draft furnaces another type of burner is required, and for high temperature work, still another. Burners not scientifically designed to meet the individual operating requirements will be wasteful of fuel. Burners of the proper type but not properly applied or intelligently operated will also cause excessive fuel costs.

The problem of selection, application and operation of the right oil burners for furnaces requires a more thorough knowledge of combustion principles than has been acquired by the average railroad shop man and it is important that expert advice be obtained on these matters, not only in the case of new installations of oil-burning furnaces, but where these furnaces are already in operation. Most of the reliable manufacturers of oil-burning equipment are willing to give the benefit of their experience and advice as furnace engineers without cost, and it is greatly in the interest of the railroads to use this engineering service in making sure that they are now getting the best possible results with oil-burning furnaces and equipment.

Centenary of the Delaware & Hudson

On April 23 the Delaware & Hudson Company celebrated the one hundredth anniversary of its incorporation with suitable ceremonies at New York and Scranton. It is an interesting circumstance that when this company was formed, it was principally for carrying on coal mining and transportation by canal. At that time railroads were hardly considered practical and the locomotive had yet to prove its superiority over the horse. The gravity railroad from Carbondale to Honesdale was constructed in 1827 to supplement the D. & H. canal and the first locomotive was tried out in 1829. It was found to be too heavy for the rails and was set aside and not used.

The centenary was the occasion for a review of transportation developments in this country which brought out in a striking manner the important part which railroads have played in the development of the nation. Looking back on such a significant occasion to consider the conditions existing one hundred years ago should make critics of our present system realize what progress in industry and transportation has done to promote the well-being of the people.

Even as recently as one hundred seventy-five years ago there was hardly need for an extensive transportation system. Food, clothing and fuel were produced locally and for the most part by primitive methods that had changed little in a thousand years. Farming was the principal occupation and was carried on by arduous manual labor. Clothing was produced on a small scale. To spin thread and weave cloth women and girls spent every spare moment at the distaff, or working hand looms. Wood cut locally was practically the universal fuel.

About 1750 there was brought out in England the first of a series of inventions which are largely responsible for our modern industrial system. John Kay and his son, Robert, applied two inventions to the loom which doubled its capacity. Soon after Robert Hargreaves invented the spinning jenny, the first machine for making thread. From that time on progress was rapid. Arkwright, Paul and Crompton added improvements to textile machinery. About 1790 Edmund Cartwright developed the power loom, and Eli Whitney the cotton gin.

In the meantime, the search for power more adaptable and reliable than water or wind had been going on. Newcomen invented the steam engine about 1700 and in 1769 James

Watt brought out the first of a series of improvements which made it of almost universal application and greatly increased its power and efficiency. Closely allied with the problem of power was that of fuel. Prior to 1750 the production of iron was dependent upon the supply of wood, but when the use of coal was begun in England, the output increased greatly. The steam-driven pump and the safety lamp made available a large supply of fuel which could be mined safely and cheaply.

These inventions together enabled production to be carried out on a larger scale and far more efficiently than before, but without improved transportation there would have been little benefit from the ingenuity of the great inventors. Quantity production would have been useless without facilities for widespread and economical distribution of raw material and finished goods, for which horse-drawn vehicles were entirely inadequate. Adam Smith wrote, "A broad wheeled wagon attended by two men and drawn by eight horses in about six weeks' time brings back between London and Edinburgh (400 miles) a four-ton weight of goods."

Contrast these conditions, which existed a brief one hundred years ago, with our modern transportation system. Two men can now handle machines that exert three thousand five hundred horsepower. Thirty pounds of coal, a lump about ten inches square, will haul one thousand tons a mile on level track. We are likely to accept as commonplace the fact that the cost of transportation is so low that fresh fruits from California can be sold in Maine at a reasonable price. As a matter of fact, it is a wonderful achievement and illustrates how much the railroad has done to give to the common people of today advantages which kings could not command a hundred years ago. In the realization of what transportation means in modern life, every railroad man should find an inspiration to further progress.

New Books

HANDBOOK OF STEAM LOCOMOTIVE CONSTRUCTION (*Handbuch des Dampflokomotivbaues*). *By Dr. Martin Igel.* 606 *pages.* 5½ *in. by* 8 *in.,* 10 *plates, bound in cardboard. Published by G. Reder, Berlin, Germany.*

European locomotives show a greater diversity of general design than is usual in America and this probably explains why many more treatises on motive power are published in foreign countries. The majority of these are of considerable interest to American readers because they illustrate numerous unusual designs. In this book the author has attempted to cover an extremely wide field in a short treatise.

The first chapter deals very briefly with the history of locomotive construction, which is followed by statistics of operation and a list of builders in various countries. In developing the general theory of locomotive design, various elements of resistance are first taken up and the method of calculating the leading dimensions of the locomotives are outlined. The section dealing with the details of construction is comprehensive and in general is well illustrated. Some interesting diagrams for adapting wheel arrangements to curves are shown. The section on counterbalancing, while brief, gives a good idea of the methods used with various types of locomotives. The description of cylinder and wheel arrangements is unusually complete. Boiler and machinery parts are shown which are typical of standard practice, and also some of the most radical innovations. Following the portion on the details of design is a section which includes photographs, drawings and condensed descriptions of a wide variety of representative locomotives from all over the world.

The book is elementary in some respects, principally because of the attempt to cover an extremely wide field in a small space. It should be useful to anyone who wishes to get a bird's-eye view of locomotive development in general and, in particular, the practice of the German railways.

What Our Readers Think

Co-ordination Needed to Get Results

CHICAGO

TO THE EDITOR:

The abstract of the paper by G. M. Basford, published in the April issue of the *Railway Mechanical Engineer,* has no doubt been read with interest by many of your readers, and while perhaps complete agreement as to methods of attaining the results indicated could hardly be expected, no one except those "who have eyes to see and see not" will deny that we are commencing an era of refinement of locomotive design by real engineering methods, instead of rule of thumb, and that such refinement is becoming imperative owing to limits having been almost reached.

In the writer's opinion, the paragraph commencing, "Many operating officers do not yet realize—" and ending, "We must tell them about it," strikes the keynote of the whole situation; for what is the use of the refined locomotive if all departments of a railroad that will use directly or indirectly such modern power are not equally refined and efficient in their methods? Co-ordination of design in locomotive detail and facilities is good, but co-ordination of effort of department with department, officer with officer, and officer with rank and file of the railroads themselves is in the writer's opinion of first necessity.

One has only to trace an order for equipment, for instance, back to its genesis to make the lack of co-ordination apparent. For example, a railroad has a "hunch" that more and better equipment is wanted. After months of voluminous interdepartmental and committee correspondence, all of which could often be boiled down into one comprehensive letter by any business man outside a railroad who really knew what he wanted, the mechanical department is asked to prepare specifications, drawings of standards, etc., the time allowed being about one week, and most generally varying inversely as the value of the order.

The specification being merely a re-hash and hodge-podge of previous specifications means about as much as the prior correspondence, so that in order to protect himself from any lurking danger of subsequent litigation, the builder will draw up a concise and business-like specification and return it to the railroad for approval and check, with a polite letter hiding the real reason.

Or again, a mechanical department proceeds to make all arrangements to build some cars only to find from an outside source that an order has already been placed weeks before by some other department, with an outside concern.

How will the refined locomotive fare at the hands of officials who have not the technical training to appreciate it, or under a condition where any petty officer or even locomotive man may have its lap, lead, or exhaust nozzle, etc., changed to suit his particular whim or fancy without a thorough investigation by the engineering staff of the mechanical department first?

Again, not a few railroad officers seem to be incapable of placing proper values on any new device brought before them and are not always willing to accept the advice of those most capable of giving a disinterested opinion. Hence we find they are very much impressed by so-called tests and comparisons, always, of course, in favor of the device. Such tests are generally found to have been carried out under quite different conditions, and so are valueless from an engineering point of view although no doubt useful as "selling talk."

Absence of co-ordination spells avoidance of individual responsibility and leads to "passing the buck." How can co-ordination of effort be obtained when a head of a department does not know the men working for him even when they are on the same floor of the office building? To use an analogy, how can a locomotive deliver ton-miles if the engineer is not sufficiently interested to see for himself whether each part of his engine functions properly, nor keen enough on his job to see whether more work per pound of coal can be obtained by careful instruction of his firemen, attention to small details, etc.?

If departmental heads did make it part of their business to really know their men, we should not have incompetents getting relatively high salaries and technical men with ability being driven out of railroad service to more lucrative and appreciative, although not by any means more interesting, fields of endeavor.

When conditions in railroad operating and mechanical departments are such that only thoroughly trained technical men have the deciding voice, then the highly refined locomotive will have an open road, with resulting lowered costs to the public, higher dividends to the shareholders and higher salaries to railroad employees all around.

It is very doubtful if the builders always have the freedom to turn out as good a locomotive as they are capable of doing, owing to prejudice, badly written specifications and desire on the part of the railroad to incorporate perhaps some device that does not harmonize with the whole or refusal to accept another that might mean the difference between efficiency and inefficiency in the particular engine. Entropy.

Effect of Length of Center Sill on Impact Stress

Butler, Pa.

To the Editor:

In his article, "Present Day Tendencies in Car Construction," in the *Railway Mechanical Engineer* for March, 1923, E. R. Viberg states that with the final buffing shock taken by the striking plate, the center sill is increased considerably in length and naturally makes a weaker structure than would be the case if the shock is delivered to the rear draft lugs. The writer believes this statement to be incorrect and that instead of creating a weaker structure, this increased length will reduce the effect of buffing shock upon the center sill, car structure and lading.

Whether the solid impact be delivered to the center sill at the lugs or at the striking plate, the unsupported length of the sill does not alter. If the center sill is assumed to be a column resisting a static load applied at the lugs, the unsupported length of the column may be assumed as the distance between bolster centers; although the cross bearers will contribute toward staying the column both laterally and vertically, especially if the car sides are the load-carrying members. If the load be applied at the striking plates, the above assumptions will still hold good: The column is stayed at the same points by center braces, bolsters and cross bearers. In discussing these assumptions, however, it should be remembered that the impact shock is a dynamic and not a static load, and that a resilient structure will have less stress under a dynamic load than a rigid one.

The following practical illustration shows that a long center sill will absorb more energy and so help the draft gear to dissipate the impact, than will a short one. If one should attempt to cut off a rivet head with a 2-ft. cold chisel and a 2-lb. hammer, the hammer blow will be absorbed by the long chisel and very little cutting effect produced. A shorter chisel will cut faster with the same expended energy because less energy is absorbed by the short chisel and so the force delivered at the rivet head is greater. The analogy is true for the center sill.

That a given impact will produce less stress in a long sill than in a short one, lends itself to simple mathematical proof. If the impact energy is denoted by B, the force produced in the sill by P and the amount of compression by D, we may write $B = \frac{P \times D}{2}$ since the force increases from zero to P and we are assuming the stress to be within the elastic limit of the material. If f is the unit stress and A the area of the sill than $P = f \times A$. Since $E = f \div \frac{D}{L}$ where E is the modulus of elasticity and L the length of the column, then $D = \frac{f \times L}{E}$ which shows, incidentally, that the amount of compression varies directly as the unit stress and the length. Substituting the new values for P and D in the first equation, we obtain $B = \frac{A \times L \times f^2}{2 \times E}$ showing that the capacity for absorbing energy is directly proportional to the area, the length and the square of the unit stress. Transposing, we have $\frac{2 \times E \times B}{A} = L \times f^2$ which may be written, $K = L \times f^2$, because for a given impact, area and material, B, A and E are constant. Now let c be the stress for a length C and f the stress for a length L. Then $K = C \times c^2 = L \times f^2$ and $f^2 = \frac{C \times c^2}{L}$, or $f = c\sqrt{\frac{C}{L}}$ which shows that the stress varies inversely as the square root of the length.

Assume the length over striking plates as 41 ft. 4½ in., or 496.5 in., the length over draft lugs for 3-in. draft gear travel will then be 410.75 in. If a given impact applied at the lugs produces a stress of 20,000 lb. per sq. in. in the sill, the same impact applied to the striking plate would produce a stress of $f = 20{,}000\sqrt{\frac{410.75}{496.50}} = 20{,}000\sqrt{.829} = 20{,}000 \times .910 = 18{,}200$. This is a reduction of 1,800 lb. per sq. in., and for a shorter car the decrease is even greater. Thus for a car whose length over striking plates is 33 ft. 6 in., or 402 in., the length over rear lugs is 316.25 in. Using the same comparison, we find the stress to be

$$f = 20{,}000\sqrt{\frac{316.25}{402.00}} = 20{,}000\sqrt{.787} = 20{,}000 \times .887 = 17{,}740,$$

a reduction of 2,260 lb. per sq. in.

It is therefore evident that applying the final impact shock to the striking plate, instead of attempting to apply it to the rear lugs, results in a stronger structure. This statement, of course, presupposes the coupler horn to be made concentric with the center line of the coupler as suggested by the writer in his article, "Protecting the Draft Gear from Solid Impact." (Published in the *Railway Mechanical Engineer*, November, 1922).

Furthermore, the added length not only relieves the center sill from a large amount of stress, but it is obvious that the increased resilience will aid the body bolster considerably. Using the analogy of the long and short chisel, given above, it is evident that the short length between lugs and bolster will deliver a larger impact force to the bolster than would the length from striking plate to bolster and so the entire car structure and the lading would be benefited by the increased resilience. Wendel J. Meyer.

Fuel Consumption of Oil Burning Locomotives[*]

Data Obtained on Southern Pacific Facilitate Comparison of Steam and Electric Motive Power

By A. H. Babcock
Electrical Engineer, Southern Pacific Railroad

PART I

WHENEVER electrification of steam railways on a large scale is advocated, one of the principal arguments advanced is the large saving in fuel sure to result therefrom; in fact, this was the initial point of attack in the early days of the art—the early 1890's, for example—long before overtime of train and engine crews had become the very real expense in train operation it is today. Many attempts to get accurate information on locomotive fuel consumption have been made during the intervening years, for comparison with known electric locomotive performance.

Fuel consumptions of steam locomotives using coal cannot be analyzed as can those of electric locomotives, because it is impossible to obtain accurate measurements. When fuel oil is used, the possible accuracy of such measurements more nearly approaches that of electric operation, and much more precise determinations are possible.

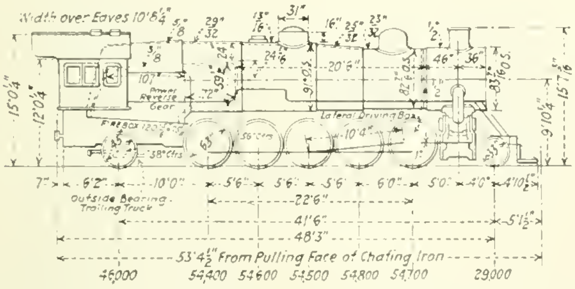

Fig. 1—Side Elevation of Locomotive No. 3614

By the use of accurately calibrated oil meters; by locating with reference to track conditions, points at which meter readings shall be taken; by choosing an engine that has shown an average fuel performance under widely different operating conditions; by giving this engine loads as closely as possible to its rating; and by not changing the train consist over the run, an accurate measure of fuel consumption for any given piece of track—over a mountain, for example—can be had.

In connection with and bearing directly upon electrification possibilities, such a study has been made of the track over the Tehachapi Pass, where topographical and operating conditions are severe; also they are representative of mountain railways on the west coast.[1]

Engine No. 3614 was selected because the records of the fuel bureau showed it to be an "average performer" in through freight service. Its characteristics are given in detail, Tables 1 and 2. On every run a different engine crew handled the train, the selection being by the usual "first in, first out" method standard on the railway. A trained observer rode the engine and made all the readings. The train weights, taken from the yardmaster's reports at the initial points, were corrected, during the runs, for fuel and water consumed.

George McCormick, general superintendent motive power, Southern Pacific Lines, afforded every facility of his department in the prosecution of the work; he prepared the engine and made valuable suggestions.

The division officials inconvenienced themselves many times to permit a single engine train to run without change of load over a congested piece of track.

William Hood, for many years chief engineer, Southern Pacific, who located and constructed this line, named the points at which the track conditions change in significant fashion. It was found during the test runs that all engineers handled the trains very much alike, changing throttle or cutoff at or near the flags that had been placed at the points selected by Mr. Hood; from which it was evident that the points so chosen were really representative. The positions of all these reference points are given in Fig. 3. Meter readings and times were recorded at all grade changes, (marked by these flags, or by the natural marks at such points), and at all starts and stops. The fuel oil was metered through a new two-inch duplex piston type meter that had been calibrated by weight measurements corrected for temperature. In the final analysis all fuel measurements were reduced to 60 deg. fahr. Approximate water measurements were made, not to determine evaporation, but as correction factors on the train tonnage. Similar fuel corrections were made.

The train tonnage, then, is gross weight of train from engine pilot to caboose markers, everything included.

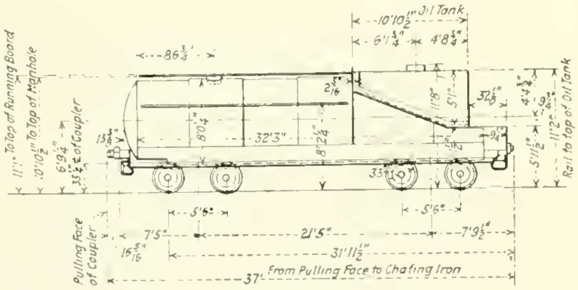

Fig. 2—Side Elevation of Tender

The result is a complete record of fuel consumption beginning with the enginehouse firing up and standby fuel consumption until the engine was called; while standing outside the house waiting for the train, testing brakes, during acceleration, running up and down the various grades, holding the train in sidings, and finally running down hill over long stretches of steep grade.

In the ordinary system of fuel records all fuel consumed in firing up, standing in the enginehouse and on the outgoing track up to the time the engineer assumes responsibility *i e.*, thirty minutes before he is called to leave the terminal, is charged to enginehouse service; all consumed from that time until the engine is placed on the incoming track at the end of the run is charged to road service.

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[*] A paper presented at the spring convention of the American Institute of Electrical Engineers at Pittsburgh, Pa., on April 25. This is the first part of an article in two parts. It describes a method employed for securing an accurate measurement of the efficiency of an oil-burning steam locomotive in moving a 1,000-ton train over a given piece of track. The second part of the article will describe the manner in which the method was applied and will include the results obtained.

[1] See also TRANSACTIONS, American Institute of Electrical Engineers, Vol. XXXII, p. 1845, "Mountain Railway Electrification."—*Babcock.*

Such records, brought probably to the highest state of perfection in the practise of the Southern Pacific Company, give merely a method of distribution of charges between departments, provided a basis of comparison between present and past performances quite sufficient for economic operation in pre-war days, but by no means adequate in these days of intensive economic studies. No details of performance are uncovered.

TABLE I

Specifications for 2-10-2 Type Locomotive No. 3,614

Cylinders, diameter and stroke	27½ in. by 32 in.
Weights in working order:	
On drivers	273,000 lb.
On front truck	29,000 lb.
On trailing truck	46,000 lb.
Total engine	348,000 lb.
Wheel bases:	
Driving	22 ft. 6 in.
Total engine	41 ft. 6 in.
Driving wheel, diameter outside tire	63 in.
Boiler:	
Steam pressure	200 lb.
Diameter, first ring, outside	$82\frac{7}{16}$ in.
Firebox, length and width	$120\frac{13}{16}$ in. by 75¼ in.
Combustion chamber length	72 in.
Tubes, number and diameter	279—2 in.
Flues, number and diameter	40—5⅛ in.
Length over tube sheets	20 ft. 6 in.
Grate area	63 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	327 sq. ft.
Tubes and flues	4,130 sq. ft.
Total evaporative	4,457 sq. ft.
Superheating	972 sq. ft.
Comb. evaporative and superheating	5,429 sq. ft.
General data estimated:	
Rated tractive force, 85 per cent	65,300 lb.
Cylinder horsepower (Cole)	2,724
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	78.5
Weight on drivers ÷ tractive force	4.18
Total weight engine ÷ cylinder hp	127.6
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp	1.99
Tractive force ÷ comb. heat. surface	12.02
Tractive force × dia. drivers ÷ comb. heat. surface	758
Cylinder hp. ÷ grate area	43.1
Firebox heat. surface ÷ grate area	5.2
Firebox heat. surface, per cent of evap. heat. surface	7.3
Superheat. surface, per cent of evap. heat. surface	21.8

These may be divided into three groups:

1. Variation of fuel used in firing up with respect to feed water temperatures, *i. e.*, losses independent of the manner in which the engine is used after steam is raised.

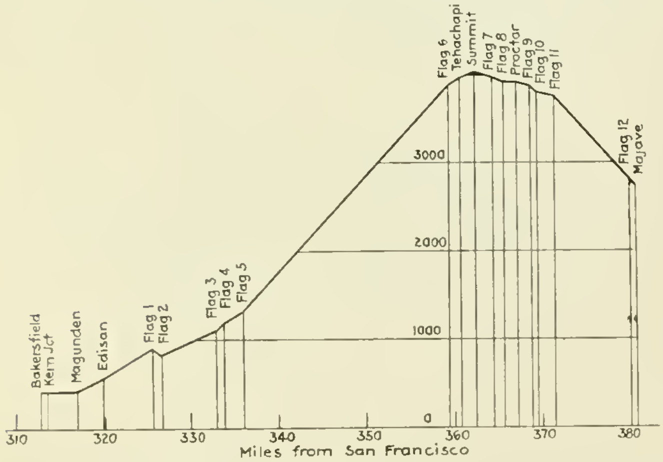


Fig. 3—Profile Map, Bakersfield to Mojave

2. Fuel burned in holding the engine under steam at terminals or on the road; *i. e.*, losses dependent upon operating staff efficiency rather than upon tonnage, and independent of speed.

3. Fuel consumption while moving; accelerating, running, entering and leaving sidings, etc., all of which are dependent largely upon tonnage, and speed. With known tonnage, as in these tests, the ton-mile fuel cost becomes known over widely varying road and running conditions.

Group 1. For this determination the boiler was filled to ⅓ gage glass (engine in enginehouse), with water at 120 deg. fahr. Steam for oil atomizer and blower was taken from the house steam lines until the boiler pressure reached 70 lb. gage. Fig. 4 shows fuel with respect to boiler water temperature and steam gage pressure. A second curve shows fuel consumption with time. Evidently not all the heat in the fuel reached the water at first because of the cold firebox lining.

From other tests it has been determined that the atomizer and blower add 14 per cent to the fuel consumption. Therefore, if 14 per cent of the 84 gal. used up to the time when the boiler furnished its own steam for these purposes be added to the 119 gal. metered to the burner to bring the boiler pressure up to 200 lb. gage, we have 131 gal., total fuel used to raise steam with feed water at 120 deg. fahr.

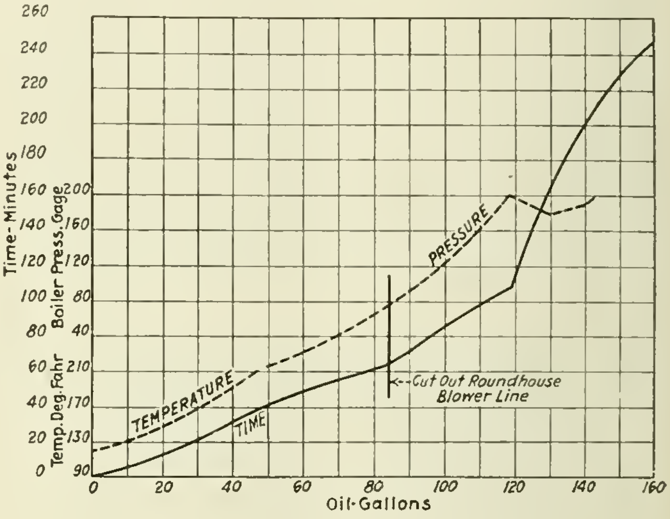


Fig. 4—Fuel and Time Required for Firing Locomotive

If it be assumed, as seems reasonable all things considered, that the fuel consumption for all practical purposes is proportional to the rise in temperature, the fuel per degree rise is 47/(210-120), or 0.522 gal.; from which then can be determined value of storing the heat from boilers being blown down for washing, to use in firing up other engines for the road. Thus, to fire up with feed water at 60 deg., ordinary hydrant water, costs 1.14 [0.522 (212 — 60) + (84 — 47)] + (119 — 84) = 167 gal. Similarly for 180 deg. feed water, from a hot water boiler washing and filling plant; 1.14 [0.522 (212 — 180) + (84 — 47)] + (119 — 84) = 96 gal.

TABLE II

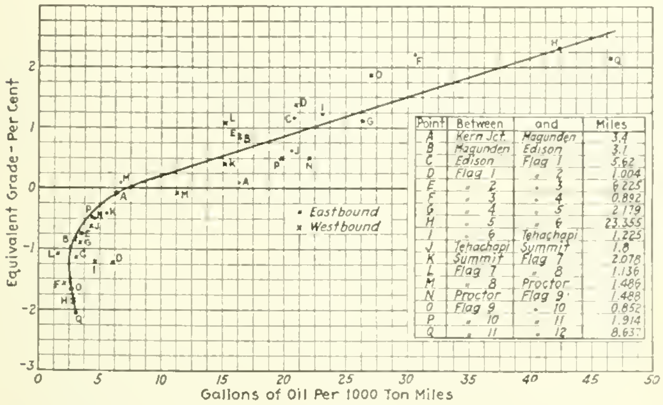
Specifications for 10,000-Gallon Cylindrical Tender

Capacity of fuel oil	3,120 gal.
Capacity of water	10,030 gal.
Weight of tender empty	64,900 lb.
Weight of 10,030 gallons of water	83,600 lb.
Weight of 3,120 gallons of fuel oil	24,960 lb.
Weight of tender loaded	173,460 lb.
Tender axle journals	6 in. x 11 in.
Weight of truck	8,580 lb.
Height from top of rail to bottom of tank (loaded tender)	2 ft. 9¼ in.
Width over front steps	9 ft. 6 in.
Width over back steps	10 ft. 2½ in.
Extreme width over end sills	9 ft. 10 in.
Diameter of tank outside	8 ft. ¼ in.

With fuel oil at $1.50 per bbl. the 71 gal. saved per engine fired up amounts to $2.54, but the money saved by such procedure is even more than is apparent from the figures, because the time of turning an engine washed and filled with hot water is, by record, 3½ hours less than the 7½ to 8 hours required when cold water is used. Heavy power represents an investment worth at least $4.00 per hour. It could not be rented for this figure. Hence the time saved adds $14.00 per engine turned to the fuel saved, and the total economy then is $16.54 per engine turned.

Group 2. The upward branch of the time-oil curve, Fig. 4, shows the fuel required to hold an engine under steam while standing in the enginehouse where these tests were made, to be 60(159 — 119)/(246 — 108) = 17.4 gal. per hour. It is fairly representative of large engines standing in a well kept enginehouse, no auxiliaries running.

Power of this class has air reverse gear; hence, if the engine is standing where occasional movements must be made, at least one air pump must be cut in. During the tests it was determined by placing this engine in the open yard, that oil was used at the average rate of 36.6 gal. per hour. Air temperatures during this period ranged, roughly, from 20 deg. to 50 deg. fahr., therefore 36.6 — 17.4 = 19.2 gal. is the excess fuel consumed per engine-hour when standing in the open in ordinary weather.



Point	Between	and	Miles
A	Kern Jct.	Magunden	3.4
B	Magunden	Edison	3.1
C	Edison	Flag 1	5.62
D	Flag 1	„ 2	1.004
E	„ 2	„ 3	6.225
F	„ 3	„ 4	0.892
G	„ 4	„ 5	2.179
H	„ 5	„ 6	23.355
I	„ 6	Tehachapi	1.225
J	Tehachapi	Summit	1.8
K	Summit	Flag 7	2.078
L	Flag 7	„ 8	1.136
M	„ 8	Proctor	1.486
N	Proctor	Flag 9	1.488
O	Flag 9	„ 10	0.852
P	„ 10	„ 11	1.914
Q	„ 11	„ 12	8.637

ig. 5—Fuel Consumed per 1,000 Ton Miles on Various Grades

Similarly, the fuel cost of standing on sidings with full tonnage train, is found to be 42.8 gal. per hour. Since no steam was used for heating in either case, 42.8 — 36.6 = 6.2 gal. is the fuel cost per hour of maintaining air pressure in the train line, ready for service.

Group 3. The results obtained for the first two groups are evident upon even a cursory study of the curves; but to obtain results for the third group a more rigid treatment is necessary. The reduction of the test observations in these determinations occupied many weeks full time of the two observers (who rode the engine alternately during the tests), C. M. Barbour and R. S. Twogood, assistant engineers, Southern Pacific Company. Mr. Twogood is responsible for the details of the test and the analysis of the results. To him acknowledgments are due for the following, most of which are taken literally or abstracted from his report.

In the reductions of the observations, the fuel oil density is taken at 0.96; the heat content 18,000 B. t. u. per pound. The constants to correct the meter readings for meter error and to reduce to standard temperature, 60 deg. fahr., are:

Oil Temperature	Meter Constant
130 deg.	0.949
120	0.952
110	0.956
100	0.959
90	0.965

The time, fuel meter reading, fuel temperature, and location of train, were recorded at every start, grade change or other important point, and stop. The speeds were determined by counting engine driver revolutions. All grade changes at other than station points were marked by white flags—see profile, Fig. 3. Grade compensation for curvature is applied at 0.04 per cent grade per degree of curvature. The equivalent grades eastbound and westbound for the same section of track obviously are of opposite sign, and of different numerical value.

From the log sheets of the trip were tabulated: fuel metered, fuel consumed, fuel and water in tender; time running at normal speed, running slowly and standing. These sheets then were reduced to show for every section of the track: the train weight corrected for fuel and water consumed, the times between sidings, running through sidings, running between stations or flag points, and standing. Then by combination of these elements there were deduced: Total train resistances, horsepower hours at drivers, thermal horsepower-hours based on actual average thermal efficiency for the trip, and computed fuel vs. actual fuel burned. Based on Schmidt's tables, the train resistance for level tangent track was taken at 7 lb. per ton. The average thermal efficiency was determined from the total horsepower-hours and the fuel burned when moving over sections where the total resistance was positive. A fair average standard time and fuel used to fire up, stand by, test air, and put engine away, were assumed for all trips.

The average gallons of fuel per thousand ton-miles, in both directions, for every section of tracks, but not corrected for variations in speed within a section, were determined under actual operating conditions of the test, and are shown in Fig. 5 plotted against equivalent grade; wherein the curve as drawn has been adjusted to give fuel requirements for constant speed. Thus is shown the fuel cost of acceleration, and how, in the stop, provided the brakes are not used, a large proportion of the work done in acceleration is made useful in moving the train over the track. This is indicated by points on the left of the curve; points on the right show increase fuel consumptions during acceleration.

(To be continued)

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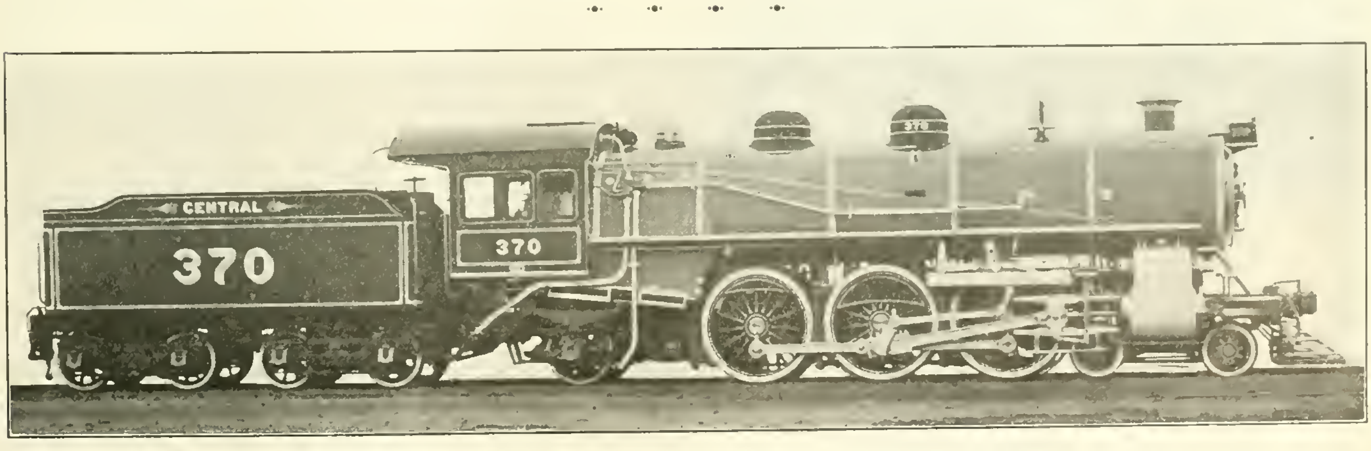
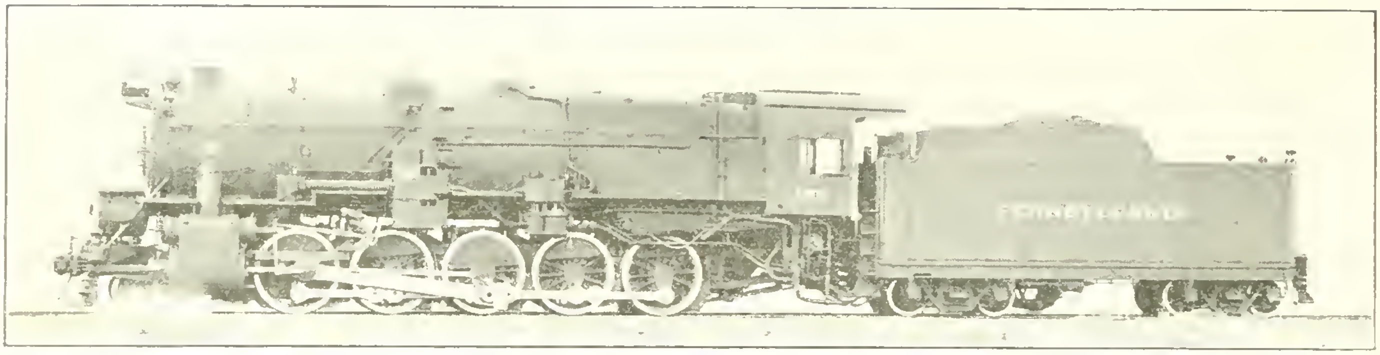


Broad Gage Pacific Type Locomotive for the Central Railway of Brazil

Built by the American Locomotive Company and Displayed at Brazilian Continental Exposition.



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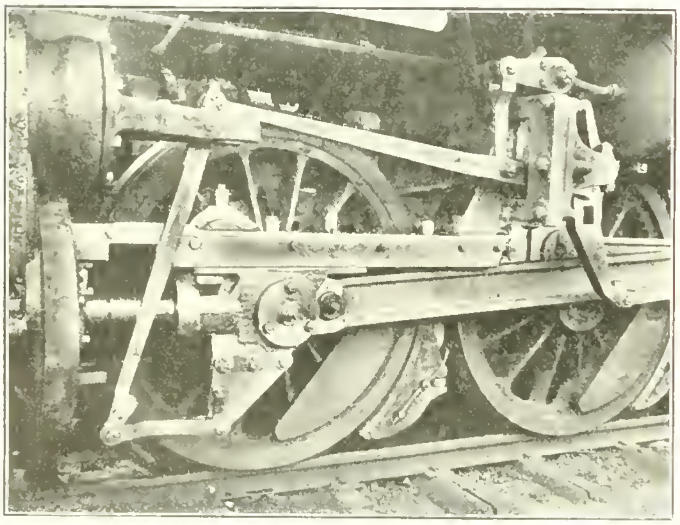
Unique Type of Crosshead for Heavy Locomotives

After Extended Experiments Pennsylvania Adopts Crosshead with Large Bearings Which Greatly Increase Durability

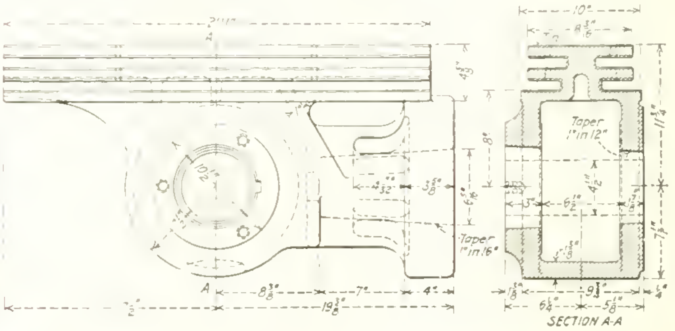
THE Pennsylvania Railroad Decapod locomotives, Class I1s, are noteworthy in the size of the cylinders, the high steam pressure employed and the limitation of the cut-off in full gear to 50 per cent. With cylinders 30½ in. in diameter by 32 in. stroke and a boiler pressure of 250 lb. per sq. in., the maximum piston thrust reaches the unusual figure of 182,655 lb. As the main rods are 11 ft. 1½ in. long, the maximum vertical thrust on the crosshead, with no vertical offset between the center lines of the cylinders and the wheels, would be about 22,000 lb. The design of a suitable crosshead was made even more difficult by the limitation in permissible width of guides caused by the restrictions of 91½-in. cylinder centers and a distance of 7[illegible] over the outside hub faces of the main pair of driving wheels. The reduction of the unit bearing pressure on the crosshead therefore presented a difficult problem.



Experimental Crosshead Applied to Pennsylvania 2-8-2 Type Locomotive, Class L1s

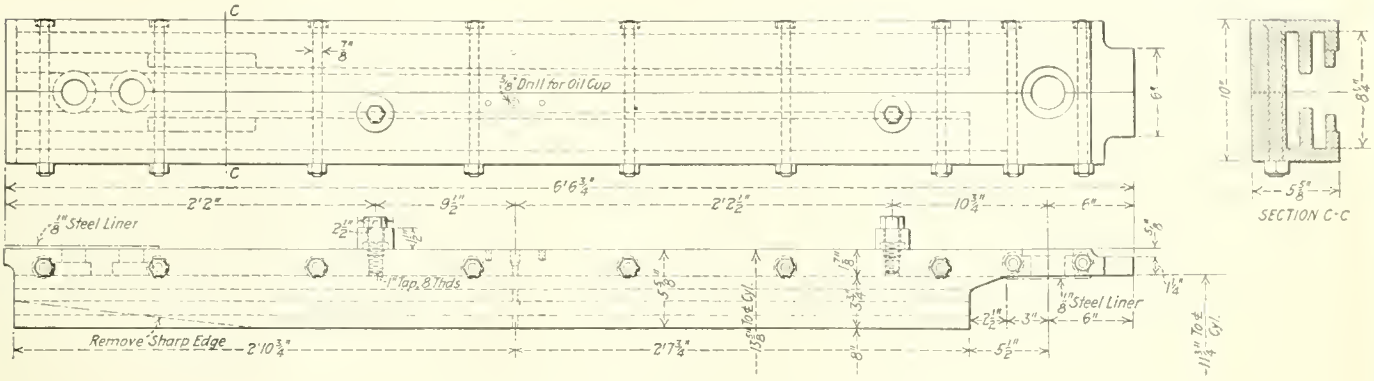
While conditions are unusual on these locomotives, a considerable amount of attention at terminals is now required to maintain the crossheads and guides on heavy modern power so that the vertical play of the crosshead shall not exceed ¼ in. and the lateral play shall not exceed 5/16 in. The manner in which the problem has been solved by the Pennsylvania should thus be of interest to many other roads.

In order to secure a material increase in the bearing area over the amount possible with either the usual Laird or the alligator type crosshead and thus eliminate the necessity for frequent repairs, the Pennsylvania in September, 1920, designed and applied to an L1s, or Mikado type, locomotive an experimental set of unique guides and crossheads, with double longitudinal bearing ribs, a modification of the type used on the K4s (Pacific type). These particular crossheads on the L1s were 28 in. long and had a bearing area between crosshead and guide of 490 sq. in. on the upper side—divided between three planes—and 266 sq. in. on the lower side—divided between two planes. The experimental crossheads have proved highly satisfactory in service, having increased the average time between relining from 60 days to 360 days. As a result of these tests, the same general type has been made standard for the new I1s Decapod locomotives, of which 475 have been ordered recently.

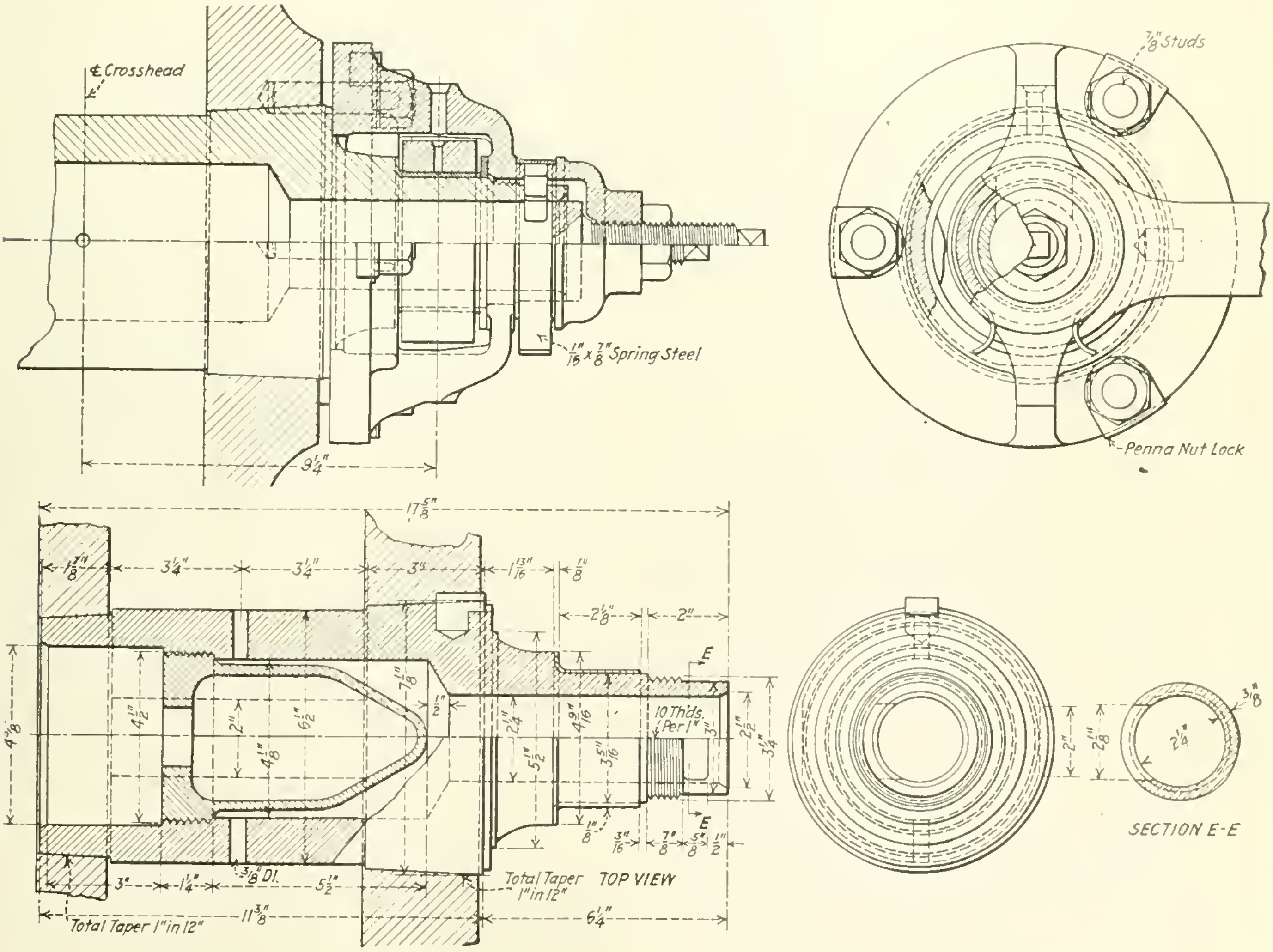


New Design of Crosshead for I1s Decapod

The guides and crossheads for these new locomotives are shown in the accompanying drawings. As will be noted, the crosshead has two bearing ribs or flanges, 35 in. long. These provide an area of 720¼ sq. in., not counting radii, for upward thrust and 370¼ sq. in. for downward thrusts. Neglecting the weight of the crosshead and rod, the vertical thrust of 22,000 lb. on the crosshead thus results in an upward pressure of 30.4 lb. per sq. in. when the locomotive is going ahead and a downward pressure of 58.5 lb. per sq. in. when the locomotive is backing up The weight of each crosshead is 875 lb., including the pin. The guides are parted longitudinally along the center line for ease in machining, the two halves being securely bolted together after they have been finished.



Guidance for Pennsylvania I1s Decapod Locomotive



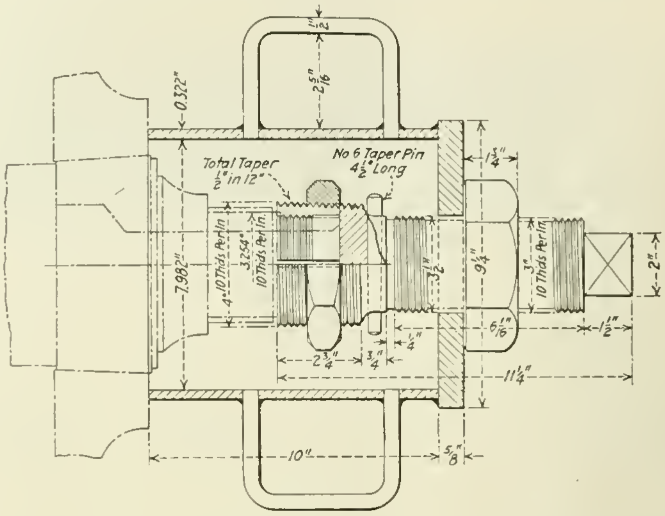
Grease Lubricated Crosshead Pin with Bearing for Union Link Removable from the Outer Side of the Crosshead

The former I1s locomotives had crossheads of the alligator type which were 35 in. long with guides 9 in. wide. This gave an area of 315 sq. in. for either upward or downward thrusts, and a pressure of 69.8 lb. per sq. in. The bearing areas of the new standard crossheads consequently are 230 per cent of that of the old design for upward thrusts, and 120 per cent for downward thrusts.

The crosshead pin used on the I1s locomotives is also of a new design which combines many desirable features. Because of the high piston thrust the bearing has been made

6½ in. by 6½ in. and the pin has been hollow bored to make it as light as possible. At the outside the pin extends beyond the crosshead to form a bearing for the union link.

The pin enters the crosshead from the outside and is held in place by a steel retainer casting which is drawn tight against the shoulder on the pin by three studs in the crosshead. In addition to securing the crosshead pin, the retainer holds the collar at the outer end of the bearing for the union link and carries the plunger which is used to force hard grease to the main crosshead pin bearing. The bore of the pin is closed at its inner end by a cast iron casting, which when screwed into place, reduces the space allowed for grease and at the same time provides a passage for the grease which is fed to the front and the rear of the bearing by two ¼-in. holes. The grease is inserted in the bore of the pin through a slot in the retainer casting which is covered by a flat steel spring to exclude dirt. The retainer casting is provided with a threaded hole which is in engagement with the thread on the grease plug shank, so that there will be no difficulty in starting the compression of the grease, irrespective of the amount of grease in the cavity. This construction will prevent damage to the threads which hold the grease plugs in place and the loss of the plug. The crosshead pin can be removed by taking off the retainer, placing puller and yoke which are shown in the last drawing, over the projecting end of the pin and screwing a nut on the 3-in. diameter threaded portion at the outer end.

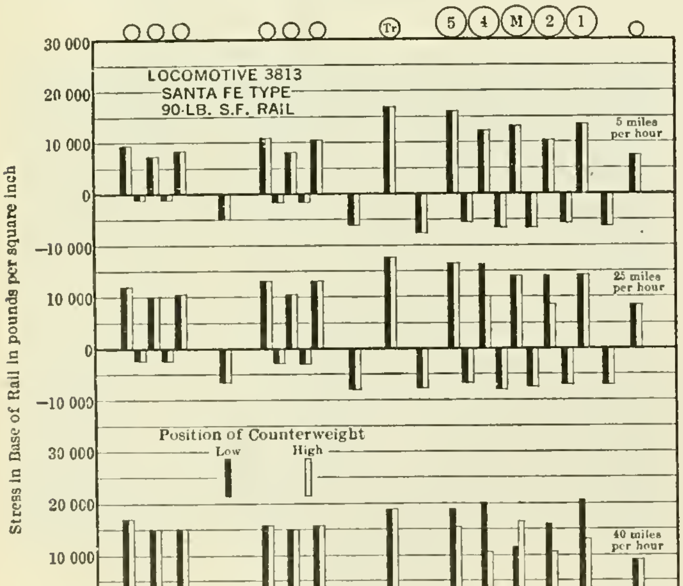


Crosshead Pin Puller

Stresses In Straight and Curved Track*

Joint Committee of American Society of Civil Engineers and American Railway Association Presents Progress Report

SINCE its organization in 1914, the Joint Committee on Stresses in Railroad Track has been carrying on an extensive series of tests to determine the stresses set up by different types of locomotives when operated at various speeds. The first progress report was submitted in 1918. This was followed by a second report in 1920 and a third report in 1923, of which a brief abstract is given herewith. The committee will continue the tests and investigations, the results of which will be presented as further information is obtained.



Stress on Straight Track at High and Low Position of Counterweight—Heavy 2-10-2 Type

The work reported herein includes tests on straight track and curved track. In the tests on straight track, consideration was given to the effect of counterbalance, the effect of speed and the combined effect of speed and counterbalance, and the lateral bending moments and stresses in the rail. In the tests on curved track are taken up the general action of curved track as the locomotive traverses the curve, the magnitude of the vertical bending stresses in the rail and the corresponding vertical loads producing them as contrasted with the normal loads, the lateral bending moments and stresses under the several wheels, the distortion of the alinement of the curves, and the general effect of speed, degree of curve, and super-elevation. The tests were conducted on the Illinois Central, the Delaware, Lackawanna & Western, the Atchison, Topeka & Santa Fe, and the Southern Pacific. In the tests, 13 locomotives of eight distinct types were used. In several types, there were variations in the design of the locomotives of the different railroads. The report is presented under the heads of Tests on Straight Track and Tests on Curved Track, covers 162 pages and records the results of 470,000 readings of operations.

Effect of Locomotive Counterbalance

As may be expected, at a speed of 5 miles per hour, the variation in stress due to other causes is so much greater than that due to the effect of counterbalance as to mask any effect of counterbalance.

From the data it was noted that the highest stress in the rail under the main driver in all the locomotives except the Pacific type of the Delaware, Lackawanna & Western and the Balanced Compound Prairie type of the Atchison, Topeka & Santa Fe occurs when the counterweight is up. For several of the locomotives, a calculation for the counterbalance in the main driver would indicate that, in many cases, the high stress may be expected to occur when the counterweight is down, if the method of calculation is that so generally used of neglecting the effect of the plane of motion of the main rod and other outside rotating parts not being coincident with the plane of motion of the counterweight and wheel and rail, whereas, the opposite condition may be shown by the results.

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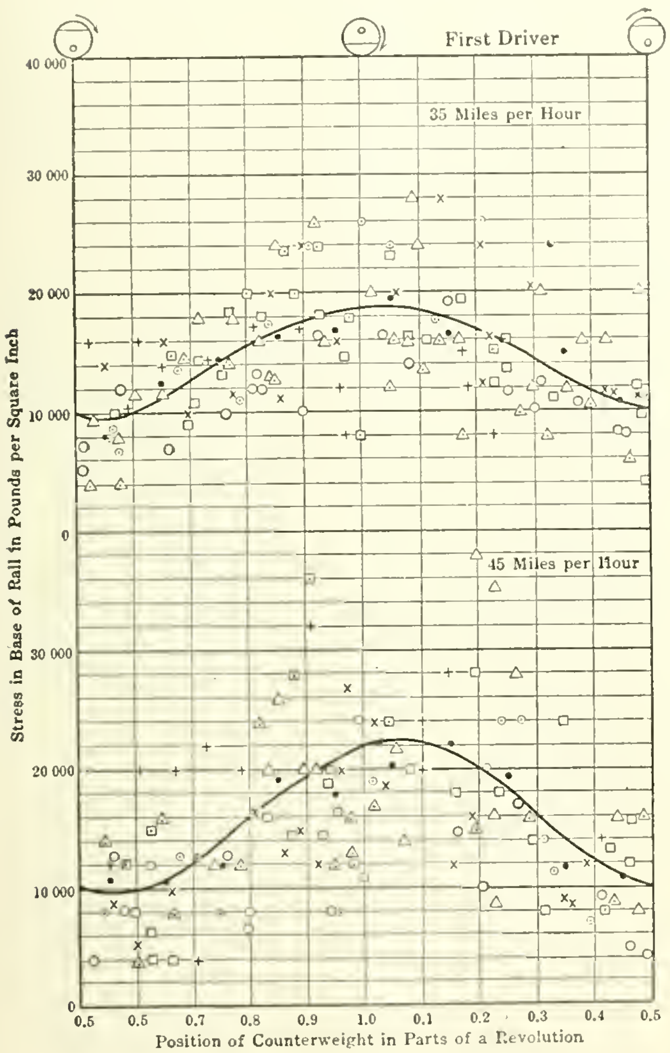
*Report presented at the annual meeting of the American Society of Civil Engineers, New York, January 17, 1923, and the annual convention of the American Railway Engineering Association, Chicago, March 13, 1923.

In general, for all the locomotives except the Light Santa Fe type, the stresses attributable to counterbalance at the highest speeds run, which in some cases were greater than the scheduled maximum speed allowed for the locomotive, are less than 5,000 lb. per sq. in. and, in most cases, considerably less than this. The counterbalance effect at the highest speeds used may be said generally to be not more than 30 or 40 per cent of the average stress in rail at 5 miles per hour; in some few cases, it runs higher; but, in most cases, it is lower. A counterbalance effect of 30 per cent will not be considered to be excessive, and the only question is whether the scheduled speeds are likely to be exceeded very much. It is seen that an increase of speed of 25 per cent will increase the counterbalance effect by 56 per cent of itself, and an increase of speed of 41 per cent will double the counterbalance effect. It is evident that great care must be exercised to prevent the scheduled limits of speed being exceeded very much if the stresses due to counterbalance are to be kept within moderate bounds. It is also clear that every care should be taken in the design, construction, and maintenance of the proper counterbalance, and checks should be exercised to insure that the conditions of counterbalance are known with certainty, as it has frequently happened that the counterbalance effect has varied from the reported or expected condition. Attention should be given to the main driver and a careful determination made of the effect of the outside rotating parts not being in the plane of the wheel and counterweight.



Observed Values of Stress on Straight Track, Light 2-10-2 Type

Effect of Speed and Combined Effect of Speed and Counterbalance

With the exception of the Light Prairie type and the Light Santa Fe type, the general increase in stress in rail under the drivers due to speed alone in changing from 5 miles per hour to the highest speed used in the tests ranges from 15 to 27 per cent, which may be called a moderate and allowable speed effect. With the same exceptions, the maximum speed effect under any one driver ranges from 24 to 30 per cent. For these locomotives and these tracks, therefore, the increase in stress in rail due only to the change in speed noted may be said generally to be less than 35 per cent.

Speed, in miles per hour.	Position of counterweight.	Trailer.		Driver Number.					Ffout truck wheel.
		2	1	5	4	Main	2	1	
5	Mean value	9 200	8 900	9 500	11 400	11 100	11 900	11 900	11 700
25	Up	......	......	9 000	10 500	15 500	11 000	12 500	......
	Down	......	......	12 500	14 500	9 000	15 000	15 000	......
	Mean value	10 400	10 100	10 100	12 400	12 200	13 000	13 900	12 400
40	Up	......	......	10 500	9 500	20 000	11 000	12 500	......
	Down	......	......	14 500	15 500	10 000	16 500	16 500	......
	Mean value	11 500	11 100	12 400	13 800	12 900	14 000	14 900	18 800
Calculated stress under static load.		8 700	7 500	12 600	9 500	10 000	11 300	14 500	8 600
Calculated additional stress due to counterbalance at 40 miles per hour		......	......	+3 700	+3 600	-2 800	+3 600	+3 700	......

Stresses with 2-10-4 Double Trailer Locomotive on Curves

For the combined effect of speed and counterbalance for the same locomotives for the maximum speed used, the range of general total increase in stress in rail is 30 to 53 per cent, and the maximum increase under any driver ranges from 43 to 80 per cent. The stresses in rail at the maximum range from 20,000 to 29,000 lb. per sq. in., in the three sections of rails used.

Principal Values of Increase in Stress in Rail at a Given Speed Over the Stress at 5 Miles Per Hour

The Increase Is Given in Percentage of the Stress at 5 Miles Per Hour

Type of locomotive	Drivers					Tender wheels	
	Speed alone		Combined speed and counterbalance				
	General value	Maximum under one driver	General value	Maximum under one driver	Trailer	General value	Maxi- under one wheel
Atchison, Topeka & Santa Fe Railway:							
Pacific, 60 miles per hour	27	30	53	53	15	75	93
Balanced Compound Prairie type, 50 miles per hour	15	26	30	43	29	50	87
Mountain, 60 miles per hour	20	30	35	50, 55	10	40, 60	110
Light Santa Fe, 45 miles per hour	40	77	105	190	10	25	35
Heavy Santa Fe, 40 miles per hour	18	28	50	80	15	75, 70, 50	110
Delaware, Lackawanna & Western Railroad:							
Facific, 60 miles per hour	20	24	42	59	14	45	57

Stresses With Experimental Four-Wheel Trailing Truck

The placing of a four-wheel trailing truck under a heavy Santa Fe type locomotive, thus converting it into a 2-10-4 type, for the purpose of learning experimentally the effect of this form of construction in changing the stresses in rail under the trailers and under the drivers was a novel undertaking that gave results of much interest. Although the double trailer was put in one of the regular locomotives and thus the design did not have all the proportions which would be desired in a new design, it gave very successful results and decreased the stresses under both drivers and trailer, at the same time working smoothly and satisfactorily. The introduction of the double trailer brings a marked change in the distribution of stress under the several wheels of the locomotive. The stress in 90-lb. rail under the trailer of the 2-10-2 locomotive is changed from 16,900 lb. per sq. in. to 9,000 lb. per sq. in. under each trailer in the 2-10-4 locomotive. Considerable load has evidently been removed from the last three drivers as the stress at 5 m.p.h. was decreased 40 per cent under the fifth driver. With these changes has come an increase of 60 per cent in the stress under the wheel of the front truck, although the resulting stress is not especially high on the straight track. Under the trailers, the effect of speed is to increase the stress 25 per cent, in the change from 5 to 40 m.p.h. Even at 40 m.p.h., the stress in the 90-lb. rail under the trailers is only 11,300 lb. per sq. in. and the stresses under the drivers (not including the effect of counterbalance) are only about 13,700 lb. per sq. in. The stresses indicate a smoothly running locomotive on straight track.

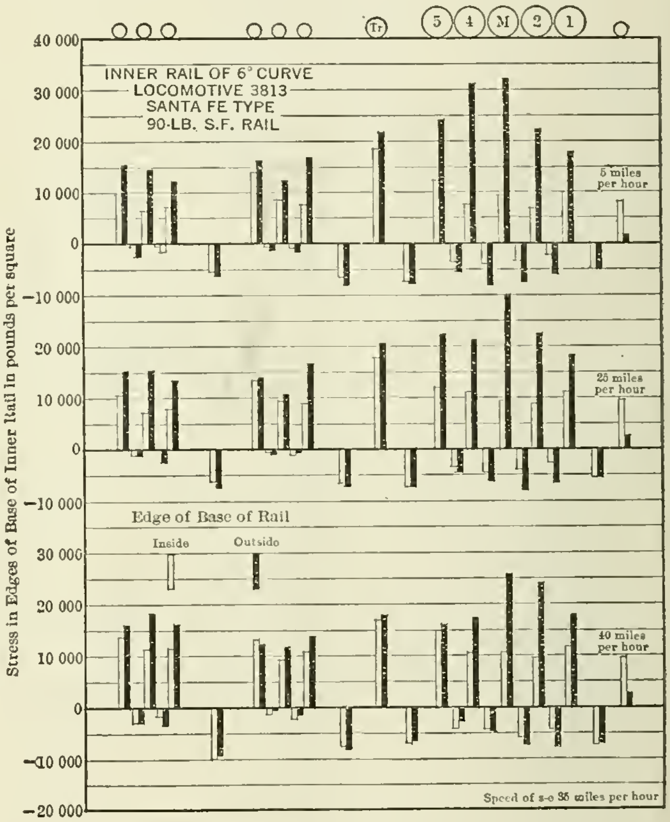
Result of Tests on Curved Track

The outstanding result of the study of vertical bending stresses on curved track is the variable distribution of load among the drivers, and, particularly, the greatly increased loads found on some of the drivers beyond that normally expected. These high loads occur principally on the inner rail and are most marked at the low speed, although high values were found in a number of cases at speeds two-thirds that corresponding to the super-elevation. Further examples of high loads under individual drivers at moderate speeds occurred in the tests in California. Loads ranging up to 100 per cent in excess of the normal load were found with several of the locomotives. These excessive loads produce high stresses in the rail, but more important still they give very high bearing pressures on the rail. As the bearing pressures found are considerably higher under some of the wheels than those which ordinary analysis of the effect of transverse inclination of track and centrifugal force would predict, it would seem well to have a study made of the action of the equalizing levers and the springs on curved track to try to find the cause of the concentration of load, and to attempt to modify the design so as to obviate such gross inequalities.

Lateral Bending of Rail on Curves

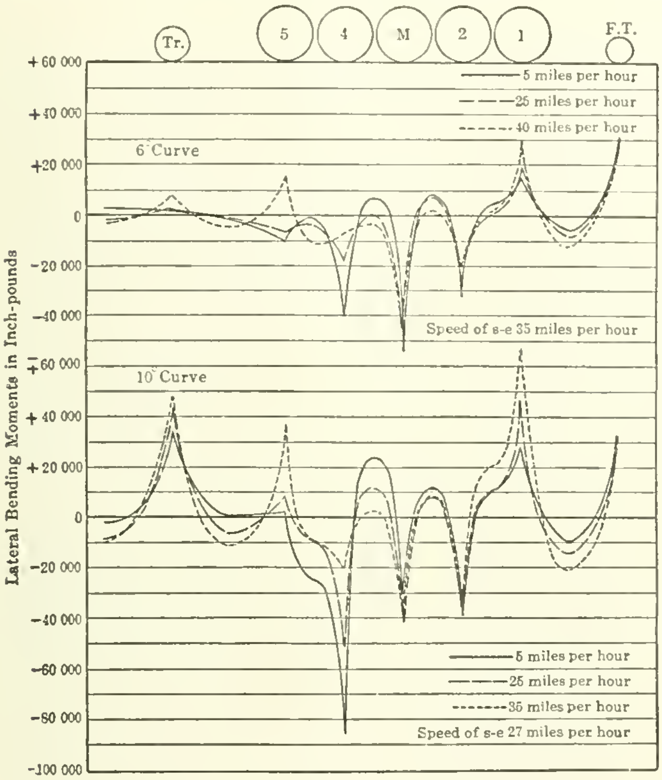
The lateral bending in the outer rail, under the wheels of the front truck, is found to be always positive (indicating an outward thrust) and it is generally positive also in the inner rail. This is true at all speeds. It indicates that the flanges of the outer wheel of the front truck always have an important part in changing the direction of the locomotive when moving on curved track.

In the locomotive having two-wheel front trucks, the lateral bending of the outer rail at the outer front driver is positive at all speeds, with the exception of the Mikado type on the deg. curve, where the super-elevation is 8.5 in. With the locomotives having four-wheel leading trucks, the bending at the outer front driver is generally negative at the low speed, becoming positive at a higher speed, with the exception that it remains negative in the case of the Pacific type locomotive on the 7½ deg. curve. The outer rear driver gives a positive lateral bending in the outer rail (outward thrust on the rail) at all speeds, the one exception being the Pacific type locomotive on the 4 deg. curve at a speed of 5 miles per hour. At low speeds, all the other drivers generally give negative bending in both inner and outer rail, tending to straighten the rail. The principal exception is that the bending moment under the inner fifth driver of the Santa Fe type locomotive is sometimes positive. An increase of speed results in an increase of lateral bending in the outer rail, decreasing the value of the lateral bending stress if the bending is negative and increasing the stress if it is positive. An increase of speed results in a decrease in the lateral bending in the inner rail, the numerical value of the lateral stress decreasing when the bending moment is negative and increasing when it is positive. When the stress due to lateral bending is combined with that due to vertical bending, it will be seen that the resulting stress may be very great. This is the more marked because the high lateral bending stresses generally occur under wheels giving very high vertical bending stresses, much greater than those developed on straight track. Thus, for example, at the outside edge of the base of the inner rail of the 10 deg. curve under the fourth driver of the Santa Fe type locomotive, at 5 miles per hour, the stress is the sum of 23,500 and 29,200, resulting in a stress of 52,700 lb. per sq. in. This value is the average of a large number of runs; not infrequently stresses several thousand pounds greater than this were found, indeed, one of 75,000 lb. per sq. in. was recorded. It may be added that the value of the lateral bending stresses under many of the wheels ranged from 40 to 100 per cent of the vertical bending stress under the same wheel.



Stress at Edges of Base of Inner Rail on 6-deg. Curve—Heavy 2-10-2 Type

The general trend of the combined bending moments under and between the several wheels is very striking. Intense and severe lateral bending action comes on the track as a whole as the locomotive passes around the curve, tending to push the ties and ballast first to one side and then to another and to throw the curve out of line. The ratio of the lateral bending moment in the inner rail under the fourth driver of three Santa Fe type locomotives (two of them belonging to the Atchison, Topeka & Santa Fe and one to the Southern Pacific) to the vertical bending moments developed at the same time averages 0.16 at the lowest speed on the 10 deg. curves. It should be recalled too that the vertical bending stress under this driver was far greater than the normal and that the pressure of the driver on the rail must have been nearly twice the normal load. The ratio of the lateral bending moment under the same wheels to the vertical bending moment found generally on straight track averaged 0.04, although values as great as 0.14 were found. As the section modulus of the rail about a vertical axis is only about one-fifth that about a horizontal axis, the lateral bending stresses in the rail are relatively great in comparison with the lateral bending moments. It will be seen that the lateral bending effect on the 10 deg. curve under the fourth driver of this locomotive (taking the average value found) is at least four times the average value found on straight track and at least twice the highest value that may be expected.



Combined Lateral Bending Moments in the Two Rails of Curved Track—Heavy 2-10-2 Type

Effect of Speed and Counterbalance on Curves

The effect of counterbalance on the stresses in rail on curved track is much more variable than that found on straight track. One interesting result of the study of the data is that, under a number of the wheels, the stresses at the outside edge of the rail showed marked effect of counterbalance, whereas those at the inside edge show almost no counterbalance effect.

The effect of speed on the division of the load of the locomotive between the two rails of the curve is quite another matter. At and near the speed of super-elevation, in most of the tests on curved track, the vertical bending stresses in the two rails do not differ much from each other. It may be noted that analysis shows that the speed may be increased considerably beyond the speed of super-elevation before the load on the outer rail would become equal to that imposed on the inner rail at low speeds. Although the ratio varies with the degree of curve and the super-elevation used, it may be said that for the track used in the tests the speed may be increased 30 to 40 per cent beyond that of super-elevation before the load on the outer rail may be expected to equal that found on the inner rail at low speeds. The foregoing discussion refers to the sum of the loads under all the wheels; the distribution of load among several drivers may be quite unequal, the vertical bending stresses in the rail under one driver of one type of locomotive being as much as double what might be expected in the case of the 10 deg. curve and 50 per cent more on the 6 deg. curve. The lateral bending stresses developed in the rails also vary with the speed. The lateral bending stresses in the inner rails are very great at the slow speeds, especially at the driver in front of the rear driver, and sometimes the one in front of this, in the case of the locomotives having eight and ten drivers. For medium speeds, say, up to two-thirds of the speed of super-elevation, the lateral bending stress under the rear intermediate driver continues to be of considerable magnitude. For the higher speeds, the lateral bending stresses under these wheels decrease markedly and at the speed of super-elevation the highest lateral bending stress in the inner rail may not differ greatly from the highest stress found in the outer rail. The greatest lateral bending in the outer rail under a driver is found at the outer front driver in those locomotives in which the wheel of the leading truck does not assume the principal part in changing the direction of the locomotive. With an increase in speed, this lateral bending stress increases. As the stresses in the outer rail under the wheels of the front truck do not increase with an increase in speed, it is evident that the greater effort to change the direction of the locomotive at the higher speeds is taken by the flange of this first outer driver.

Type of Locomotive

In the matter of changing the direction of the locomotive, it seems evident from the tests that the four-wheel truck of the Pacific and Mountain types presents advantages over the two-wheel truck of the Santa Fe and Mikado types. With the four-wheel leading truck used, the loads on the wheels are such as to give moderate vertical bending stresses. With the locomotives having the four-wheel trucks, there is little or no outward bending stress developed in the outer rail under the first driver, this driver participating in the turning action only at the highest speeds. With the two-wheel front truck, the lateral bending stress in the outer rail under the first driver may become very great.

Lateral Bending of the Rail Section

When a lateral force is applied to the head of the rail and the base of the rail is held in place either wholly or partly, it may be expected that the rail web will bend and the head of the rail will deflect outwardly or inwardly relatively to the original vertical axis of the rail. Measurable values of the lateral bending of the rail section were found. The deflection varied from zero to 0.016 in. The values on the 10 deg. curve were somewhat higher than on the 6 deg. curve. The Santa Fe type gave somewhat higher values than the Mountain type. As would be expected from the low speed used, the deflections were greatest in the inner rail, and the direction of deflection in the inner rail was generally away from the track. The direction of the deflection in the outer rail did not always correspond with the character of the observed lateral stress in the base of rail. As the lateral bending of the rail itself is the result of a number of forces, including those acting at the supports of the rail, it is possible that the sign of the bending moment at a wheel point may not be in keeping with the direction of the lateral force acting at that point. An interesting feature occurred when the Santa Fe type was backed over the track. A very high value of the deflection was observed in the inner rail under the fifth driver, a deflection of 0.016 in. away from the track for the 10 deg. curve, and one of 0.014 in. for the 6 deg. curve. The absence of leading wheels to guide the driving wheel-base is evident in these results. Values of the deflection as great as 0.007 in. were found at the wheels of the tender, the middle wheel of a truck on the inner rail giving large deflections.

Locomotive Boiler Water Circulation

Rate of Heat Transfer Depends on Rapidity of Water Movement Owing to Its Poor Conductivity

By C. A. Seley
Consulting Engineer, Locomotive Firebox Company

THE Babcock & Wilcox publication entitled "Steam, its Generation and Use," contains a chapter on circulation of water in steam boilers, showing by glass models of vertical and inclined tubes the circulation induced by various heat applications. Mr. Babcock makes the statement that if the surface of ice cold water was raised to boiling temperature, the heat would not begin melting the ice at a depth of three inches in less than about two hours. In this case there is no circulation at all and water of itself is such a poor conductor of heat as to give the result described.

Water circulation is a prime essential in a steam boiler for several reasons. Without it there will be little evaporation. For quantity evaporation every particle of water must be brought into contact with a heated surface and the only possible means is by moving or circulating the water particles against the heated surfaces. Each particle is not thus instantly converted into steam but it absorbs heat, raising its temperature, increasing its volume or decreasing its weight per unit of volume and enabling it, by the law of gravity, to assist in setting up, with its fellows similarly heated, an upward movement or current balanced by a downward movement of the colder particles.

These currents in various parts of the boiler combine to set up a general circulation of the water, dependent on the boiler design and proportions, and facilitate the gradual heating of the entire mass of water. As the highly heated particles again come in contact with heating surfaces they may absorb the final addition of heat which converts them to steam in the form of bubbles, now of greatly increased volume. We must bear in mind constantly that there is practically no conduction or radiation of heat in the water as between its particles, that no firebox or flue heat is transmitted to water not in contact with their surfaces, and that to fully utilize heating surface the steam bubbles as formed should be swept off and not allowed to linger. Another point is that by circulation the entire body of water is maintained at a more even and a higher temperature, resulting in a reduction of stresses in the structure which otherwise lead to maintenance trouble and expense.

No one will question the advantage of a large volume of highly heated water in operation. Every runner likes "a good steamer" and for that there must be proper water circulation and no sluggish areas. To obtain the highest evaporative effect each unit of heating surface should be swept by such a rapid circulation that steam bubbles are quickly removed from the surfaces after formation in a medium of so nearly equal temperature as not to condense the steam bubble in its path to the steam space. Furthermore, the more direct this path the freer the steam separation.

The evolution of the boiler from the day of the 8-wheel type engine has been accomplished without much attention to the matter of water circulation. It was largely automatic, the working out of a natural law which fortunately was in line with the needs and sufficed in the boilers of long past years.

The early boilers had a deep firebox set between the frames and a greater proportion of firebox heating surface relative to the small grate areas than is possible with boxes of later design in which the depth of water legs was materially reduced. The amount of water contained in the boiler was relatively small and the upward current in the deep legs induced an amount of circulation considered sufficient, if thought of at all.

With the need of increased power the boilers were made larger and longer and the volume of contained water greatly increased, with a tendency toward retarding circulation until, for another reason, arch tubes came into general use. But the arch tubes perform a very valuable function in stimulating water circulation. Being in the fire they are valuable heating surfaces, drawing water from the throat, to which the colder water in the belly of the boiler gravitates, and discharging mingled steam and water at steam temperature at the back head a few inches below the crown sheet. Thus the arch tube has been a lifesaver, so to speak, in boilers with long tubes or with deep combustion chambers.

Now, after 10 or 15 years in which the arch tube has come generally into use in heavy power, the report of the Committee on Design and Maintenance of Locomotive Boilers presented to the 1922 convention of the A. R. A., Mechanical Division, called for "Careful consideration of the design of boilers to the end of perfecting circulation of water." This seemed to imply that the question was still open, the last word not yet being said on improvement in that line. The discussion of the report brought out the fact that water leg devices in the past had been used in fireboxes, but as none seemed to remain or to have been developed to recognized standing, there must have been something wrong fundamentally, either in the manner of connection or in their relation to the direction of circulation.

Some 10 years ago, Dr. W. F. M. Goss made some locomotive boiler tests at Coatesville, Pa. Certain of the tests were made with the water and steam surrounding the firebox isolated from the water and steam in the barrel section of the boiler, the object being to ascertain the respective values of firebox and flue heating surface. When using oil as fuel, the results were 7.6 lb. of water per sq. ft. of firebox heating surface to 1 lb. of water evaporated in the barrel. For coal as fuel the results were 6.15 lb. to 1 lb. These boilers had 2¼-in. tubes, 18 ft. 2 in. long, about 3,000 sq. ft. of total heating surface, of which 206 sq. ft. were in the firebox, 58 sq. ft. of grate surface, and shells 70 in. in diameter at the front end.

The relatively high value of firebox heating surface for locomotive boilers shows one thing in relief; that the firebox is the place where, in proportioning the boiler, results of greatest value may be gained or lost. With the low value found for the flue heating surface it is evident that addition or omission of flues is not so material in the design at the barrel end as is consideration of lasting bridges, flue maintenance, circulation and water volume.

The high value of firebox heating surface is due to the combustion therein. The tubes are only about one-fourth the thickness of firebox sheets, but this advantage is lost because of the temperature reduction of the gases on entering the flues and because they are capable only of imparting heat by convection or rubbing on the tube walls.

Bureau of Mines Bulletin No. 18 gives the results of some very interesting stationary boiler tests from which the following points are noted. It was found that the resistance to the passage of heat through boiler plates was very small as was that to the passage of heat to the plate and from it to the water if the surfaces are moderately clean, and that the heating plates transmit to the boiler water all the heat that can be imparted to their fire sides. With constant temperature of the gases, increasing their velocity over the plates increases the rate at which the plates transmit the heat and likewise increases the rate of steam making.

Here then is a plain case of the value of circulation of the gases. Based on the findings there seems to be a good argument for likewise stimulating the circulation of the water, whereby the water in contact with the heating surfaces may be so rapidly changed as to more effectively, thoroughly and evenly absorb and distribute the heat to the entire volume of contained water in the boiler.

During the Coatesville tests an attempt was made to measure the rate and direction of flow of the water in the boilers tested by special apparatus, but at only about a half dozen locations in a zone approximately central of the side water leg, 21 in., 45 in., and 69 in., above the bottom of the mudring. As no other locations are mentioned it is difficult to find support for certain assumptions made in the review of the findings, that "enough water passes back from the barrel to the water legs of the boiler to make good that which the firebox evaporates and no more." If that be true, I am wondering how a temperature reading of only 13 deg. below the boiling point was found at the lower back corner. The test showed a downward current in the leg on the outer side at the various points investigated but the high temperature noted would seem to be indicative of a fairly general circulation of the water, including the barrel content.

The water discharge of the arch tubes and of the water legs, at the sides and back of the firebox must create a head of water at the firebox. It is hardly possible that all of it is immediately converted to steam and if there is an additional head it must flow forward into the barrel and create a movement forward at the top of the barrel, due to its highly heated condition and the passage through it of the steam bubbles arising from the flue heating surface. But if the conclusion from these tests is correct it seems high time to consider means of inducing circulation from the barrel of the boiler, that there be no zones of sluggish movement and reduced temperature.

Circulation between the boiler and the Nicholson Thermic Syphon is brought about by the unbalanced head of the lighter weight of hotter water and steam in the syphon as compared with an equal volume of water in the barrel of the boiler, carrying out the law of gravity. Heat is the prime mover of water in a boiler and the movement, in a general way, may be said to be proportional to the amount of heat absorbed when bringing the water up to the boiling point. This is true also of the syphon and the circulation through it before boiling occurs is probably not more than twice as vigorous as in any other portion of the firebox well exposed to heat, taking into consideration that the syphon has both sides so exposed.

When making steam, however, a very different set of conditions obtains. Assume for example that the heating surface of a syphon will convert one cubic foot of water into steam in a certain time interval. The discharge from the syphon, then for the given time interval will include one cubic foot of water converted into steam, which would be a relatively small amount were it not for the fact that in its conversion to steam, say at 200 lb. pressure, its volume is increased over 115 times, therefore, in the time interval named above, space for 115 cu. ft. of water is made in the syphon and quickly supplied from the barrel of the boiler, as it is inevitable that the bubbles must go up and their place be taken by water from below. Thus a large flow of water is produced into and through the syphon, carrying with it the one cubic foot of water now in the form of steam bubbles weighing less than half a pound for each cubic foot.

It does not follow that the relatively large volume of flow through the syphon causes violent ebullition, nor is it constant in action except with uniform boiler conditions. The pumping action of the syphon depends mainly on heat absorption by the water passing through it and its conversion to steam. There is no doubt also of an induced action from the swiftly rising steam bubbles, pushing upward the water in the syphon

It has been calculated that even without this induced action the water passes through the neck of the syphon at approximately four lineal feet per second, but because the discharge opening in the crown sheet is 10 to 12 times the neck area, the steam is quietly released. Calorimeter tests have shown exactly the same dryness of steam at the dome as on non-syphon engines. This quiet release at the syphon openings insures correct indications of height of water in gages and permits a generally lower water level with safety, with a corresponding increase and betterment of the steam space and steam quality.

It is one of the incidental advantages of the stimulated circulation caused by the syphon that mud and much of the precipitated matter are swept to washout points for convenient cleaning and keeping the boiler in a generally cleaner condition. Another advantage is a shortening of the time required in firing up. The saving of an hour has been demonstrated, plainly due to the stimulated circulation and additional firebox heating surface afforded by the syphon.

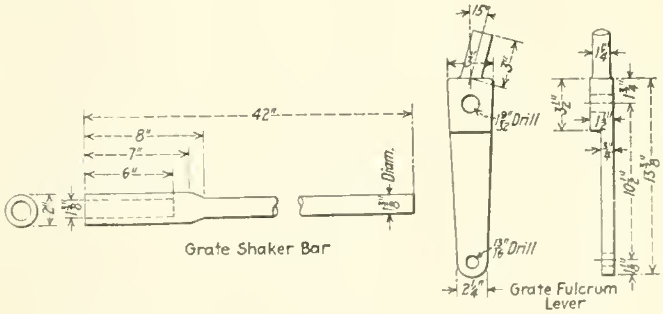
What has been said so far is altogether of a theoretical nature which may be very good so far as it goes, but the value in results is the proof of the pudding. Syphons have been furnished to 43 railroads of the United States for over 500 locomotives. A number of these roads have made tests of syphon equipped engines in comparison with others of the same class not so equipped. Results of a dozen or more road tests made by various railroads, about equally divided between saturated and superheated engines of the same classes, demonstrated coal savings on a 1,000 adjusted ton mile basis in favor of the syphon equipped engines ranging from 12 per cent to 25 per cent.

An Improved Grate Lever and Shaker Bar

By H. G. Bonney

Assistant Master Mechanic, Lehigh & New England

THE shaking attachments for grates, while simple and comparatively an unimportant feature of the locomotive, have been responsible for more injuries in the last three years than any other single part. According to the report of the Interstate Commerce Commission, the injuries caused by grate shakers totaled 109 in 1920, 85 in 1921, and 49 in 1922. The matter was mentioned especially in the report of the Chief Inspector of the Bureau of Locomotive Inspection for the fiscal year ended June 30, 1922.



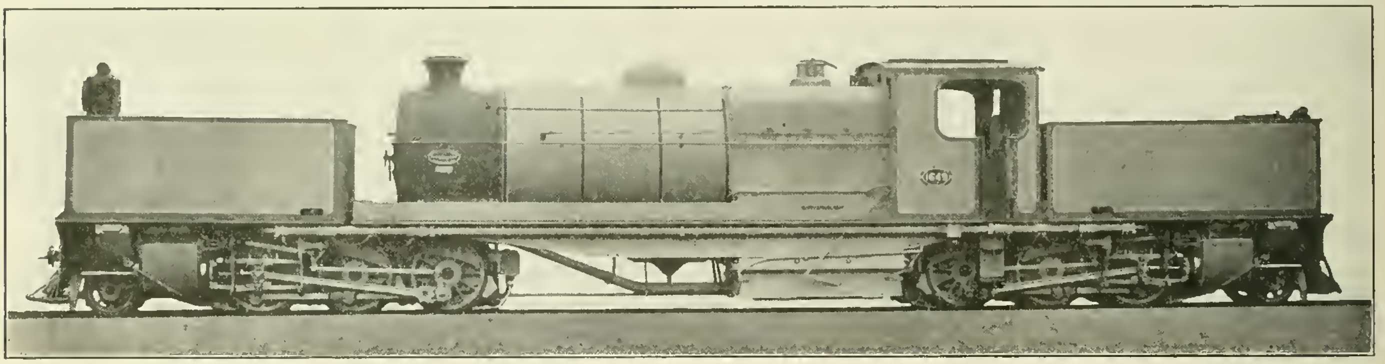
Shaker Bar and Lever Adopted as Standard on L. & N. E.

On the Lehigh & New England troubles with grate shakers have been practically eliminated by a simple design of bar of the type shown in the illustration. The upper end of the grate fulcrum lever has a circular section 1¼ in. in diameter and 3 in. long on which the lever fits. The socket in the lever is 1⅜ in. in diameter. The absence of taper on either the socket or lever eliminates the tendency for the lever to work off when grates are being shaken. The shaker bars are all interchangeable and are easily made by welding a piece of seamless tubing to the end of a 1⅜-in. round bar.

Garratt Articulated Locomotives

THE provision of locomotives of great tractive force for mountain sections or for the haulage of unusually heavy loads is a problem which has to be met on many roads. When the requirements have been too severe for the conventional types, such as 2-8-2, 2-10-2, etc., the alternative so far used has been the Mallet articulated locomotive. There is, however, another form of articulated locomotive now in use in Australia, Brazil, South Africa and elsewhere, which offers certain advantages and is of interest as another solution of the problem. This is the Garratt type which was introduced in 1909 on the Tasmanian Government Railways. This locomotive was of the 0-4-4-0 type, 2 ft. gage, weight 71,700 lb., with compound cylinders and 16,250 lb. rated tractive force. Since that time the same type has been built for a number of other roads in several countries.

An example of a recent design of Garratt locomotives, shown in the accompanying illustration, was built for the South African Railways. These railways, which are of 3 ft. 6 in. gage, operate some of the most difficult sections of main line in the world. Continuous grades of 3 per cent are common, combined with uncompensated reverse curves of 19 deg., over which trains of 400 tons have to be handled at a speed of 10 miles per hour.


Garratt Locomotive of the 2-6-6-2 Type Built by Beyer, Peacock & Co. for the South African Railways

This locomotive, which is of the 2-6-6-2 type, was designed for freight traffic but has been used for heavy passenger trains. However, orders have recently been placed for two additional Garratt locomotives of the 2-6-2—2-6-2 type for certain passenger traffic.

The locomotive consists of three units: A boiler unit mounted on a girder frame carried at each end by an engine unit, each of which has a water or fuel tank built on to it. The pivot centers are located on the engine frames so as to give proper weight distribution. The Garratt locomotive is in reality simply two plain engines with one large boiler.

An important feature of the Garratt locomotive is the practically unlimited latitude permitted in the design of the boiler. The capacity may be all that is required, the grate area may be ample for even low grade fuels, while the volume of the firebox and the height from the grate to the crown sheet may be proportioned to give good combustion without resorting to an additional chamber. The firebox is thus a plain rectangular box—with a brick arch—constructed of three plates, tube plate, inner back head and wrapper sheet with but two seams and easily stayed. An unusual length of boiler barrel with long tubes is not required to give weight on the forward engine unit. As there are no axles underneath the ash pan, it can be of ample size and easy of access.

The distribution of the weight over the axles is positive, resulting from the location of the center or pivot castings. No weight adjusting links are required between the boiler and engine units and as there are no lateral control arrangements for centering the engine units, running is as free as with two separate small locomotives. The boiler unit when on a curve assumes the line of the chord instead of overhanging the outside as in the Mallet type, consequently high speed running is perfectly safe and a speed up to 60 miles per hour has been made on 3 ft. 6 in. gage track with 60-in. drivers. The Garratt locomotive is a true double ender and there is no need for turning at the end of the trip.

The South African locomotive shown weighs 299,650 lb. with tanks filled, of which 234,350 lb., or 78.3 per cent, is on the drivers. The load on any pair of wheels is less than 40,000 lb. The total length over couplers is 65 ft. 5 in., the length over pivot centers 33 ft. 3 in., the driving wheel base of the separate units 9 ft. and the total wheel base of the two units, 58 ft. 7 in. The driving wheels are 48 in. in diameter and the rated tractive force, 53,725 lb.

The boiler is 81 in. in diameter, carries 180 lb. steam pressure, has an evaporative heating surface of 2,554 sq. ft., of which 211 sq. ft. are in the firebox. There are 40 superheater units, Schmidt type, with 526½ sq. ft. heating surface. The grate area is 51.8 sq. ft.

The two engine units are practically alike with interchangeable cylinders, valve gear, rods, journal boxes, spring and brake rigging. The cylinders are 18 in. by 26 in. and develop 2,100 rated horsepower.

The ball joints of the live steam pipes are located directly under the pivot centers, being attached to the upper portion so that the ball simply rotates in its cup. The exhaust pipe ball joints are placed to one side and provided with slip joints to allow of the slight longitudinal movement.

Nine tons of coal and 1,250 Imp. gal. of water are carried in the combined tank on the hind engine frame, the shoveling plate extending into the cab, so that the foot plate arrangements are the same as for a locomotive with a tender. The front tank holds 3,350 Imp. gal. of water, the level of the two tanks being equalized by a large pipe placed outside the boiler frame and fitted with flexible connections to the elbow pipes under the tanks.

The majority of the Garrett locomotives at present running have been designed and built by Beyer, Peacock & Co., Ltd., of Manchester, England. They range from small locomotives for 2-ft. gage track to those on the San Paulo, Brazil, which are used on 5 ft. 3 in. gage track.

Water Treatment on Missouri Pacific*

By W. C. Smith

Mechanical Superintendent, Missouri Pacific, St. Louis, Mo.

THE experience of the past year has demonstrated clearly and beyond question the great advantage of careful attention to the quality of locomotive boiler water supply. It is recognized that the question of proper water supply is an individual problem in each instance. The Missouri Pacific, after experience with many varieties of proprietary compounds and also soda ash, adopted a constructive program for the improvement of the quality of its water supply by the elimination of the largest possible amount of impurities before turning the water into its locomotives. These experiences are not intended as representing recommendations for universal practice, but are submitted as information and it is probable that they may prove of benefit in suggesting a method which has effected large economy and materially assisted in the improvement of locomotive operation and maintenance.

The Missouri Pacific system operates over approximately 7,500 miles of railroad. It taps nine states extending from the Mississippi west through the plains of western Kansas to the Rocky mountains and from the Missouri river south through the Ozarks of Arkansas and the bayous of Louisiana. The characteristics of the water supply sources vary from the best to among the worst in the country. Water supply problems include the handling of the coal mine waters in Illinois, the muddy waters of the Missouri, the gyp and alkali waters of the Kansas plains, the salt waters from oil fields and the soft soda waters from southern deep wells. With such variety in the quality of water supplies the marked difference in effect upon engine performance and operation was noticed early. Trouble from scale with consequent leaking and short life of flues and fire boxes on bad water districts was a problem of the first importance. Various compounds and soda ash were tried out as internal treatments, but in most cases they resulted in an increase in foaming and involved the road in such heavy expense for a careful follow-up system, that it was decided to place reliance on more careful and reliable methods.

First Plant Built in 1905

Complete water softening plants were first installed in 1905. The terminals at Little Rock, Ark., Kansas City, Mo., Hoisington, Kan., and Wichita and Pueblo, Colo., were equipped and a number of intermediate stations between Poplar Bluff, Mo., and St. Louis and Bush, Ill.; also between Kansas City and Pueblo, about 32 stations in all. A summary for the year 1909 developed the following: Water treated, 312,234,000 gal.; scale removed, 591,000 lb. Compared to 1905, there was a 44.7 per cent reduction in engine failures due to leaky flues, etc., and also a reduction of 33.3 per cent in boiler maintenance and consequent increase in net tons handled per mile.

In view of these results and the large return on the investment, an appropriation was made for 18 additional plants to be installed in the bad water district west of Kansas City. Up to this time, the entire supervision for all plants had been centered at St. Louis, but it was found that the distance severely interfered with the obtaining of efficient and regular results, so in 1910 traveling chemists with small laboratories were located at Kansas City and Little Rock, these being central and convenient headquarters. This arrangement worked out very well and excellent results were obtained.

In 1917, eight additional plants were installed on the district between Hoisington and Pueblo, which completed the treating equipment at all water stations on this territory. The results obtained were so definite and satisfactory that the district from Kansas City to Omaha was similarly equipped in 1919 and 1920. Since that year the development has been continuing steadily until there are now 81 softening plants (including nine soda ash plants) in service and six additional plants are under construction. Of the total of 81 softening plants in service, 36 are of the intermittent type and 45 of the continuous type. Hydrated lime and soda ash are used for the removal of objectionable matter in supplies, except at the nine soda ash plants where treatment consists only in the removal of the incrusting sulphates.

The cost of chemicals used in treatment varies from 1.2 to 13.3 cents per thousand gallons depending on the quality of the raw water; an average cost is approximately four cents. The total average cost of treatment, including cost of chemicals, operation of plant, depreciation and supervision is approximately nine cents per thousand gallons. Installation costs for plants will vary over a considerable range, from $75 for the conversion of a roadside tank into a soda ash plant, to $22,000—the cost of some of the patented softening plants now on the market. An average cost for installations in use on this system is approximately $4,000.

Large Savings Effected

With the installation of six or eight more plants at some of the points of greatest consumption, it is expected that the quality of water on the Missouri Pacific will be very well in hand. Statistics for 1922 will show that there are 387 water stations in service. Approximately 7,000,000,000 gal. were supplied, of which 6,000,000,000 gal. were used for steam purposes. Of this amount, 2,400,000,000 was softened and approximately 5,000,000 lb. of scale removed which would otherwise have gone into the boilers, causing scale and its attendant troubles. It is estimated that a saving of 70,000 tons of coal was effected in 1922 by keeping this insulating coating from forming on the tubes and sheets. The saving in boiler maintenance engine time and in reduced engine failures has also been very large. It is estimated that the net saving, after subtracting the cost of treatment, will be in the neighborhood of $500,000, although the investment in treating facilities does not exceed $300,000. The intangible benefits such as the improved morale of the forces and the greater reliability of the power are factors which have also benefited greatly by these facilities but cannot be reduced to dollars and cents.

The following may be of interest, as being largely attributable to water softening:

	Increased life of flues and fire boxes	Reduction in boiler work	Reduction in engine failures due to boiler troubles
Little Rock district.....	150 per cent	45 per cent	40 per cent
Kansas City district.....	200 per cent	55 per cent	30 per cent
Wichita district	300 per cent	75 per cent	85 per cent
Hoisington district......	300 per cent	65 per cent	70 per cent
Falls City district......	100 per cent	40 per cent	30 per cent

An interesting feature was brought out on our Colorado division which runs from Hoisington, Kan., to Pueblo, Colo., 338 miles, and is divided into two engine districts at Horace. Before water treatment it was necessary to take out a "V" of flues every four to six months and clean out the scale, and to renew the entire set after 10 or 12 months' service. The flues in locomotive boilers are now run from 30 to 42 months. Instead of ¼-in. scale on the flues when they are removed there is less than 1/16-in. scale. An engine running on one district could not work on another without several weeks of bad leaky troubles but engines are now operated through from Hoisington to Pueblo without any difficulty.

On the district between Kansas City and Omaha, we formerly experienced considerable trouble with leaky staybolts, making it necessary to hold an engine for staybolt inspection and repairs about three days per month. Since the complete treatment of water supplies was put into effect we have practically eliminated the leaky staybolts and engines can be returned to service in much less time.

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*Abstract of a paper presented before the Western Society of Engineers, Chicago, January 22, 1923.

As an example of water treating results for stationary boilers at our Sedalia, Mo., power plant, where water is treated for five Babcock and Wilcox double-deck water tube boilers of 275 hp. each, about 650 of the 840 four-inch tubes were in service 12 years, using treated water. The raw water here contains about 20 grains per gallon of incrusting matter or nearly three pounds per 1,000 gal. and with its use untreated, tube failures were frequent and the scale heavy and very hard.

Many such individual instances can be cited but it is probable that any other railroad, which has given careful attention to its water problems, can do likewise. In fact, although we cannot say our scale troubles have been eliminated, they have been materially reduced. Also although engine failures from leaking have not been entirely eliminated, it is a fact that they are becoming very rare.

A factor which must be given attention in the correction of water supplies is the matter of organization and supervision. The best and most expensive apparatus will not give results unless operated correctly and regularly. If a water treating plant is not run properly it is worse than useless. Not only is the investment a loss but expected results are not secured and the entire plan is discredited. Only by careful and systematic organization and by placing definite responsibility, can good results be secured. The methods which have been established and worked out for taking care of these facilities on the Missouri Pacific are as follows:

The water supply supervision is centered in the engineering department, an engineer of water service being placed in direct charge. Small laboratories in charge of traveling chemists have been installed at Little Rock, Kansas City and Osawatomie, Kan. Samples of both raw and treated water are sent from each treating plant to the designated laboratory on each Wednesday and Saturday where tests are made promptly and reports are furnished to all concerned. Any indication of unfavorable tests results in an inspection of the plant on the ground. The treatments are governed largely by the inspection of conditions in boilers and the chemical tests are made to assure water being maintained in a condition found to be most favorable. The traveling chemists in the course of their inspection, consult freely with operating officers, general and division master mechanics, roundhouse and boiler foremen and others interested and any complaint is taken care of without delay. The engineer of water service and general boiler inspector co-operate with each other and all concerned. In this manner water troubles are adjusted and minimized.

A point which is always brought up in a discussion of water treatment is the question of foaming. It is a fact that as a general rule when a water softening plant is put in service considerable foaming complaint results. This is also more or less true when an engine is transferred from one district with one quality of water to another with different water. In most cases, this trouble stops after a few weeks. We have had some foaming trouble on the Missouri Pacific but with the use of an anti-foaming preparation, which is essentially a weak acid emulsion of castor oil made up by our chemical department, this trouble has been kept at a minimum.

The chief difficulty encountered with boiler waters at present is pitting and corrosion. The solution of this problem is still under study to determine the cause more exactly, but in this connection it can be said that while our present system of treatment has not eliminated this trouble, the improvement in conditions has been very marked.

In summarizing, permit me to emphasize again the importance of careful and conscientious study of water supply problems by a specially trained organization. This, together with close co-operation between the water service, operating and mechanical departments, will insure remarkable and satisfactory results and economies. Our experiences on the Missouri Pacific, where treating plants have been installed and properly supervised, have proven conclusively that these results can be accomplished.

Economics of Water Treatment*

By C. H. Koyl

Engineer Water Service, Chicago, Milwaukee & St. Paul

In 1920, the Chicago, Milwaukee & St. Paul began the installation of water treating plants on the tracks east, west and south of Mitchell, S. D., where the water is very bad. We had had for some years a water treating plant at Mitchell, and one at Sioux City, and on the road had used all the anti-scale compound the boilers could carry; but in spite of all that had been done, the service was poor and expensive. On each engine district there were continuous boiler leaking and failures on the road every week; every boiler spent about two months in the shop every year, and averaged about $2,000 per year in heavy boiler repairs.

It is now two years since the first of the new plants were put in operation. Since then not one of the boilers using treated water exclusively has gone to the shop for boiler repairs. Because a successful effort was made to reduce the careless use of coal on the road not all the coal saving can be attributed to the treated water and my only means of determining this amount is to deduct from the total saving a percentage equal to that on adjoining divisions.

It was noted quite early that, whereas the division of 678 miles was saving 4,000 tons of coal per month, the 130 miles which was completely treated was saving three-quarters of the total, and the 548 miles of untreated water only one-quarter of the total. It was remarked also that about half the water treated on this 130 miles of east-and-west line was taken by engines of north-and-south lines crossing it; so that the good accomplished by the treated water did not all show on the record of the 130 miles, nor even on this division, but on adjoining divisions. And since the north-and-south engines which took water also took coal, our record of coal saved on this section of road was probably not more than half of the coal saved by the water treated there.

As the months went by, we found that the winter savings were far in excess of the summer savings, evidently because, with untreated water, the boiler failures and delays along the road were much worse in cold weather than in warm. As against the previous year, the freight trains carried 100 tons more load, each, and there was saved an average of 60 lb. of coal per thousand gross ton-miles, which was about 25 per cent. More than half of this was saved during the winter.

On the 14 engines operating on this line, at least $28,000 per year is being saved in heavy repairs and at least $12,000 in running repairs. On the same 14 engines, 600 tons of coal per month is being saved, which, at $4 per ton, amounts to $29,000 per year. This is a total of $69,000 per year saved in repairs and fuel. The other savings due entirely to treated water amount to at least $60,000 per year. This makes a yearly minimum saved of $129,000 due to the change from bad boiler water to good on a strip of road 130 miles long, where the water treating plants which effected the change cost $90,000 for construction and where the cost of treating the water is 12 cents per thousand gallons, or $7,200 per year for the amount used.

In addition to improved service on that 130 miles, and a reduction of $129,000 in operating expense, we have also released 3 of the 14 engines, whose construction cost was more than that of the water treating plants. And what is true on the 130 miles is true all over the treated water district.

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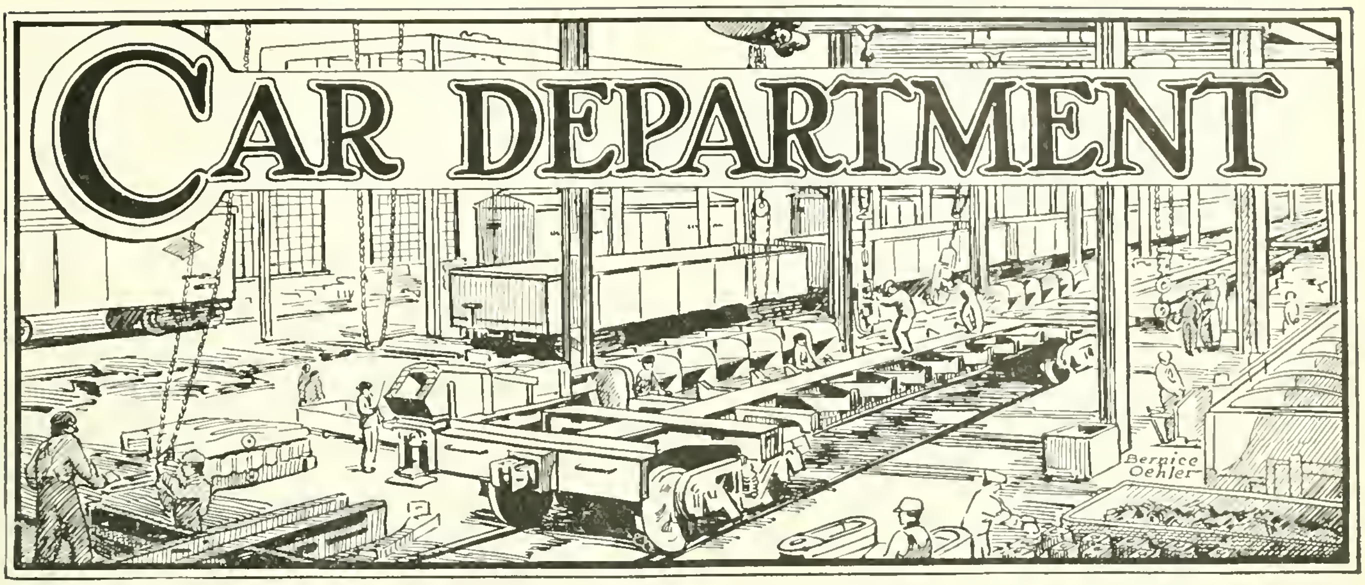
*Abstract of a paper presented before the Western Society of Engineers, Chicago, January 22, 1923.



Comparative Cost of Spray and Brush Painting on Tank Cars

THE application of spray painting by a refinery to its tank cars recently afforded an opportunity for a comparative test of the cost of brush and spray painting. The material used was a scrap enamel, which pulled and was therefore difficult to apply with the brush. To overcome this, the brush painters applied a heavier coat of material than was necessary.

Applying Paint to Tank Cars With An Extension Spray

Three cars were painted by each method and records kept of the time required and the paint consumption. The total time required to paint the three cars by brush was between 42 and 48 hours, and 21 gallons of paint were used. The three cars that were spray painted, using a De Vilbiss extension spray, were completed in five hours with a paint consumption of 10 gallons. The cost of brush painting was $15 a car, while the job was completed by the spray system at a cost of $4.17 a car.

The marked saving effected by the spray system in the amount of paint used is probably the result of the special character of the paint applied in this case and such a saving would not be obtained in the case of a freer flowing material. But the greater covering capacity of the spray coat, resulting from its uniform thickness always tends to reduce the amount required to a minimum.

Tank Car Specifications

The Mechanical Division of the American Railway Association has recently issued Circular D. V. 274 dealing with certain sections of the Tank Car Specifications.

Attention is called in the circular to trouble experienced in classification yards due to the failure of cast-iron plugs in the heads of tank cars. This is brought about by the use of hollow plugs, whereas Section 7 (b) of the Specifications for Class I, II, III and IV Tank Cars requires that such plugs should be solid and made of a good grade of cast-iron. An examination should be made of all tank cars as found practicable and solid plugs complying with the Tank Car Specifications substituted wherever the cored plugs are found in use.

Attention is called to a misprint in the first paragraph of Section 7 (d) of the Specifications for Class II Tank Cars as revised in 1922. This section should apply to both new cars and replacements, the first sentence reading: (d). Effective July 1, 1923, for *new cars* and replacements on existing cars.

In view of the approval by letter ballot of the recommendations of the Committee on Car Construction for a special center sill section for all new cars other than flat cars or cars with extremely low sides requiring fish belly type of center sills, Fig. 4 of the 1922 Tank Car Specifications, is withdrawn and an illustration showing the new center sill section is substituted therefor.

THE CAR PAINTING SHOP of the Canadian Pacific at Vancouver, B. C., was completely destroyed by fire on the night of April 10. Six pullman cars and adjoining freight sheds were also damaged, the total loss being estimated at about $250,000.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Cars Break Away While Switching; Handling Line Responsible for Damage

On December 16, 1921, while doing station switching, a brakeman of St. Louis-San Francisco train No. 42 attempted to hold three cars, placed on the main line, by placing a piece of wood under the wheels. These cars broke away and struck two cars attached to the locomotive, which at the time was moving back toward them preparatory to entering a siding. Missouri Pacific car No. 2807, which was between the locomotive and an empty box car, was broken in two. This is a 60,000-lb. capacity, eight sill, all wood flat car, claimed by the owners to be in good condition. It was not derailed and none of the other cars involved were damaged. At the time of the impact, the locomotive and two cars were slowing down but had not come to a full stop. The original wire report of the accident stated that the cars were moving at the rate of 10 miles an hour when damaged. The superintendent's completion report, rendered after an investigation, revised this estimate to from two to three miles an hour. The wrecking foreman reported the cause "unknown, not due to defective equipment." The St. Louis-San Francisco first asked the owner for the depreciated value of the car but later wrote the case up under Rule 120. The owner's contention is that the damage was caused under conditions defined in item (3), section (d) Rule 32, which makes the delivering company responsible for "letting cars get away on incline." The St. Louis-San Francisco contends that the speeds shown on both the preliminary wire report and the completion report are estimates of which the latter is more dependable since it is based on a thorough investigation, and that the fact that none of the other equipment was damaged shows that the speed was not the primary cause of the damage. It further contends that the type of construction of the car and the fact that it was not the car actually struck, proves that the damage was solely due to its light construction and weakened condition. It cited arbitration decisions Nos. 1123, 1148, 1182, 1185, 1195, 1196, 1197, 1198, 1204, 1205 and 1210 as covering this case and making the car owners responsible.

The decision of the Arbitration Committee states: "Damage to Missouri Pacific car No. 2807 was due to neglect on the part of the handling line to properly secure the cut of three cars against moving when set on main track. The handling line is responsible."—*Case No. 1245, Missouri Pacific vs. St. Louis-San Francisco.*

Responsibility for Cost of Transfer

On February 18, 1919, the Sand Springs Railway delivered Mobile & Ohio car No. 40760 under load to the Atchison, Topeka & Santa Fe. The Santa Fe inspector reported one center sill split and broken, one center sill split, draft bolt broken, one intermediate sill split, one needle beam split and one queen post missing. A request for authority to transfer the load was refused by the Sand Springs Railway. On February 27 a joint inspection was made, with the Santa Fe inspector present but not concurring. The report of this inspection showed one metal queen post missing, two draft bolts broken and one center sill split slightly, and stated "that the Atchison, Topeka & Santa Fe must accept the car and transfer it at their own expense and that there was no M. C. B. rule that held the Sand Springs Railway responsible." The Santa Fe transfered the load and billed against the Sand Springs Railway, which refused payment. The contention of the Santa Fe was, first, that the Sand Springs Railway was not under Federal control and therefore, the modifications of the M. C. B. rules (1918 code) did not apply to this case; second, that car service Rule 15 [Rule 2 (g)], makes the delivering road responsible for the cost of transfer on the showing of the joint inspection report, and finally that the joint inspectors exceeded their authority in rendering any "decision" beyond a statement of the physical condition of the car. It cited arbitration cases 913, 955, 1085 and 1142. The Sand Springs Railway set forth that since the car was in the yards of the Santa Fe which had the closest facilities to repair or transfer, to have repaired and transferred the car on the Sand Springs Railway would have required its movement to another point, causing a delay at a time when it was essential that the movement of freight be expedited. The Arbitration Committee decided that: "In the judgment of the receiving line, the defective condition of the car was such as to justify transfer in accordance with provisions of Rule 2; therefore, the delivering line is responsible for the cost of transfer."—*Case No. 1248, Atchison, Topeka & Santa Fe vs. Sand Springs Railway.*

The Relation of Rule 12 to Rule 91

On December 6, 1920, the Philadelphia & Reading applied an H type triple valve to Bessemer & Lake Erie car No. 80369. Charge for this repair was included in the December, 1920, bill, which was mailed January 12, 1921. When the car came home on January 14, 1921, a joint evidence card was made showing that it was equipped with the H type triple. On March 25, 1922, the B. & L. E. sent the repair card, dated December 6, 1920, and the joint evidence card, dated January 14, 1921, to the P. & R., requesting its defect card to cover the cost of making this repair standard. This the P. & R. refused to furnish, claiming that at the time the joint evidence card was issued the car owner had in its possession the billing repair card covering the original repairs, that according to Rule 13, it was at liberty to render bill for the correction of the wrong repairs if within the limit of one year, as prescribed by Rule 91, and that its failure to present the case so that defect card could be obtained within that time had outlawed the claim. The P. & R. further contended that the intent of the 16 months' allowance in Rule 12 was not to apply where not required to permit the correction of the wrong repairs and that Rule 91 should govern. The car owner maintained that the joint evidence card was obtained within 90 days of the return home of the card, that it was obtained and used within the time limits set by Rule 12, and that none of the provisions of Rule 91 become effective until after the defect card is furnished.

The decision of the Arbitration Committee states that: "In view of car owner having forwarded the joint evidence to the repairing line within 16 months, which is the limit set in Rule 12, fourth paragraph, the time required for rendering bill is a reasonable exception to the limit of one year prescribed in Rule 91. Therefore, defect card should be issued."—*Case No. 1250, Bessemer & Lake Erie vs. Philadelphia & Reading.*

A Speed of 233.87 Miles an Hour is the record of a flight of one kilometer, in a Curtiss aeroplane on the course at Wilbur Wright Field, Dayton, Ohio, on March 26, by Lieutenant R. L. Maughan.

Starting to Look Over the Train

Prize Articles in Contest on Car Inspection

Two Winning Papers Discuss General Inspection and Handling of Interchange

A LARGE number of articles on various phases of car inspection were received in the competition announced in the February issue of the *Railway Mechanical Engineer.* Practically all the papers contained valuable constructive ideas, and it required careful consideration to select the prize winners. After all the entries had been reviewed several times, the first prize of $50 was awarded to A. J. Mitchener, division general car foreman of the Michigan Central, St. Thomas, Ontario, for his paper on the Inspection and Lubrication of Freight Cars. The second prize of $35 was given to W. J. Owen, chief interchange inspector, Peoria & Pekin Joint Car Inspection Bureau, whose paper deals with Interchange and Industrial Inspection of Freight Train Cars.

Among others who submitted especially good papers were E. Erickson, New York Central, Chicago, Ill.; D. P. Crillman, Michigan Central, Detroit, Mich.; T. J. O'Donnell, Buffalo, N. Y.; M. H. Quinn, Port Jervis, N. Y.; Arthur Schafnitt,. Birmingham, Ala., and N. J. Walsh, Union Pacific, North Platte, Neb. The two prize-winning papers are published herewith, and it is planned to publish other papers either complete or abstracted in succeeding issues.

The Inspection and Lubrication of Freight Cars

By A. J. Mitchener

Division General Car Foreman, Michigan Central, St. Thomas, Ont.

IN the inspection of cars the couplers, draft gear, air brakes and trucks are equally important factors in the safe and continued running of car to avoid accidents and delays.

Couplers

The finding of coupler defects which result in break-in-twos and derailments of trains requires careful attention by inspectors and repairers in train yard and repair tracks and to obtain results co-operation with the operating department and the car department is essential in reporting any partings in trains en route to terminal, to insure inspection and repairs of defective parts; also the use of the A. R. A. gage to locate couplers with more than the 5⅛ in. allowed in worn or distorted couplers or parts. The use of the gage is also imperative in gaging every coupler where opportunity presents in trains and repair tracks.

Draft Gear

Derailments due to couplers pulling out are largely due to draft keys working out, coupler pocket rivets breaking and broken coupler pockets. Inspection in train yards to discern and replace draft key pins, one or more broken pocket rivets or a top or bottom section of pocket fractured or broken will in many cases avoid a delay to the train en route and consequent expense of repairs on the road or chaining of the car to a terminal for permanent repairs.

Air Brakes

The maintenance of air brakes is a very important feature to insure proper handling of trains and prevent damage to equipment by undesired emergency applications of air brakes, brakes dragging and heating and cracking wheels and in some cases causing wheels to break and derail the car. To obtain this desirable condition careful test and inspection must be given all cars in train yards to locate any cars with porous or suspicious air hose and remove same; or brakes having excessive or short piston travel and where brakes do not apply and release properly. Where such defects cannot be remedied in train yards an air brake defect card should be applied and repairs made at the first opportunity. Such a card should prevent the car from being interchanged to a connecting road until the defects are repaired.

All cars passing over repair tracks should be tested with a standard testing set to locate defects in triple valve, cylinder and train line equipment and where triple valve repairs are necessary, the triple should be properly tagged and given a test on a standard test rack to insure proper repairs. All cars with stencilling over the 12 months allowed should be given attention on repair tracks and air brake equipment given cleaning and lubrication and proper test on completion. To insure careful observance of this feature a daily report from each repair point should be required showing the following:

Number of cars having air brakes cleaned,
Number of cars let go which were due for cleaning,
Number of air brake men working.

With this information a check of conditions can be maintained and force of air brake mechanics adjusted as necessary to obtain proper efficiency and the desired object in maintaining air brake equipment at 100 per cent.

Trucks

The inspection and lubrication of trucks is a very special and essential part of not only a train yard inspector's and oiler's duties but of repair track foremen and assistants as well. In train yards oilers should be required to spud journal packing well back under the journal. It is unnecessary to use a large amount of free oil and it should only be applied where necessary, as it is very evident that the lubrication is required at the back end of the journal, as cases of burnt off journals indicate that journals invariably burn off at the inside end and never at the outside end of the journal. If packing is in proper condition and well placed at the back end of the journal, no trouble will be experienced from lack of lubrication.

The originating point of a car should be the especial care of car department men, as too severe inspection and lubricating care cannot be given cars where loaded, and if such attention is not given at the originating point the car may possibly pass an inspection point a short distance from the point of origin and give every indication of running cool and when placed in a through train, develop hot journals in a short distance. Care should also be given to examine cars where hot journals are found to ascertain if overloaded. Where truck springs are fully compressed it is certain evidence of the car being loaded over capacity.

The examination of journal bearings to locate thin brasses is a point inspectors should follow closely. In changing brasses it should be ascertained that the wedge or box key is bearing in the center as a worn or distorted wedge or box causing the wedge to bear at the front or back of the brass will cause the journal to pick up strands of packing and a "waste grab" and hot journal is the result.

Careful tabulation of results obtained by inspection and oiling stations and monthly bulletining of such information to all points concerned is found to bring competitive results. When a man knows whether his efforts are bringing results and if improvement is being made, he is the more anxious to use every means in his power to increase the visible fruits of his efforts. To do this it is necessary to keep a record of the hot journals out of each inspection and lubricating point and the number of cars despatched, car miles, number of miles per hot box, and number of cars to every hot box, such information to cover the entire 24-hour period for the entire month and indicate the shifts and side of car upon which hot boxes developed after leaving the oiling station. Thus, it will show the number of hot journals out of each station, and the actual accomplishment of each point by shifts.

On the Canada Southern Division of the Michigan Central this arrangement has resulted in the past year in an average better than 40,000 miles per hot box, which, I believe, has not been equalled by any standard railroad in the United States or Canada. This figure is authentic and can be verified by records.

Cracked Wheels

The particular feature, however, is to locate and remove defective wheels from equipment, which condition can only be obtained by directing the attention of car inspectors and car repairers in the train yard, and car foremen and assistant car foremen on repair tracks, continually to the necessity of extreme care being given this particular feature.

Particularly is this true as regards the cracked wheel feature which is the most important and difficult defect in wheels to be located by an inspector or repair track foreman or assistant. This desired condition can be obtained by publishing monthly at each inspection and repair point on the division the names of inspectors and other employees who locate cracked wheels and also notify each man individually and complimenting him on each wheel found, thereby stimulating a competition to obtain the best showing by each individual man concerned. I have found this to be entirely practicable and for the past year I show the number of cracked wheels located on the Canada Southern Division of the Michigan Central:

March, 1922	36
April	107
May	153
June	92
July	85
August	135
September	132
October	189
November	154
December	126
January, 1923	279
February	175
Total	1,663

It is found that the men who become adept at locating cracked wheels are also very particular in finding other defective wheels, defects in couplers, out of gage, etc., cracked truck sides at inaccessible points and defective brake beams, brake hanger pins, etc.

The main argument, however, is the number of cracked wheels located as shown and whereas formerly scarcely any of these wheels were found as regular business, it is now a daily occurrence and wheels are being found which were overlooked prior to the inauguration of the system mentioned.

It might be well to state that no special means of locating these cracked wheels are used, simply care on the part of the men who handle the inspection and repairs of freight cars and the stimulus given the matter of general inspection in following out the system mentioned.

For the past year the points enumerated have resulted in 75 per cent of our bad order cars being located at terminal or grouping stations when cars are received on the division, thereby reducing the extra switching at intermediate points and the consequent delay in completing repairs. Also no serious derailments due to car defects have occurred during the same period. Following out the inspection methods explained has resulted in the use of two repair track tool cars for repairs to cars along the road, also the services of two steam derricks being practically dispensed with.

Interchange and Industrial Inspection of Freight Train Cars

By W. J. Owen

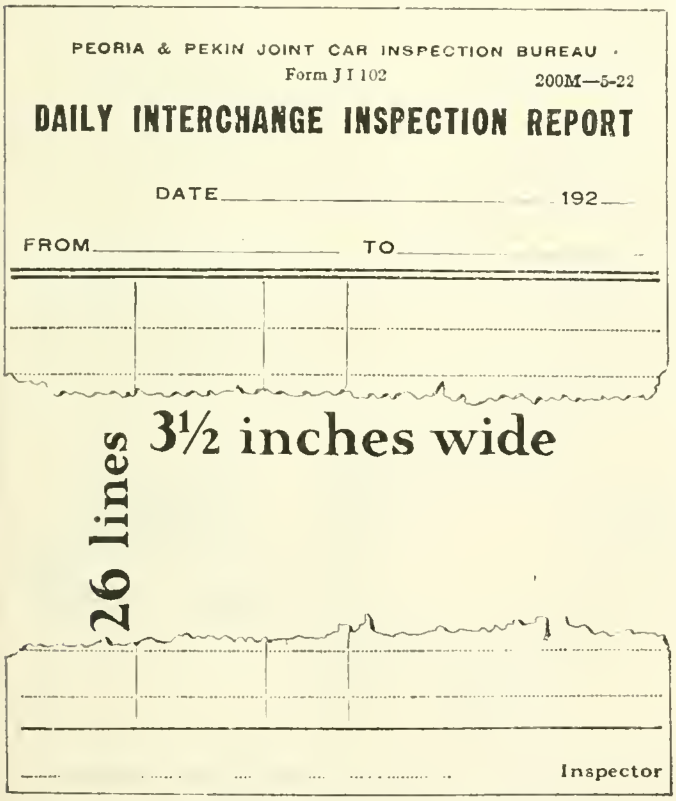
Chief Interchange Inspector, Peoria & Pekin Joint Car Inspection Bureau, Peoria, Ill.

Second Prize

All car inspection in the Peoria district terminals is performed by inspectors in the employ of the Peoria & Pekin Joint Car Inspection Bureau.

Immediately upon receipt of cuts or trains on interchange tracks they are properly protected at both ends by blue flag or light signals and the cars are then given a thorough interchange inspection, in accordance with the A. R. A. rules. At this time defect cards are issued to cover all cardable defects, empty house cars classified for loading, bad order cars carded and routed to the proper repair track, light repairs are made by inspectors or light repair men, and all necessary records made at the car.

Our system of interchange inspection provides for inspectors working in pairs, one on each side of a train, at points where the work justifies the maintenance of more than one inspector. Our methods include separation of air hose between all cars, opening of all journal boxes to insure proper examination of journals, journal bearings, etc. When possible, inspectors are stationed at the entrance when trains are entering the yard, in order to detect flat wheels as trains are passing.



PEORIA & PEKIN JOINT CAR INSPECTION BUREAU

Form J I 102 200M—5-22

DAILY INTERCHANGE INSPECTION REPORT

DATE________________192___

FROM____________ TO____________

3½ inches wide

26 lines

Inspector

Fig. 1—Inspection Report, Form J.I.102

A top inspection is made of all house, stock, and refrigerator cars to determine the condition of the roof, running boards, handholds, brake staff, and attachments, also, an interior inspection of all empty gondola cars, as well as an examination of the lading on all open top cars, to ascertain whether there is any damage to lading or load depression, indicating loss of lading.

A thorough inspection is made of all safety appliances, couplers and attachments, center members, center bearings, side bearing clearances, brake rigging, trucks, etc.

A light colored pasteboard bad-order card, 4 in. by 8in., is used for all bad order cars. This card has the names of the parts of cars printed on both sides, with a space provided for the inspector to put a check mark in front of the name of defective parts. This saves a great deal of the inspector's time, as it avoids writing out the names of the various defective parts.

This card has two red bars ½ in. wide across the face on one side and a single red bar across the face on the other side. This card, when applied with the two red bars exposed, indicates to the switch crews that the car should be moved direct to the repair track. When one red bar is exposed it indicates that defects exist that do not render the car unsafe to move to a local industry to unload, or to a connection, but that the car must move to a repair track when empty and not be reloaded until repairs have been made.

Each railroad or switching line in these terminals is assigned an interchange number or pool mark and each car inspector an inspection number. All cars arriving in the terminal, inspected at industries and interchanged between connections, are pool marked on each side of the car upon the completion of the inspection. This pool mark designates the line delivering or receiving the car, the date of the movement, and the number of the inspector making the inspection of the car.

That the application of this pool mark has a very beneficial effect is evidenced from the results obtained, the inspector in pooling the car thereby signifying that he has inspected same, accepting responsibility for this inspection. Also, the application of pool marks assist the shop forces, in case a car is shopped for any defects; and the joint office, in checking the records and movements of cars.

All of our inspectors are required to make the following records on form J.I. 102, as shown in Fig. 1:

A—All defects on bad order cars.
B—Cars showing a visible loss of or damage to lading.
C—Defect card applied.
D—Foreign defect card data.
E—Wrong repairs to cars of member lines.
F—Repairs made to cars in yard.
G—Classification of empty cars.

All records are filed in a one-hundred pigeon hole case, the last two figures of the car number being the filing reference. To accomplish this it is necessary that a separate or individual inspection form 102 be made up for each car recorded under Items *A* to *E* inclusive.

Classification of empty box cars in interchange is filed by road reference, this report not requiring an individual record for each car, but an individual record for the cars of each line.

Under Item *F*, Cars Repaired in Yard, in addition to the form 102, the inspector making the repairs is required to execute the original record of repairs on the regulation work card.

As a check on the performance of each shift of inspectors at each point, performance sheet, form J.I. 103, shown in Fig. 2, is made up to cover the operations during each eight-hour period. At completion of inspection of each train the inspectors are required to enter on this form all necessary information on inbound or interchange trains or cuts, the road, train number, time of arrival, completion of inspection, number of cars in train, and number of cars marked bad order.

On outbound trains they must show the time the train was ordered, time made up, time inspection was finished, time engine coupled on to train, time air test was completed, and time of departure; also, the number of cars in train and number of bad orders set out.

Where it becomes necessary to set cars out of outbound trains, or where trains are delayed, a full explanation is made on the back of form 103, showing car number and initial of car set out and nature of defects, or cause of delay.

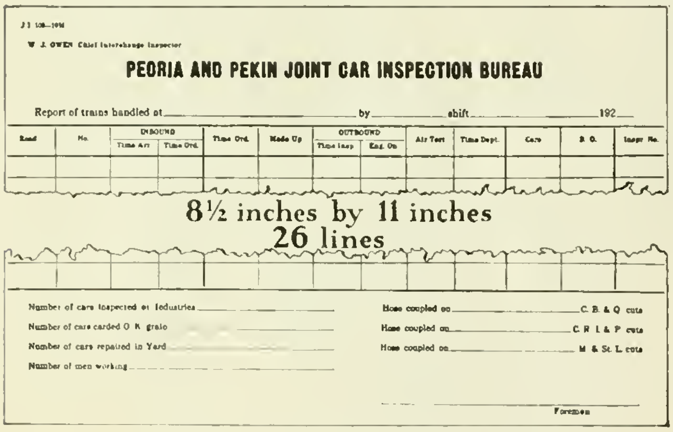
Inspectors handling each train must show their numbers in the column provided. The additional information called for at the bottom of this form gives the office a full and complete report of the work done during any eight-hour period at each point.

These reports, form 103, are assembled in the office each day and compiled on form J.I. 147, Fig. 3, and each point's performance checked against an efficiency rating gotten up to cover the working condition of the various yards. Each point's rating is shown in the right hand margin under the item, "Percentage of Efficiency."

Method of Inspection and Classification of Empty Box Cars for Grain and Other Ladings

Car inspectors are directly responsible for the proper classification of cars; and the fitness of a car for loading any commodity can be determined only by a thorough interior and exterior examination.

For careful selection, inspection, and preparation of box cars for loading, to insure proper protection of freight, is of the utmost importance. The interest of both carrier and shipper is mutual in this respect, consequently, the use of unfit cars, even when the need may appear to be pressing, cannot be justified, as it usually means damaged freight, delays to lading and equipment, dissatisfied customers, and consequent losses to all parties concerned.


J I 103—1926

W. J. OWEN Chief Interchange Inspector

PEORIA AND PEKIN JOINT CAR INSPECTION BUREAU

Report of trains handled at ________ by ________ shift ________ 192__

Road	No.	INBOUND		Time Ord.	Made Up	OUTBOUND		Air Test	Time Dept.	Cars	B. O.	Inspr No.
		Time Arr	Time Ord.			Time Insp	Eng. On					

8½ inches by 11 inches
26 lines

Number of cars inspected at Industries ________

Number of cars carded O K grain ________

Number of cars repaired in Yard ________

Number of men working ________

Hose coupled on ________ C. B. & Q. cuts

Hose coupled on ________ C. R. I. & P. cuts

Hose coupled on ________ M. & St. L. cuts

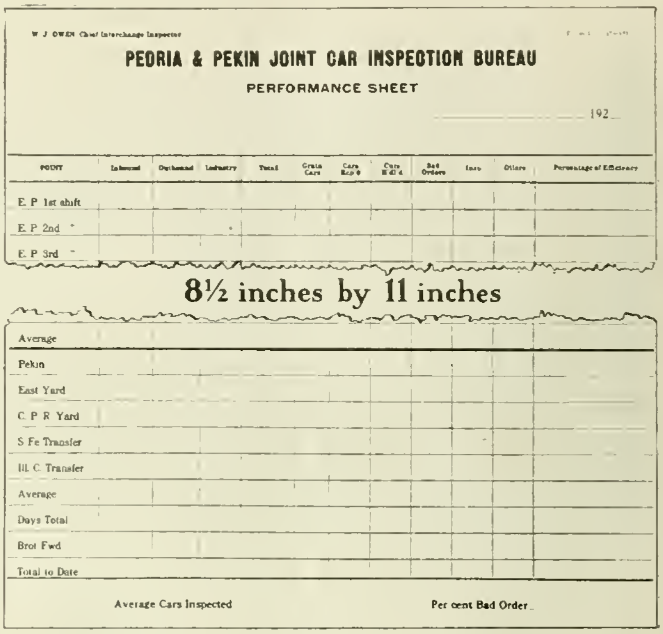
________ Foreman

Fig. 2—Report of Trains, Form J.I.103

This bureau has a standard set of rules or specifications for the classification of empty box cars, a copy of which is furnished each inspector. This is necessary in order to bring about a uniform classification of cars by all inspectors. This standard specification for the inspection of empty box cars brings about a common understanding among all inspectors as to the proper classification of each car, thereby avoiding the reclassifying of many cars after being set to an industry for loading, and the elimination of any unnecessary switching or handling of the car.

A standard six-way commodity card, form J.I. 130, shown as Fig. 4, is used for all empty box cars, and folded to show the commodity for which the car is fit. These cards are securely attached to both sides of the car with two tacks. On cars that are fit for both flour and grain, or sacked feed and merchandise, they are folded diagonally to show both of these classifications. The folding of the commodity card in this manner, to show more than one class of lading, often eliminates an extra move or switching of the car.

Immediately upon arrival of empty box cars in these terminals, they are given a thorough inspection and are classified for industrial loading, as well as being given an interchange inspection, and the commodity cards, showing the classification, are applied at this time. All box cars unloaded at industries are immediately inspected when empty and the commodity cards applied.


W. J. OWEN Chief Interchange Inspector

PEORIA & PEKIN JOINT CAR INSPECTION BUREAU

PERFORMANCE SHEET

________ 192__

POINT	Inbound	Outbound	Industry	Total	Grain Cars	Cars Rep'd	Cars Rd'd	Bad Orders	Insp	Others	Percentage of Efficiency
E. P. 1st shift											
E. P. 2nd "											
E. P. 3rd "											

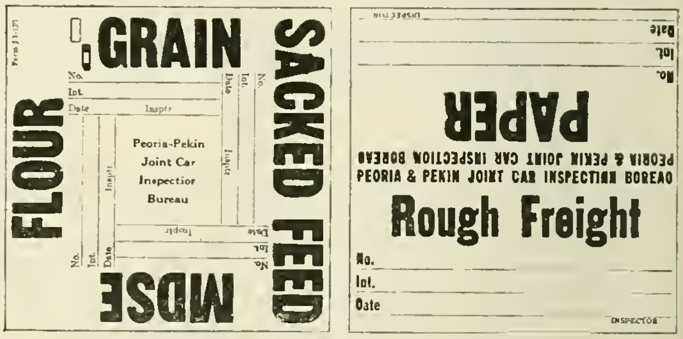
8½ inches by 11 inches

Average											
Pekin											
East Yard											
C. P. R. Yard											
S. Fe Transfer											
Ill. C. Transfer											
Average											
Days Total											
Brot Fwd											
Total to Date											

Average Cars Inspected ________ Per cent Bad Order ________

Fig. 3—Performance Sheet, Form J.I.147

A special record form, J.I. 102, is used by inspectors for reporting the classification of all empty box cars. This form is shown as Fig. 1. Where inspections are made at industries, the records show the location of the industries. Where such inspections are made at the time of arrival in the terminal, the record shows the train number, time of arrival, and the line delivering the car. In either case, the car number, initial, and commodity for which the car is fit, are shown on the record. Where cars are not fit for flour, or similar first-class lading, a notation is made on the record, showing the condition rendering the car unfit for a better class of lading. This record is mailed to the chief inspector's office and a copy is furnished by the inspector to the local yardmaster or agent in charge of that district.


GRAIN

SACKED FEED

MDSE

FLOUR

No.

Int.

Date

Inspt'r

Peoria-Pekin
Joint Car
Inspection
Bureau

PAPER

PEORIA & PEKIN JOINT CAR INSPECTION BUREAU

Rough Freight

No.

Int.

Date

INSPECTOR

Fig. 4—Commodity Card, Form J.I.130

The results of this system, of classifying all empty box cars on inbound inspection and the application of the commodity card, has been very satisfactory, as this method assists the transportation department in properly disposing of cars without any unnecessary switching, and the selection of only such cars as are suitable for loading at industries, or on special orders for connecting lines.

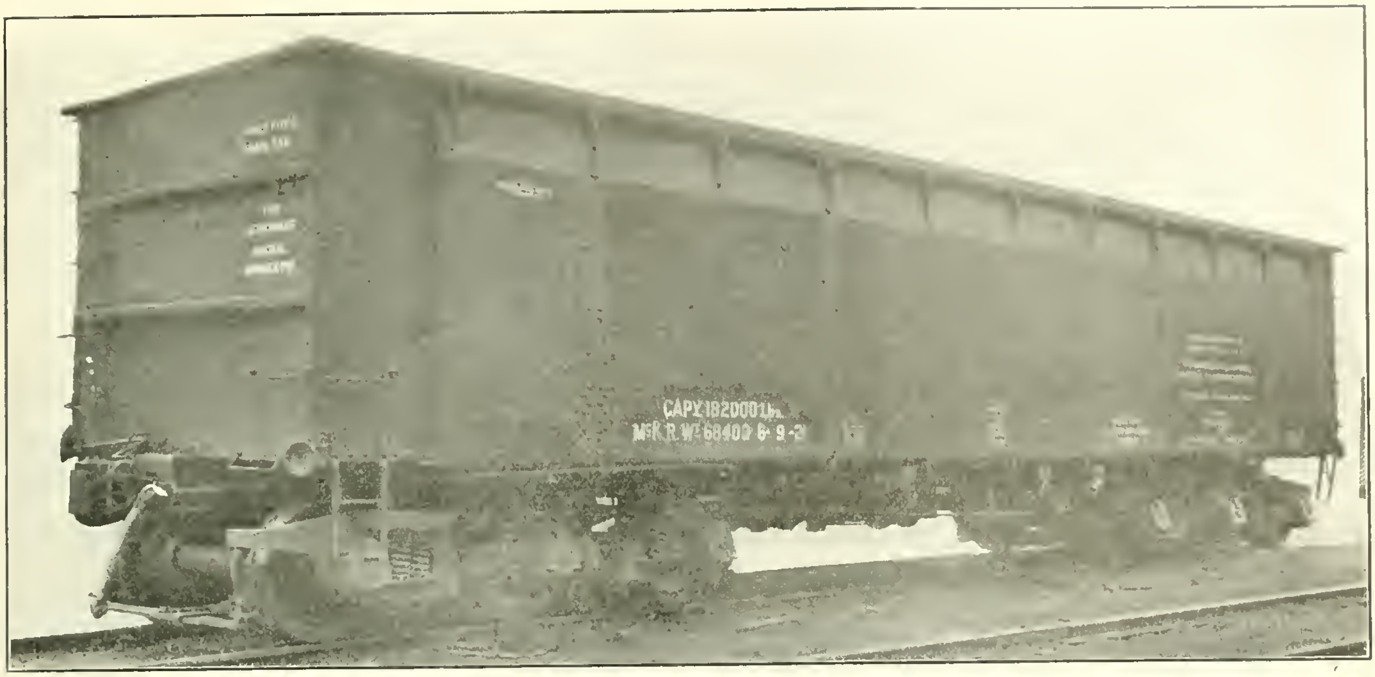


Fig. 1—100 Ton Gondola Coal Car with Boyden Six-Wheel Co-ordinating Trucks

The Boyden Six-Wheel Co-Ordinating Truck

Designed To Provide Extreme Flexibility in Order To Minimize Curve Resistance and Flange Wear

A SIX-WHEEL truck for freight cars, in which each axle is free to assume a true radial position when passing around curves has been designed and built recently by the Boyden Steel Corporation, Baltimore, Md. The object in developing this new type of truck has been to minimize resistance and wear of wheels and rails on curves at the same time providing a simple, durable construction easy to build and maintain.

The first Boyden co-ordinating truck was the conception of John C. Boyden. After a model had been made, a company called the Boyden Co-ordinating Car Corporation, Baltimore, Md., was organized to carry on the initial development work.

Drawings were completed, patterns made, castings produced and a full sized truck assembled at the Camden Iron Works, Camden, N. J., in 1919. This truck, which weighed 22,000 lb., was submitted to many tests to determine its action in passing around various curves.

Being satisfied from these tests that the principle of the design was a correct one, steps were next taken to build two trucks for further tests under a car. A number of modifications in the patterns used for the second design, which was intended for a 120-ton capacity freight car, reduced the weight of a complete truck to 19,600 lb. Castings were made by the Pittsburgh Steel Foundry Company and the trucks assembled at the plant of the Cambria Steel Company, Johnstown, Pa. They were placed under a 100-ton capacity coal car obtained from the Chesapeake & Ohio and, with the car loaded to its full capacity, runs were made around the sharpest curves and over the poorest track available at the car plant. This work was carried on in 1920 and 1921.

Following these tests the third design was made and a

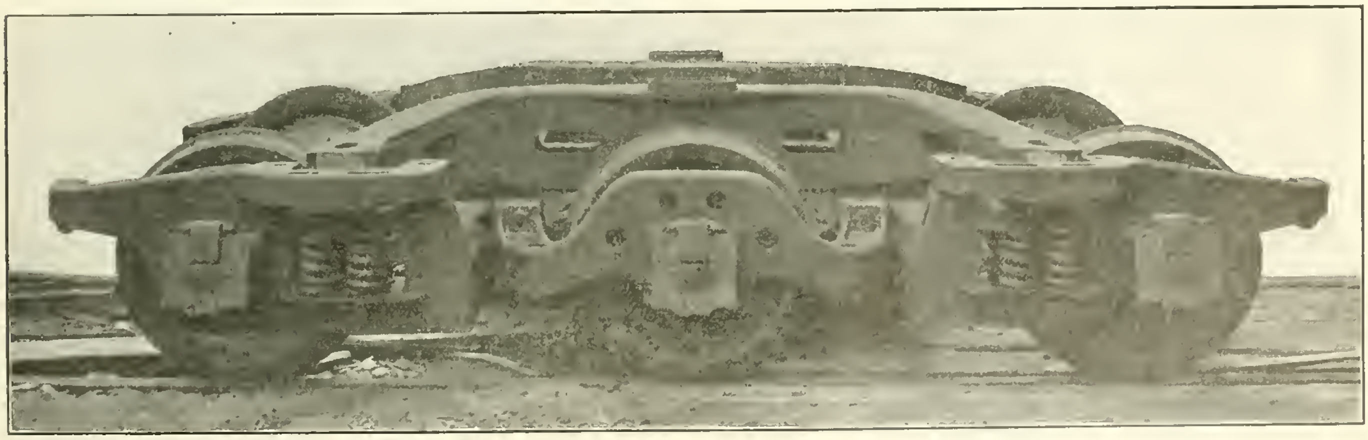


Fig. 2—Boyden Six-Wheel Truck—Brake Rigging Not Applied

pair of trucks built by the Wheeling Mold & Foundry Company, Wheeling, W. Va., in this design the shape of the cast steel members was of a box section instead of an I-section as employed in the previous design. The trucks weighed 20,100 lb. each, complete with brake rigging, and as with the previous design were suitable for cars of 120 tons capacity. Of this weight the four main steel castings made up approximately 9,000 lb. The trucks were substituted for the older ones under the Chesapeake & Ohio 100-ton coal car in 1922 and the car placed in service. This is the design shown in the accompanying drawing, Fig. 3, and the photographs, Fig. 1 and Fig. 2.

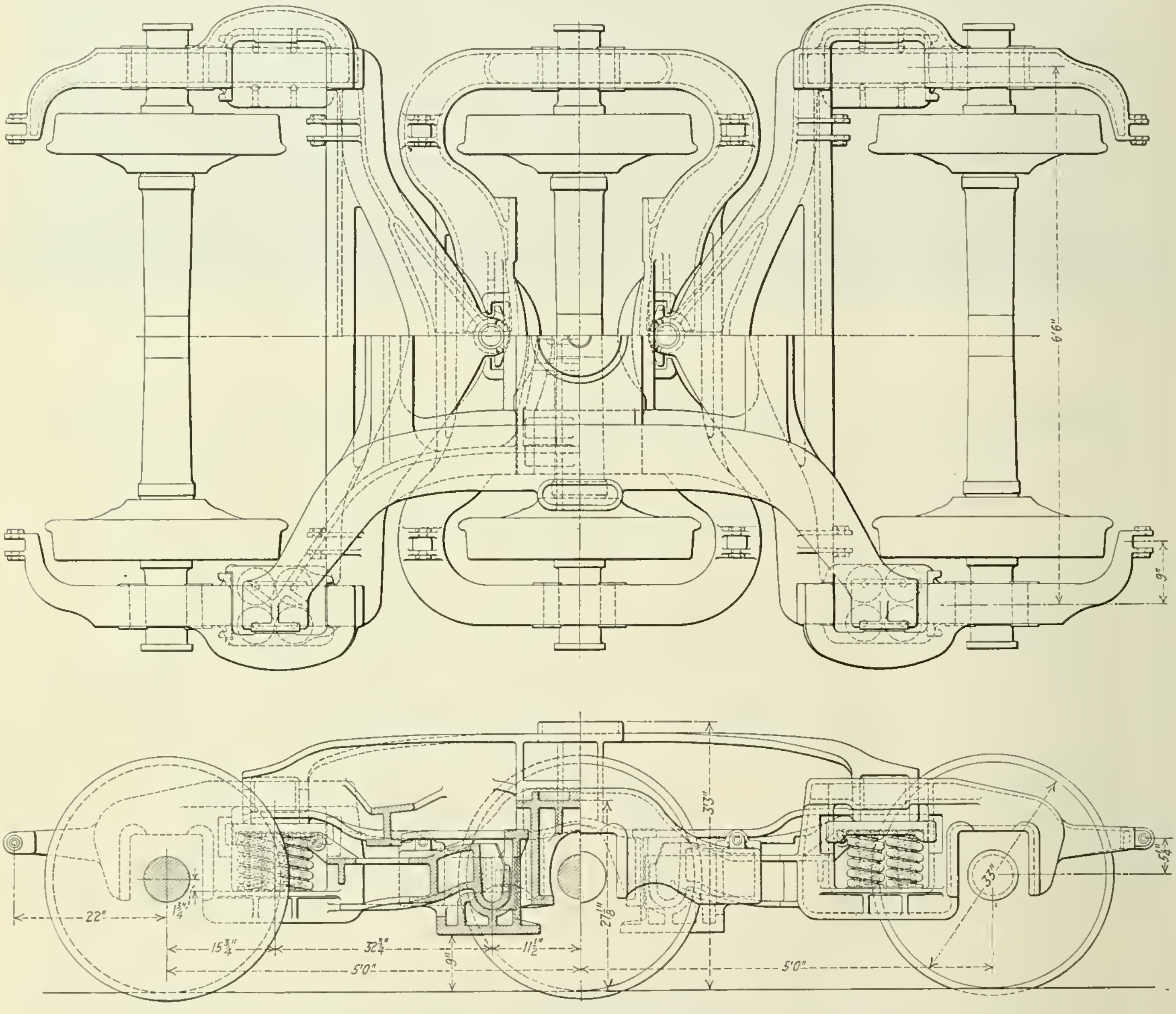


Fig. 3—Plan and Elevation of Boyden Six-Wheel Co-ordinating Truck

For an understanding of the principles and the operation of the Boyden co-ordinating truck, attention is directed especially to Fig. 4, Fig. 5 and Fig. 6. The truck frame consists of four substantial steel castings, a center frame, two end frames and a co-ordinating bolster, shown detached in Fig. 4. Wheels, axles, journal boxes, brasses, wedges, etc., are of the standard types now in general use. The center frame which carries the boxes for the middle axle contains two large sockets. Each end frame is provided with an arm and a ball joint which rests in the socket on the center frame. The three frames are thus so flexibly tied together that each pair of wheels is free to swivel as required by the varying curvature of the track. The relative position of the parts is indicated in Fig. 5, which shows the three frames with their journal boxes, wheels and axles on a curve. The co-ordinating bolster sets over the center frame and acts as a guide to the center axle. Its four arms rest on springs carried in pockets on the end frames. At each of the four points there is a nest of four double springs with a common upper spring seat. The location of the spring pockets is such that the weight is distributed equally between the different axles. The co-ordinating bolster is shown detached in Fig. 4 and in place in Fig. 6, the latter illustration showing the position occupied on a sharp curve. It is so designed as to permit its center to take a radial horizontal motion as well as a vertical motion to a degree sufficient to take up any irregularities in movement of the several parts of the truck. The truck may be described as consisting of two pony trucks placed back to back on a common supporting member and all parts held in co-ordination by a four-armed bolster frame.

The axles are placed 5 ft. apart, making the wheelbase 10 ft. Hanger brackets are provided for the support of the clasp brake with which the truck is equipped. Journal boxes of standard design are bolted to the truck frames.

In working out the details of this truck the endeavor has been to produce a design of such flexibility that the car could be hauled around the sharpest curve with a minimum of resistance and consequently of rail and flange wear. The equalization of load, durability and accessibility of parts, simplicity of construction and ease of assembly, together with smoothness in running have also been considered.

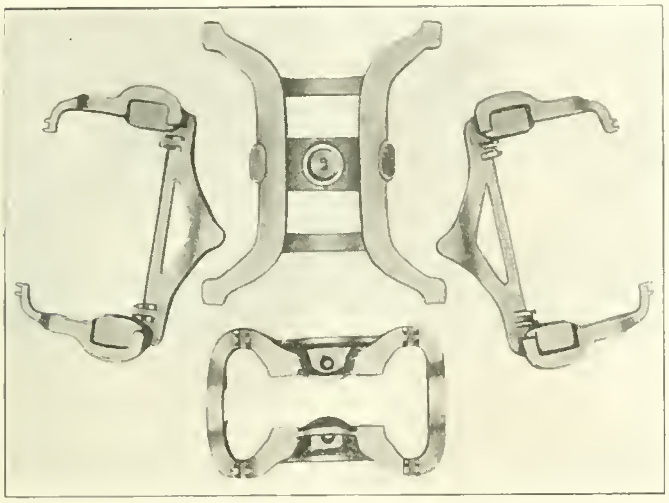


Fig. 4—Center Frame, End Frame and Co-ordinating Bolster

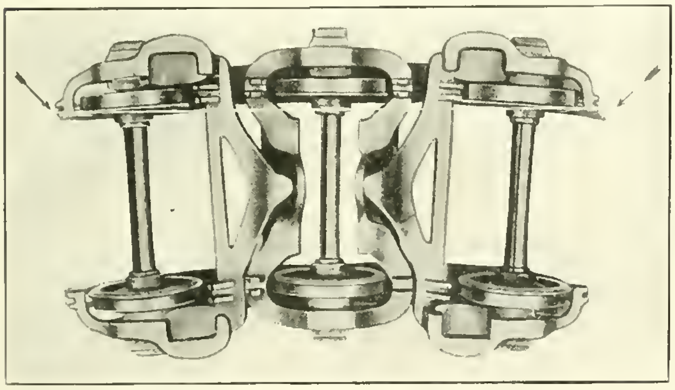


Fig. 5—Frames Assembled with Wheels and Axles Showing Position on a Curve

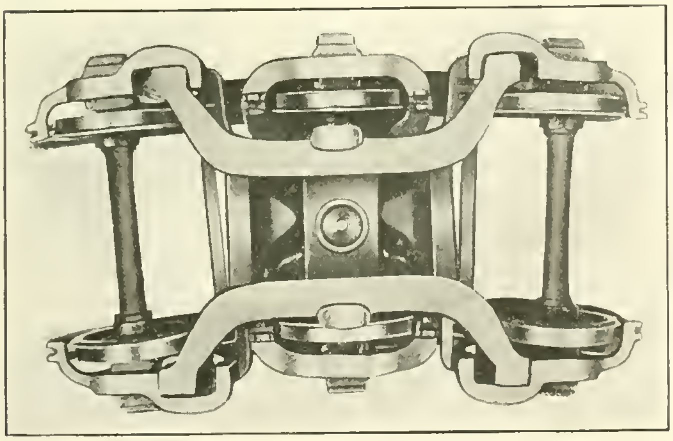


Fig. 6—Top View Showing Co-ordinating Bolster and Frames

After the car equipped with the last design of trucks had been thoroughly tested out around Wheeling, W. Va., arrangements were made for a test run under ordinary train conditions over the Baltimore and Cumberland divisions of the Baltimore & Ohio, the car running west as an empty and returning loaded. The run of 330 miles lasted from May 29 to June 2, 1922. A dynamometer car was attached ahead of the car being tested which was at the rear of the train, and observations made by a corps of inspectors. Speeds ranged up to 44 m. p. h. and in both light and loaded conditions the action of the car either on straight or curved track is said to have been very satisfactory. The vertical movement of the car body was reported as relatively slight with little rolling action. The car has since been in intermittent service on the Chesapeake & Ohio.

These trucks are now controlled by the Boyden Steel Corporation, Baltimore, Md., which has taken over the rights of the old Boyden Co-ordinating Car Corporation.

System of Delivering Material in Car Repair Shop

By W. W. Warner

Works Manager, Erie Car Shops, Kent, Ohio

Until recent years it has been the practice in most repair shops for the individual workman to go to the storehouse and get his material as required. This practice results in a great loss of time. In most cases repairmen work in gangs of two to four men. Usually one or two of these men will go after material, while the balance of the gang takes a rest until the men return with the necessary material. The system also causes a congestion at times in the storehouse when a large number of workmen call at approximately the same time, with a resultant delay in getting the material from the storehouse force. The system also affords a workman an opportunity to get away from his work and visit with some of the other workmen, furnishing the excuse to his foreman when he returns that he was looking for material. The practice also results in wasting material, due to workmen drawing more material than they actually need.

In order to overcome the loss of time and the waste of materials in the shop of which the writer is in charge, an entirely new system was put into successful use about two years ago. This system consists of an organization including one leader, five truck drivers and five laborers with the following equipment: five electric trucks, three general service trucks of platform type, two tractors, and 10 trailer trucks. With this organization and equipment we are able to supply 400 workmen now employed in the plant.

Orders for the material required are filled out by the department foremen and placed in receptacles for this purpose, of which we have 50 placed at various points throughout the plant. The receptacles are all numbered and the foremen show both the receptacle number and the number of the car on which the material is to be used, thus giving the delivery gang complete information as to where the material should be delivered. The truck drivers have their regular route to cover and stop at each order receptacle at least once each hour to take up the orders.

In case there is a need for any particular item of material before it is delivered in the regular routine, the department foreman gets in touch with the leader over the shop telephone and gives him the information necessary in order to get immediate delivery of parts required. This system also assists in disclosing any shortage of material, as the leader turns over to the storehouse foreman each day any orders for material that is not in stock.

With the system as roughly outlined above, we are able to effect a considerable saving in time (which under the present rates amounts to over one cent per minute for all mechanics) as there is no waiting for material as was the case under the old system.

Standard Car Equipment for Indian Railways

By Fred Evans

THE Standard Wagon Revision Committee of the Indian Railway Conference Association has published a report, a brief summary of which may be of interest. Three years ago the committee prepared a number of car designs for the 5 ft. 6 in. gage and the meter gage railways and sample vehicles were built. The committee was retained to watch the action of these cars in service and afterwards to incorporate whatever improvements experience has shown to be desirable and eliminate any defects detected; also to work out designs for additional types of cars. The work of the committee is now represented by 16 standard, 5 ft. 6 in. gage cars and 20 standard meter gage cars, also by three standard passenger car underframes.

Simplicity and economy of construction have been special features the committee has attempted to embody in the new construction as well as facility in repairs. Small fittings and details, including hand holds, tarpaulin cleats and label holders have been standardized. In order to reduce loss by theft no loose fittings are employed. Journal box covers are henceforth to be held in place by studs which have a neck turned at the outer edge so as to prevent the stud being wrenched off, enabling the oil and waste to be stolen from the boxes. The loss of journal box covers and the theft of oil is serious in India. The only effective alteruative would appear to be riveting the covers to the boxes. As far as possible, structural details, including doors and fastenings, have been standardized.

The Indian Railway authorities may in the early future take up the introduction of automatic center buffer couplers on their 5 ft. 6 in. gage railways; consequently the committee has given the point consideration, as several railways in other countries have substituted center buffer couplers in place of central screw couplings and side buffers. The screw couplings for wagons, in the opinion of the committee, should stand a tensile test of 100 tons as well as an impact test of not less than three blows, each of 5 foot-tons intensity; this has been rendered necessary by the increase in the weight of trains now hauled in India. With a stronger screw coupling failures in drawgears are not likely to happen so frequently.

As regards standard designs for three additional types of cars prepared by the committee, the cattle car for the broad gage is 21 ft. long and for the narrow gage 21 ft. 6 in. The tank cars are to be 23 ft. long, four-wheeled, for the broad gage, and 35 ft. long on trucks for the meter gage. The third type, vans for the conveyance of explosives, are to be 19 ft. 6 in. long for the broad gage, and 21 ft. 6 in. for the narrow gage.

Careful consideration has been given to the structural details of the tank cars. The committee has decided to discard safety valves and to substitute a 10 per cent space above the level of the oil. The tank joints are to be welded and there will be no outlets of any description at the bottom. The committee recommends that the "sunshade" should stop about 18 in. up from the main platform so that an explosive mixture of gasoline vapor and air cannot accumulate under it. A 2½-in. space is to be allowed between the outer "sunshade" and the inside lagging. To enable the entire contents of the tank to be withdrawn a well is to be welded to the bottom into which the suction pipe will dip.

Some of the more important details recommended by the committee for the construction of cattle cars may be briefly summarized. Wooden floors are to be provided with drain holes, "blinded" below so that the contents cannot be pilfered should the wagons be used for the conveyance of goods, such as grain. The hinged doors are also of wood and cattle guards are to be fitted in the door openings. Ventilators are omitted.

Suggestions for improvements of the standard types of cars have been invited from business men and users generally to supplement the work of the committee. Of the suggestions made the following may be mentioned: No leather to be used for joints and valves, all joints, etc., are to be metal to metal; the filling pipe for tank cars to be extended down to within 4 in. of the tank bottom so as to avoid splashing, which may give rise to the formation of gas while the filling is in progress; the well welded to the tank bottom to be at least 6 in. deep and placed in the center of the car; the filling pipes to be fitted with a cone screwed joint in place of a flanged joint; the dipping hole to be in 2 in. diameter. Oil companies have decided to provide their own float arrangements for determining when the tank is loaded as authorized.

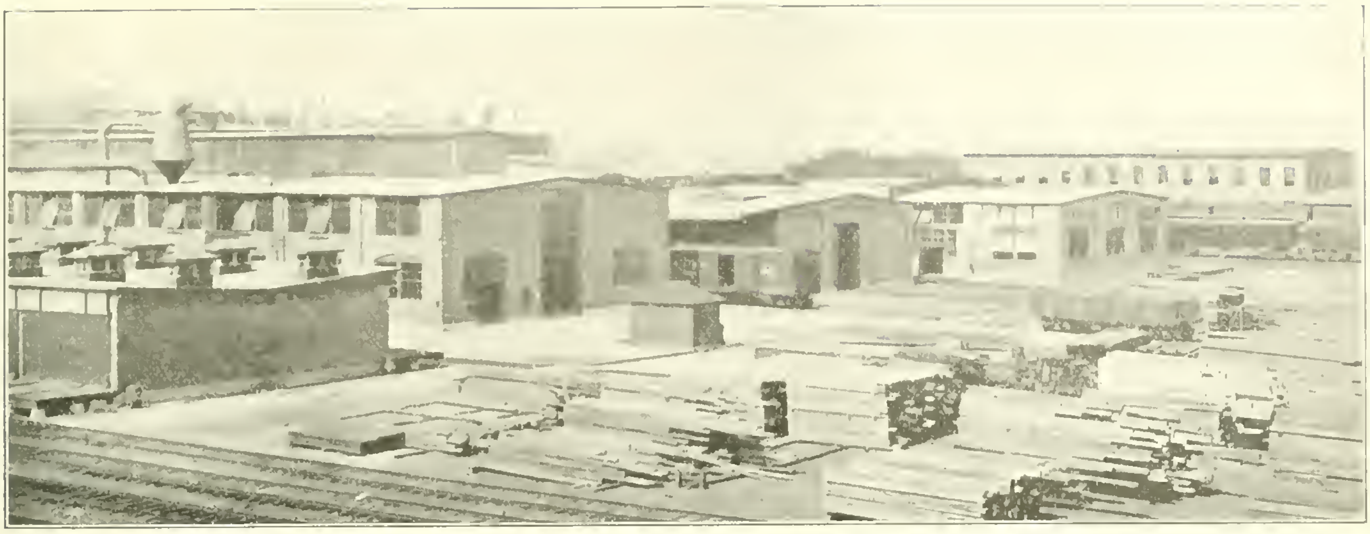
It was stated that the tank cars for the 5 ft. 6 in. gage were to be four-wheeled, while those for the meter gage were to have trucks, the reason being that it enables the cubical contents of the two types to be the same. Thus, a load could be transferred easily from a broad gage to a narrow gage, or vice versa. Oil shippers are practically unanimous in preferring welded tanks to riveted tanks. They have therefore been recommended for both gages. It is a common experience that in the case of accidents resulting in damage to rolling stock they may remain tight, whereas riveted tanks are liable to leak.

As regards vans for the conveyance of explosives, the following points were recommended for consideration: They must be kept as cool as possible; the possibility of concussion must be reduced to a minimum; shifting of loads to be avoided as far as possible. To carry out these suggestions the wagons are to be provided with wooden casing boards round the sides, ends and roofs, with a space of 2½ in. between these casing boards and the outer sheets, which is to be filled with slag wool to reduce the temperature. The outside of the vehicle is to be painted white. To reduce concussion the floor will be made of soft wood, 2½ in. thick, carefully planed and firmly secured to the underframe by means of countersunk head bolts, to be sunk 1 in. into the planks, the bolt holes being plugged up with wood or suitable substitute.

The above is a brief summary of the salient points of the report of the Standard Wagon Revision Sub-Committee. It started its work in Calcutta during September, 1921, and finished in May, 1922. The time devoted to the report was considerably longer than that of the previous 1919 committee which found three months sufficient for its duties. The work of these committees was rendered extremely difficult owing to the conflicting requirements of the mechanical and traffic staffs of the different railways. The committee has endeavored to embody the best features of modern design into vehicles which will serve as recommended standards of their respective types. The feature which the committee most desires to emphasize is that renewable parts, such as axle boxes, drawbars, buffers, wheels, brake shoes, etc., must always be interchangeable and, therefore, standard.

No attempt has been made to provide friction draftgear on either the 5 ft. 6 in., or the meter gage vehicles, but there is no doubt that approved forms of this might be adopted with advantage provided they interchange with standard details and fit in with the fixed dimensions laid down. The eye end of the drawbar lends itself to the easy attachment of such a device. The coil springs for drawbars are interchangeable with those used in the buffers.

As the distances between the chief railway centers and depots in India are considerable and the means of rapid transport are limited, it is important that the principle of standardization should be adhered to not only in leading dimensions, but in general details and especially as regards those fittings known as "renewable."



What Car Foremen Owe Their Industry[*]

Foremen Must Lead and Train Their Men—Business Management of Repairs as Important as Technical Knowledge

By C. B. Peck
Associate Editor, Railway Mechanical Engineer

THE five years which have elapsed since the inauguration of federal control of the railroads constitute the most trying period in the history of American railroads for the men charged with the responsibility of operating and maintaining the properties. No group of these men has been more severely tried than the foremen in the mechanical department. During federal control they saw the morale of the men under their supervision seriously impaired, if not completely destroyed; they were forced to assume a constantly increasing responsibility at the same time that practically all authority in matters of discipline was taken from them.

Then came the drastic retrenchment of 1921 which further disrupted car and locomotive maintenance organizations and, along with the extensive home movement of freight cars, caused a tremendous accumulation of cars held out of service for heavy repairs. The full effect of the improved business conditions in 1922 had hardly been felt before the officers and foremen of the mechanical department were again face to face with a crisis brought about by the shopmen's strike. Men who have passed through such a series of events and can still smile, who will not admit that the railroad business is not the greatest industry in the country, have certainly been tried and not been found wanting.

For the first time in the history of American railroads the weekly car loadings of revenue freight exceeded the million mark during the fall of 1920. The movement of such a volume of traffic was at that time hailed as a great accomplishment. But over a million cars of revenue freight were loaded during two successive weeks last fall, and from the end of the bituminous coal strike late in August until the end of last year, the total volume of freight loaded was practically the same as that for the similar period of the previous record year, 1920. You men know how much the car foreman had to do with the accomplishment of that result and in the face of what odds he had to work. You have a right to feel a large measure of pride in the result. No mark of appreciation which the managements can show can be too great for the high type of loyalty which made this possible.

But with the ending of the strike, which I believe marks the end of our worst troubles in the mechanical department, we can well afford to look back over these years of nightmare to see if they may not suggest something helpful for the future. It is quite evident that on many roads conditions in the shops and on the repair tracks are considerably different than they were before the strike. Whether or not the changes prove to be of permanent benefit depends largely on how well we get the lessons of these last few years and the extent to which we put them into practice.

All systematically organized operations tend to become so standardized that their performance ultimately grows to be largely a matter of routine. When the routine has once been developed, its constant repetition gradually wears such deep grooves in men's habits of thought and action, that it becomes extremely inflexible. The conditions of the National Agreement marked the ultimate result of our habits of thinking with respect to the requirements for the performance of the various jobs involved in the maintenance of equipment. The kinds of work to be performed by members of the various crafts became so minutely defined and the conditions surrounding their performance so narrowly fixed that reasonable efficiency was impossible and it seemed almost as though the rules had become the main object of the game.

Inexperienced Men Do Good Work When Trained

When emergency conditions arise the grooves of routine disappear. During the shopmen's strike every officer and foreman on the job had to give constant thought to what he was going to do and how he was going to do it. The effectiveness with which the railroads continued to function throughout the strike is all the evidence needed to prove that every man charged with any responsibility was able to visualize the immediate end that had to be attained and to plan a course which would reach that end with no waste effort. But the way equipment repairs were made with comparatively inexperienced workmen raises a question as to whether some of the long established conditions are really essential.

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[*] A paper presented before the Car Foremen's Association of St. Louis, March 6, 1923

Remarkable results have been obtained with unskilled men. Men hired off the farm or taken from the office, after a few weeks of intensive training, have demonstrated their ability to turn out car repairs which compare favorably both in quality and quantity with the work turned out by what we considered our trained men prior to the strike. There are several factors which account for this result. The first is the fresh interest with which men approached their tasks. They were subjected to no insidious suggestions that they curb a natural desire to develop skill and facility in the performance of their tasks. The second is the intensive training which these new men received at the hands of the foreman. The third is specialization. No one could expect these men to acquire the skill of all-round mechanics in the short time which served to develop them into fairly effective workers. They did demonstrate the ability to become proficient in a specialized job, however, with a very small amount of intensive training.

Apprenticeship

One of the conditions inherited by the railroads of the present day is the apprenticeship system as we have long known it, in which boys who have not yet reached complete maturity are indentured for all-round training in the work of a particular craft. Where properly conducted, with a far-sighted regard to the future relations between the boy and the company he works for, not only has this system left little to be desired as to the development of skilled workmen, but has laid the foundation for future supervisors. There was a time when apprenticeship on the railroad and in those industries requiring the performance of similar kinds of work were much the same. For at least 10 years, however, there has been taking place a marked change in some of the industries. Highly specialized production methods have been constantly narrowing the field for the all-round mechanic and extending the field for the specialist, who can command good wages after a comparatively short period of training. This condition, which is most highly developed in the automobile industry, has become general enough in many communities so that its effect has been felt by the railroads. At any rate, we are all more or less familiar with the fact that there has been a gradual change in the character of applicants for jobs as railroad apprentices in that length of time.

Not many years ago the railroads placed considerable stress on giving prior consideration to the applications of sons of employees for apprenticeship and applications from boys within the railroad family, so to speak, were sufficiently numerous so that this provision actually played a part in the selection of apprentices. Not only has it now become practically a dead letter, but it has been necessary to increase the age limit of applicants for regular apprenticeship, and this having failed to keep up the supply, to go further and give the helper a chance.

If experience during the strike is any criterion it is evident that forces for the maintenance of equipment can be kept up even though the former type of apprenticeship were gradually to disappear. Even though it may never meet all the requirements of the mechanical departments of the railroads, specialized training has sufficiently demonstrated its success in an emergency to make it a real factor for consideration in the future and we are justified in looking with more respect on the capacity of the humble helper to develop into a future skilled worker than we have generally done.

It must be clearly kept in mind, however, that whatever the source from which skilled workmen are drawn and by whatever name the system of developing them is called, it requires education and training, and for this the railroads must take the responsibility. One of the reasons for the success in the rapid development of unskilled men during the strike was the keen personal interest in training them taken by the foremen, who indeed, were largely responsible for all that was done along this line.

I have already suggested that one of the factors in securing the splendid results it has been possible to attain with comparatively inexperienced men was the natural and unhindered interest which they took in their jobs. The lack of this kind of interest was one of the leading causes for many of the mechanical department ills during the past five years. Indeed, this was so pronounced that some railroad officers have come to feel that their men were entirely devoid of a sense of honor—that they possessed so few of the common virtues of human nature as to belong to a different class of beings from the rest of mankind.

Attitude Toward the Job

However, the employees themselves are not entirely to blame for the growth of the attitude which they have been taking toward the railroads and the jobs they were paid to perform. There are several causes which have led to the development of this attitude. One of these is the old idea, now pretty much outgrown, that the employer owes nothing to his employee beyond the amount of his pay check and that it is the duty of every man in a supervisory position to oppose as a matter of principle, any improvement in conditions or pay sought by the employee. The development of a fighting spirit which in time grew extremely bitter, is the natural outcome of this complete opposition at every point in the consideration of questions each of which ought to have been settled in fairness on its own merits. This kind of opposition, once in existence, made a fertile field for the activities of bad leadership, which, with a background of bitter feeling has not found it difficult to make conduct which the men would otherwise recognize as dishonest, seem to be justified.

There is a natural human tendency in all men toward the establishment of satisfactory personal relationships in all the affairs of life. Now, there is nothing personal in the relationship between the employee and a corporation, as such, and as a practical matter the personal nature of the relationship between the employee and the head of a department must be very limited. The whole matter of a satisfactory personal relationship, or indeed of any personal relationship at all, then, comes right back to the foreman. Foremanship implies leadership to a far greater extent than is measured by the assignment and checking up on the performance of tasks. One of the greatest responsibilities of the foreman to his company and to the railroad business as a whole is that of assuming a personal leadership over his men in all matters affecting their attitude toward the company they work for and the welfare of industry as a whole.

Fortunately the attitude of hostility and the restrictive conditions of the National Agreement have been overdeveloped to such an extent that they have carried their own antidote. The relief with which the men on many roads view the clearing of the air and the willingness, even eagerness, with which they accept conditions which are less arbitrarily restrictive, both to the railroad and to their own personal opportunities, has been apparent for several months. This spirit offers the opportunity for the establishment of more natural and far more satisfactory personal relationships. It needs to be carefully fostered. It will not maintain itself unless the managements and particularly the foremen take the utmost pains to meet the men half-way in a spirit of fairness on all questions which may in the future arise between them, whether they be questions of wages, of working conditions, of the assignment of men to jobs, or promotion.

Let no one think that he can with impunity restore the old fashioned despotic control. Men who work for a living have learned how to organize to deal with what they consider to be unfair conditions or unfair treatment and there are plenty of demagogues waiting to seize upon the faults of those who have the job of running the railroads, and use them to develop a class hatred against all employers, which in the end, if they can accomplish their purpose, will destroy the prosperity of everybody in the country.

How can such a result be avoided? In the first place let me say that I have absolutely no scheme of organization to suggest for handling matters which necessarily will always come up for adjustment between managements and men. Undoubtedly some machinery is necessary. But the poorest organized machine, well lubricated, will continue to run long after the most skilfully designed machine, operated without lubrication, has been thrown on the scrap heap. The important thing, then, in fostering the new spirit of co-operation which is growing among employees in the mechanical department, is the maintenance of an attitude of the most scrupulous fairness on every question that has to be considered. This is the lubricant that will make the simplest method of organization function with success and mutual satisfaction. But the least suspicion of sharp practice will act as sand in the bearings to destroy satisfactory relations no matter how carefully every contingency may have been anticipated by the provisions of an elaborate agreement.

Does not every foreman owe it as much to his industry to use every resource at his command to keep up this spirit of fairness and co-operation, the absence of which eventually will destroy the business, as he does to be proficient in the rules of interchange or to organize his gangs and assign his work effectively? Ought he not to give as much thought to the exercise of his function as a leader of men as he does to the performance of his duties as a boss?

Foremen Control Large Expenditures

In 1920 car foremen supervised the expenditure of $714,000,000 to maintain passenger and freight cars on the Class 1 railroads. This amounts to over $3,000 for every mile of road and is over $100,000,000 greater than the amount spent in the maintenance of locomotives. In addition to their responsibility for the effective use of this vast sum they are responsible in a high degree for the safety of train operation as well as for one of the most important phases of inter railroad business,—car interchange. These duties all require a high degree of technical knowledge, the nature and importance of which it is unnecessary to deal with before you men. What I do wish to dwell on for a few moments, however, is the danger of giving too much attention to the technical side of the foreman's duties to the exclusion of any attention at all to the business aspect of spending the vast sum required to keep the rolling stock in operation.

The title of my remarks suggests that the foreman has certain obligations to the industry. Before he can be held to any business responsibility, however, the head of the department and the management in general must place more stress on the business of car maintenance than on its highly specialized technical aspects, and it owes it to the foreman to train him and give him every assistance possible so that he may develop judgment in the management of his operations on a business basis.

Methods of Departmental Management

There are two opposing ideas as to departmental management. One assumes the creation of a super-boss who delegates as little authority to the supervisors directly on the ground as possible; who takes the credit for success and blames his subordinates for failure; who gives his subordinates as little information as possible and issues arbitrary orders without explanation. The other idea assumes that the office of the head of the department is a service bureau from which each subordinate has a right to expect real assistance in the way of information showing clearly how his operations tie into the performance of the department as a whole, as well as assistance in organizing to meet any unusual conditions which may arise.

There is at least one car department in which this idea has been carried out to the extent that each foreman in charge of a car repair point has become practically a business manager over his operations. He is controlled by a budget system, but within his appropriation he has the authority to take his own measures and must assume the responsibility for the result. Each month he must render a report of his operations and after all these reports have been compiled and digested at the general office he gets a copy of the combined report which gives him the same picture of the operation of the department as a whole that the management has.

Many car foremen operate at outlying points where they have little opportunity to come directly in contact with the head of the department and ordinarily find it difficult to keep closely in touch with what is going on elsewhere. To attain the highest possible success, these men must be encouraged to develop initiative and must be given authority to settle on the ground every possible local question arising between their own department and other departments, without the necessity of referring it to a distant headquarters. Will not efforts spent in furnishing these men all the information possible as to the relation of their work to the railroad as a whole and in guiding them in the development of sound judgment and initiative be far more valuable to the railroad than all the efforts which possibly can be put forth to run their job for them from the general office?

The type of initiative of which I have been speaking does not imply any lack of control either of the extent of the operations or of standards of maintenance. It means an informed body of men who can carry out general instructions as to standards intelligently because they know the reason why those instructions are necessary.

Cars Must Be Available

The real business object of the car department is to keep cars available for service the largest possible percentage of the time. Since September 1, there has been a continuous net car shortage which reached its largest proportions late in October. It is evident that during a time of car shortage every car that must be held out of service for repairs represents a direct loss of revenue to the railroads, which amounts on the average to somewhere in the neighborhood of $200 a month. And if, in order to overcome an unnecessarily high percentage of bad order cars, the railroads buy more cars than they would otherwise require, they are obliged to pay the carrying charges on an investment of from $1,700 to $3,000 for every such car purchased. Furthermore, it is well to keep in mind the fact that the interest and depreciation on this investment keep on piling up during the period when there are normally more cars than the railroads can use as well as during the time when every car is required for traffic.

The railroads have made a good showing in the last few months in reducing the number of cars held out of service awaiting heavy repairs. There is, of course, some question as to what extent this reduction has been affected by returning them to service with the smallest amount of patch work possible, and how much it is due to constructive work which will keep the cars in service for the next four or five years with only occasional attention for running repairs. For the country as a whole bad order had been reduced from about 13 per cent at the end of September to 9.2 per cent at the beginning of February. The latter figure, however, in a period of car shortage, is sufficient to indicate that there is a long pull ahead of the car departments before conditions can be considered satisfactory.

With the present pressing demand for cars every car department officer is faced with a most difficult problem of making every man hour and every cent expended in car repairs give the maximum return in days of revenue service. Patchwork will not accomplish this result. It is only deferring the day of reckoning from the present shortage until the next, since little may be expected in the way of improvement during the intermediate period of slack business, and is shifting the responsibility from one repair track to another.

It would be useless for me to attempt to tell you how that problem is going to be solved under present conditions. Indeed, the maximum return in days available for service for every dollar of maintenance expenditure can not be attained by any emergency measures, but only on the basis of a well developed policy, which, when once established, is consistently adhered to year in and year out.

Program for Maintenance

Generally speaking, there has been little in the way of consistent policies with respect to freight car maintenance. A few railroads, however, have attempted to develop a systematic freight car maintenance program similar to that generally adhered to in the repair of locomotives. Instead of permitting freight cars to run until they are returned home in such condition that they are fit for no further service, years after they should have been overhauled, a definite period of, say, 7 to 11 years is established, depending upon the type of construction and character of service the car is designed to perform, after which the car is shopped.

It will be generally admitted that such a plan will save many trips to repair tracks for jobs of a patchwork nature from which no adequate service return is obtained. It is also reasonable to expect that a carefully considered program of this kind will put the roads in a position to provide more serviceable cars when they are most needed, with less frequent resort to emergency measures and, therefore, with the least upsetting of the planned operations of the department. This is merely applying the principles of scheduling and dispatching which have met with such success in reducing lost motion and waste in shop operation, to the operations of the department as a whole. Is it not reasonable to expect from it the same benefits in this broader field that have actually been obtained in the narrower and more specialized field of shop operation?

Transportation Vital

There is one other obligation which the foreman owes to his industry that I would like to suggest. There is no greater industry than that in which we are all directly or indirectly engaged. The foundation of our whole material civilization is transportation. Without it we would all have to go back to scratching our own living out of the ground, with the aid of the most primitive implements. We would have to produce our own textile goods on the spinning wheel and hand loom. In fact, each family would have to become a self-supporting unit, and for many of us I am afraid that would mean an increase of many hours in the day's work.

Twenty-five years ago Harriman spent $25,000,000 in about three years in rebuilding and re-equipping the run-down Union Pacific. In doing so he made a fortune for himself through the increase in the value of his holdings in Union Pacific stock. Why? Because the territory served by that railroad was awaiting the opportunity to develop and it did develop just as rapidly as the increasing capacity of the railroad to haul out the products of the soil and haul in the needed manufactured goods, would permit. Harriman's own estimate was that he saved the territory served by the Union Pacific at least 10 years of waiting.

This gives some idea of what the expansion of railroad facilities means to the expansion of the other industries upon the success or failure of which the prosperity of the country depends. Without the constant expansion of railroad capacity a continuous increase in the volume of commodities produced in this country is impossible.

There is a well organized effort, both in and out of Congress, to destroy the railroads as privately owned and operated property, in order that a situation may be created in which government will be forced to take them over.

I do not come here to discuss with you the relative merits of private ownership and government ownership of the railroads. Some of you men may believe that the interests of the public and the employees would be best served if the railroads were owned and operated by the government. I have no quarrel with any such sincere belief. I do want to call attention to one thing, however, and that is that to bring about a state of government ownership through the process of destroying the property of the railroads and their earning capacity merely because they are privately owned, serves neither the interests of the employees nor the public.

Whatever his opinion may be as to the correct ultimate solution of the railroad problem, no man who gets his living from the transportation business can afford to jeopardize his own interests by furthering, either actively or passively, the campaign of misrepresentation by which it is hoped to bring about the repeal of the Transportation Act and the passage of legislation by which the government can first destroy the value of the properties by removing their earning power and then can buy them from their owners at the depreciated value created by this vandalism.

Interests of Roads and Employees Common

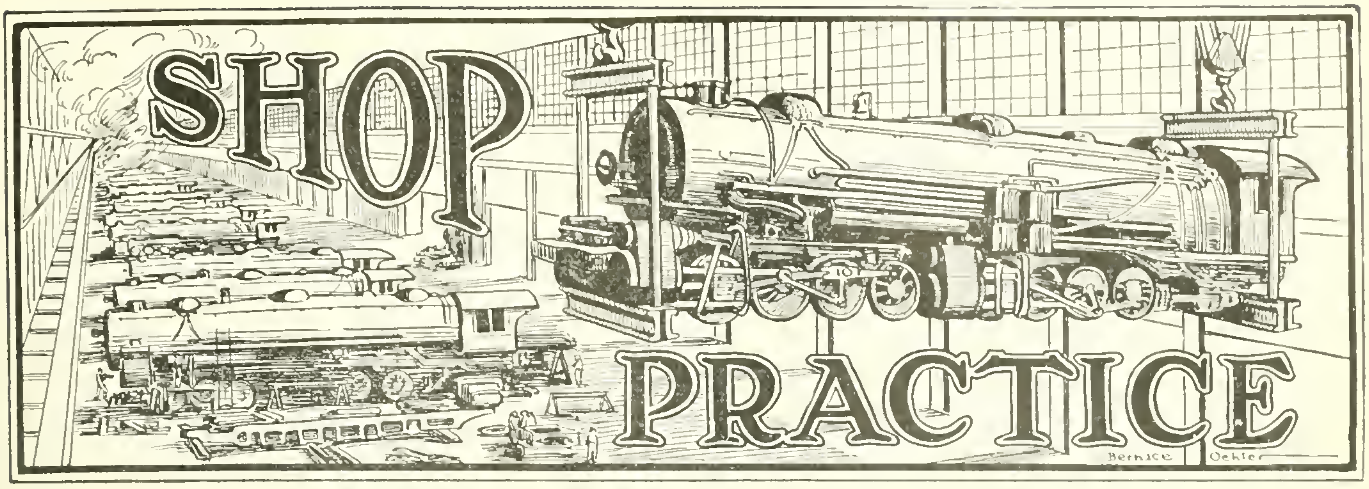
In an address before the February meeting of the Western Railway Club, W. G. Lee, president of the Brotherhood of Railroad Trainmen, clearly showed where the interest of the employees lies in this matter. He put it this way.

"The public has been diverted in the past few years by public statements made by railroad companies and their employees. The roads have said that transportation employees were extravagantly paid, that they had the easiest positions and the highest pay of any employees in the country, and that further concessions granted them simply meant robbing the public pocketbook, which, in this instance the railroad companies were quite prepared to protect. The railroad employees have countered by setting forth that the railway companies were extravagantly operated, that because of watered stocks, dishonest management and inefficient operation they were, in many instances, not showing the revenues they should, and insisting that if they were given honest management, there would be no difficulty in meeting the wage demands of their employees. Whether we agree on all subjects that come between us or not, we must agree that in the public estimation the railroad companies and their employees are not separated. The public accepts both statements as gospel truth and exacts its toll of transportation service at its own price against both of them.

"Let us satisfy the public that the railway companies and their employees are not what they have called each other, but that they are exactly the contrary; that they are serving the transportation needs of this country in a more efficient manner than they are being served in any other country in the world; that the railroad companies are efficiently managed; that their employees are giving efficient service, and that both of them are worthy of their hire."

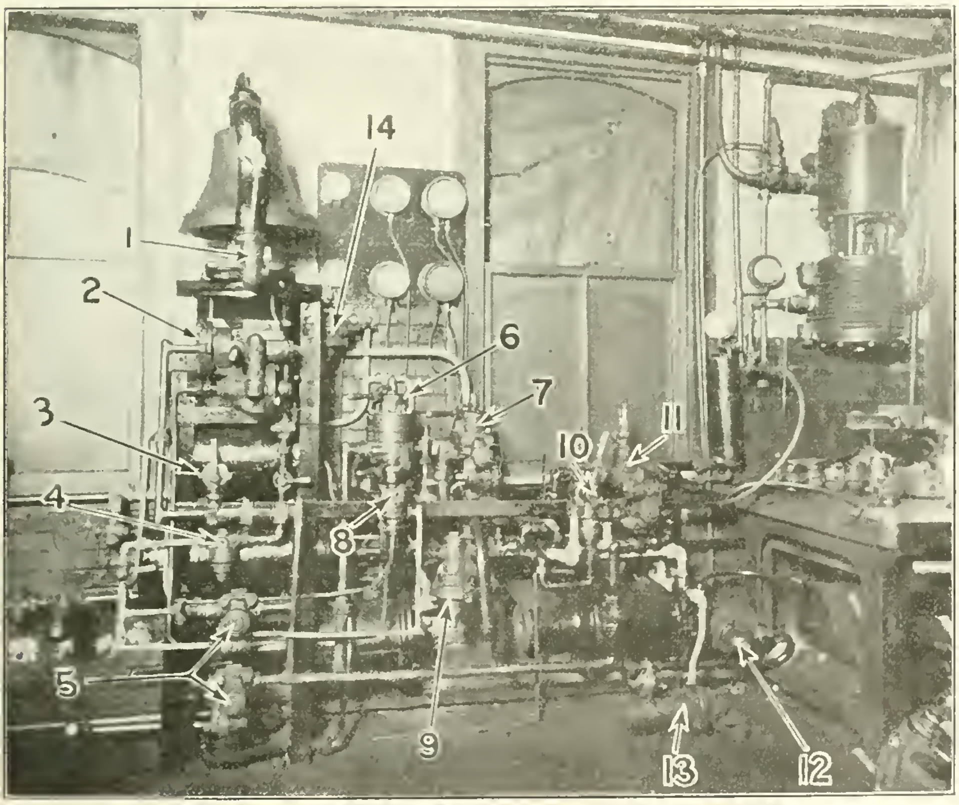
If we are going to have government ownership let us get it in an orderly manner. Let us not subject ourselves to the necessity of spending long years of our lives engaged in a bankrupt business with all the hardship that it will entail on the employees particularly and on the public in general.

In this matter is one of the most important duties that the foreman owes to the business in which he is engaged. If he has assumed the position of leadership among the men for whose work he is responsible, who is in a better position to keep them thinking straight on this all-important question, and who is in a better position to speak for the industry in his community? But if the foreman is to fulfill this duty which he owes to the business in which he is engaged, he has a right to be informed as to what the facts are with respect to it. Here is an opportunity and a duty for the management, which it ought not to let pass. The more every man in the business knows about the problems of the management and how they are being met, the more loyal he is likely to be to the company by which he is employed and in that loyalty the management has a real weapon with which to meet some of the attacks of misrepresentation to which it is subjected.



Compact Air Brake Test Rack in Enginehouse

ONE of the important functions of an enginehouse is to keep the air brake equipment on locomotives and tenders in the best possible operating condition. The air brake test rack shown in the illustration assists in attaining this end at the Hoboken enginehouse of the Delaware, Lackawanna & Western. This test rack was constructed recently by local enginehouse men under the direction of M. R. Feeley, general enginehouse foreman.



A Compact Air Brake Test Rack Recently Installed at the Hoboken Enginehouse of the D., L. & W.

Before considering a description of the test rack, its advantages may be pointed out. It frequently saves a considerable amount of time in getting locomotives with defective brake equipment back into service; it speeds up the repair of all parts of the air brake equipment. By having one or more of each kind of valve repaired in advance, when a locomotive comes in with a defective brake valve for example, the valve is removed and another which has been recently tested is applied without loss of time. This prevents holding the locomotive out of service while repairing the defective brake valve.

Another important point is that the repaired brake valve has been tested and is known to be correct. If for any reason, therefore, the brakes do not work the trouble can be looked for elsewhere than in the brake valve. This test rack makes the enginehouse self-sustaining as far as air brake repairs are concerned except for the air compressors. The actual work of repairing air brake valves is facilitated by means of this test rack because the valves can be applied to the rack, defective parts being quickly indicated to experienced repairmen by the readings of the gages.

In general, this brake test rack is a duplication in compact form of the air brake equipment on a locomotive and tender. The air compressor is driven by air from the shop line at 100 lb. The lower air cylinder is bushed and in addition has 100 lb. air pressure piped to the inlet. This enables the compressor at a few strokes to develop pressure up to 140 lb., at which the governor is set. A gage and governor is applied as in the actual installation of a locomotive. The location of the various valves is indicated plainly in the illustration and from left to right near the floor can be seen the engine brake cylinder, tender brake cylinder and auxiliary reservoir under the bench. Extra capacity in the train line to compensate for the train line capacity in actual service has been obtained by means of additional reservoirs and manifolds.

In addition to parts of the air brake equipment, arrangement has been made to test the bell ringer and sand valve. The following is a list of valves and parts which can be tested on this test rack, the numbers giving the location: (1) bell ringer, (2) distributing valve, (3) sander valve,

(4) signal line reducing valve, (5) train line and signal line feed valves, (6) H-6 automatic brake valve, (7) D-5 automatic brake valve, (8) ET straight air brake valve, (9) locomotive plain triple valve, (10) S-3-A independent brake valve, (11) air compressor governor, (12) tender quick action triple valve, (13) high speed reducing valve, (14) signal line whistle valve. It will be noted that the bell ringer is attached to an actual bell from which the clapper has been removed and thus the device is given a test under actual working conditions.

Mechanical Gas Cutting Torch a Labor-Saver

Proves Value at Billerica Shops of the Boston & Maine—Wide Variety of Possible Uses

It would be easier to mention the locomotive and car repair parts which cannot be shaped with the mechanical oxyacetylene cutting torch rather than those which can. The mechanical torch illustrated is installed in the Boston & Maine repair shops, North Billerica, Mass., and represents a type of equipment which has already accomplished important economies in several shops throughout the country.

Parts Profiled With Mechanical Torch

Name of Part	Time
Large side rod (complete)	65 min.
Solid main rod (inside and out)	80 min.
Frame section (dependent on size)	120 min.
Radius rod (long fork end)	15 min.
Union link (fork ends)	5 min.
Walschaert link	45 min.
Drawbar (including holes)	30 min.
Guide yoke (complete)	22 min.
Guide (allover)	25 min.
Main rod straps (inside and out)	35 min.
Four bar crossheads	28 min.
Brake fulcrum, levers, etc.	....

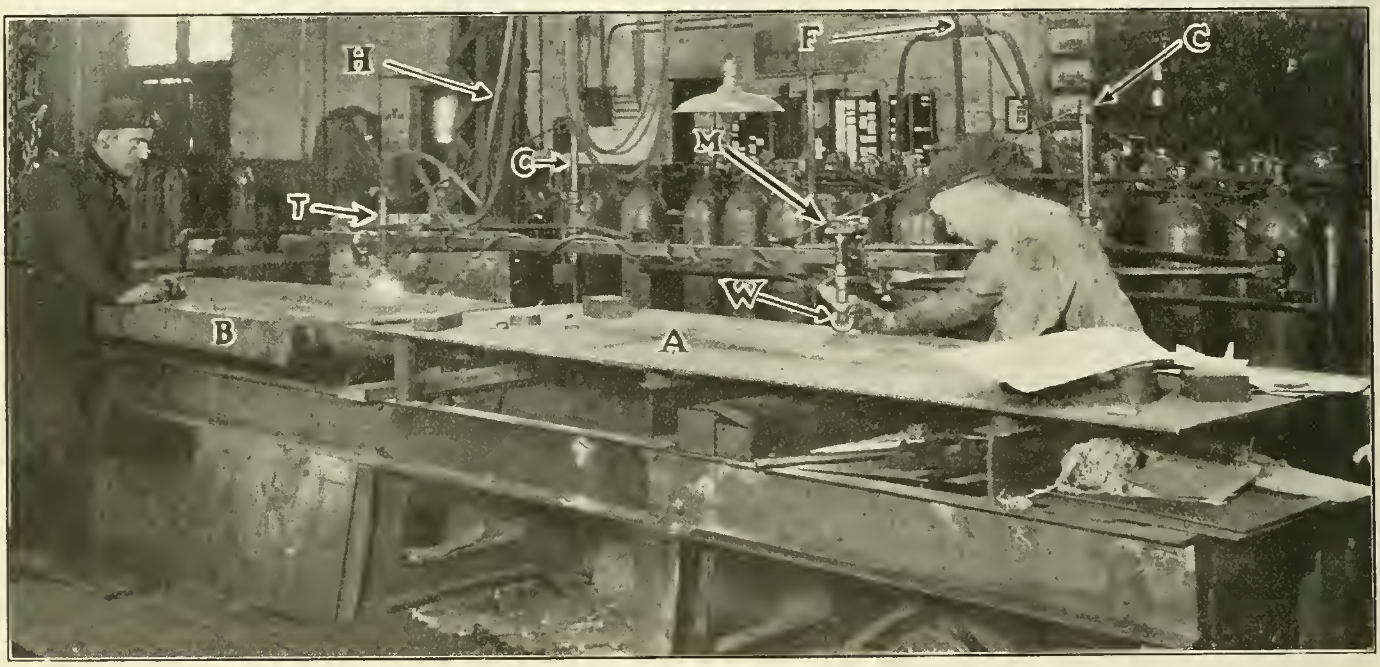


Fig. 1—Mechanical Oxyacetylene Cutting Torch Equipment Profiling a Large Front Frame Section from a 5-in. Billet

The accompanying table shows some of the parts profiled on this machine together with the approximate time required for each operation.

The character of the work turned out on this machine is excellent and the amount of time and labor saved in the representative operations listed will be appreciated by anyone familiar with locomotive shop work. Heavy forging operations on some parts are entirely eliminated and on others greatly reduced. The time and cost of machine operations are also lessened and in certain cases subsequent machining can be foregone entirely, saving the entire cost of this operation. Parts made of high-carbon steel, however, are subject to surface checks due to unequal expansion and contraction as the torch passes over the surfaces. On parts of this character it has been found best to take a light finishing machine cut after blocking out with the mechanical torch. This practice, of course, involves setting up the work for machining, but far less time is required because most of the stock has been blocked out with the torch. Low carbon hammered steel as a rule does not check, eliminating difficulty from this source.

Description of Equipment

Referring to Fig. 1, the construction and use of this mechanical oxyacetylene cutting torch will be readily apparent. The laying-out table *A* and the billet to be cut, *B*, are both supported on a channel iron frame work bolted to cast-iron box legs. (Cast-iron is used as the cross members will not be so readily cut when the torch passes over them). The movable arms of the device are supported on two uprights *CC*, the arm arrangement forming a pantograph so that any motion given to tracing wheel *W* will be imparted, both as to direction and amount, to torch *T*. A small electric motor *M* is geared to drive the tracing wheel *W*, imparting a positive steady movement to the wheel support and consequently to the cutting torch.

The cutting torch *T* is provided with the ordinary adjustments and tips for controlling the flame to suit various kinds and thicknesses of metal. Two lengths of hose *H* supply oxygen and acetylene to the torch and this hose is supported in the loops shown from an overhead radial arm, the base of which is shown at *F*. This arrangement permits easy movement of the hose to suit the movement of the torch. Three lines are apparent at *H* and one of these is the electric wire extension which appears wound around the horizontal arm and transmits electric current to the motor *M*.

In using this machine, the part to be formed is laid out on table *A* and one operator starts motor *M* guiding the tracing wheel over the outline. Sometimes a straight edge is used to assist him in following the straight line exactly. Templates are used for standard shapes and parts. Odd shapes are simply chalked on the layout table.

The second operator adjusts the cutting torch and watches it constantly to keep it at just the right adjustment. Whatever shape is traced by wheel *W* will be cut by torch *T*. Before starting a cut on a big billet, as illustrated, it has been found best to run over the outline first with the torch, preheating the billet and breaking up any scale or oxides on the surface. A smoother job is thereby obtained.

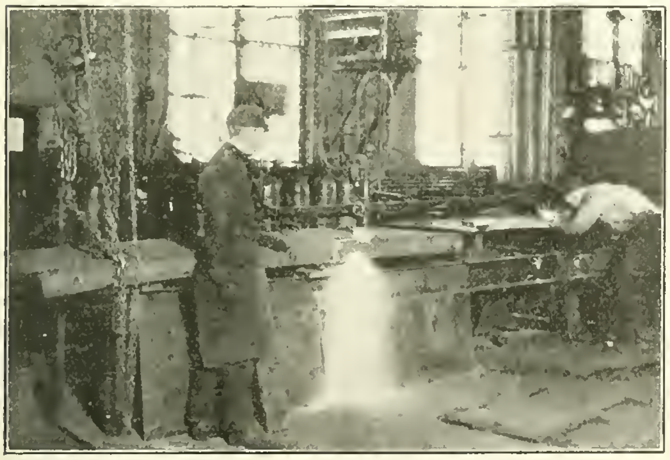


Fig. 2—View from Another Angle Showing Method of Supporting Billet

This machine has a capacity to cut metal up to 14 in. thick by 12 ft. long. Straight lines, circles and irregular lines be cut with equal ease. By means of a special extension arm arrangement large circles for boiler work can be cut.

Accuracy and Smooth Finish Secured

The accuracy and finish secured by this power-driven cutting torch is far superior to anything that can be obtained by hand. It is well known that with a hand-operated torch the effects of breathing and even heart action are reflected on the work, but such irregularities are eliminated by the constant speed motor drive of this machine. On many parts the finish is such that machining is not necessary.

The billet, illustrated in Fig. 1, is being cut into a large front frame section, the billet being 5 in. thick and the frame section 34 in. wide by 10 ft. long. Fig. 2 gives a better view of the billet, showing the method of supporting it on the channel irons and with a chain fall. A heavy cut is being taken along the outer edge.

Referring to Fig. 3, some of the work performed on this machine is indicated as follows: (A) guide yokes, (B) engine truck equalizers, (C) safety drawbars, (D) radius rods, and a pile of union links in the background. The radius rods, it will be noted, are forged out in accordance with the usual practice and the long fork ends cut out with the mechanical torch. The same method is used with the union links. The equalizers are offset by forging and the ends cut to the standard shape and size with the torch. The safety drawbars are outlined and have the two holes cut with the torch, requiring no machining.

A careful check is kept on costs with this machine at Billerica shops to make sure that parts are not cut out which can be more cheaply bought, but the demand for work already exceeds the capacity of one machine and it is said that another could be profitably employed. The possibilities of mechanical gas cutting equipment in railroad shops is almost limitless.

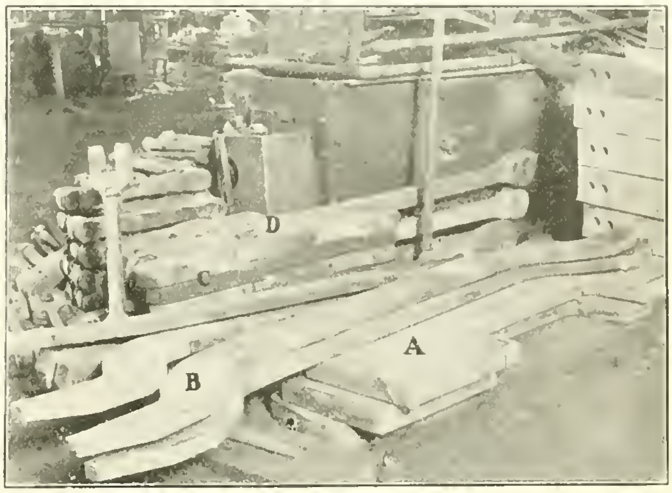


Fig. 3—Familiar Locomotive Parts Profiled with Mechanical Gas Cutting Torch

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Testing Hose Nipples and Couplings Before Mounting

By T. H. Birch

Air Brake Foreman, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

It has been our experience that many hose nipples develop porosity and sand holes, a condition which has been almost impossible to detect until the nipples have been mounted in the hose. This is especially true with respect to steam hose nipples and it therefore frequently becomes necessary to dismantle hose after the nipples have been mounted. The same condition has been experienced in the use of second-hand air hose couplings. The only guide to the condition of these couplings has been the A. R. A. gages and the inspection for such defects as were visible to the eye. It was, therefore, necessary to test all air hose after mounting, with the result that about 15 per cent of all hose mounted had to be worked over because of defects in the couplings which were not evident until the hose were tested.

To eliminate these two causes for duplication of work, the two devices here illustrated have been developed and installed in the air brake department of the Chicago, Milwaukee & St. Paul shops at West Milwaukee.

The drawing of the hose nipple testing device needs little explanation. A slack adjuster cylinder, mounted on a frame of ¾ in. by 7 in. material, provides the means for clamping the nipple in place, one end bearing against a rubber pad attached to the end of the piston and the other against a similar pad mounted on a block on the bench to which the device is attached. The lower end of the nipple sets over the end of a pipe connection, through which air is admitted. In order that irregularities in the faces of the nipple may not interfere with properly sealing the ends, the upper seal is arranged to swing freely on the end of the piston. Two ⅜-in. stop cocks, the handles of which are connected with a link, control the supply of air to the slack adjuster cylinder and through necessary piping to the nipple pipe connection.

In using the device, the hose nipples are first dipped in a pail of soap suds and then tested while still wet. In this way sand holes and other porous places will be indicated immediately by the bubbles.

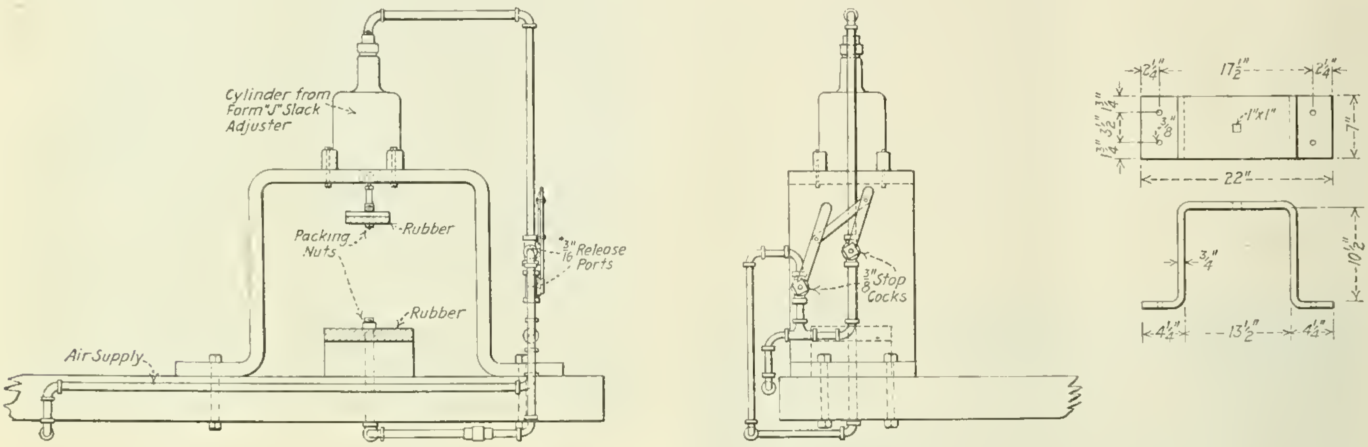


Fig. 1—Front and Side Views of Hose Nipple Testing Device

The brake hose coupling testing device is assembled on a base plate of ¾-in. material, 11 in. wide by 36 in. long. At one end of this plate is bolted an 8-in. brake cylinder and at the other end an angle bracket to hold the stationary half of the hose clamp. The movable half the clamp is attached to the end of the brake cylinder piston. A standard brake hose, connected to a ½-in. air supply pipe by a nipple and reducer, is located at right angles to the center line of the cylinder so that the open end comes between the clamp jaws. This end of the hose is reamed out so that the hose coupling can be readily inserted by hand. With the coupling in place a dummy coupling is attached and the three-way valve shown in the drawing is opened. This causes the piston to move outward, clamping the hose on the coupling just ahead of the enlarged portion of the coupling shank. At the same time, air pressure is admitted to the hose so that the coupling is subjected to a pressure test. With the aid of a brush and soap-suds, defective couplings are immediately detected.

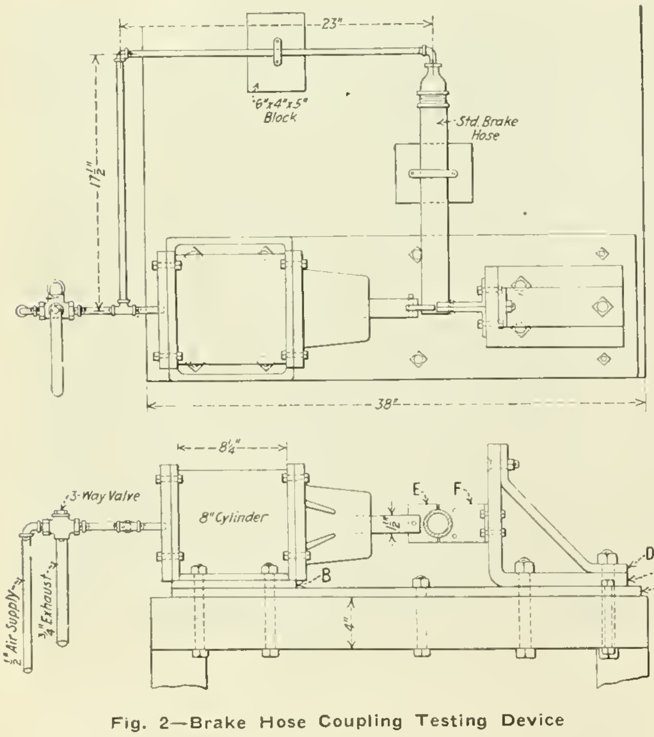


Fig. 2—Brake Hose Coupling Testing Device

As the hose wears, the end may be cut off and the hose moved forward by lengthening the nipple at the pipe connection end. In this way all but a few inches of the hose may be worn out before it becomes necessary to apply a new one.

In testing signal hose couplings, the standard brake hose is replaced with a signal hose and clamp jaws of suitable dimensions are substituted for the jaws which are shown in the drawing.

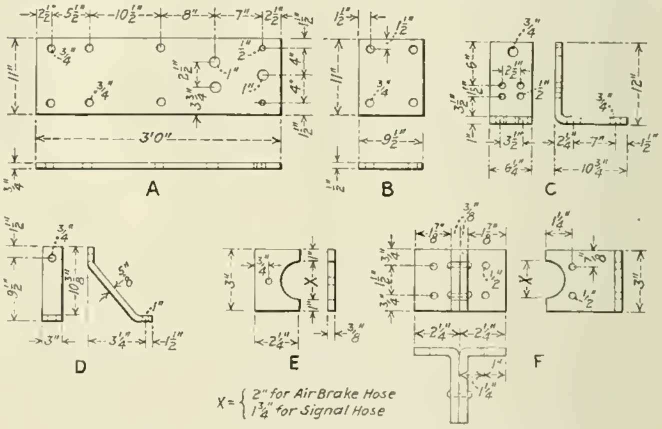


Fig. 3—Details of Coupling Testing Device

Since couplings have been tested in this device it has not been necessary to reject a single hose after mounting on account of defective couplings. The cost of making the test has been found to be one-half cent per coupling, including the cost of the necessary trucking. Not only has this practice saved a considerable duplication of work but it is also well to remember that some injury is done to the air hose tube if it is dismantled after once being assembled.

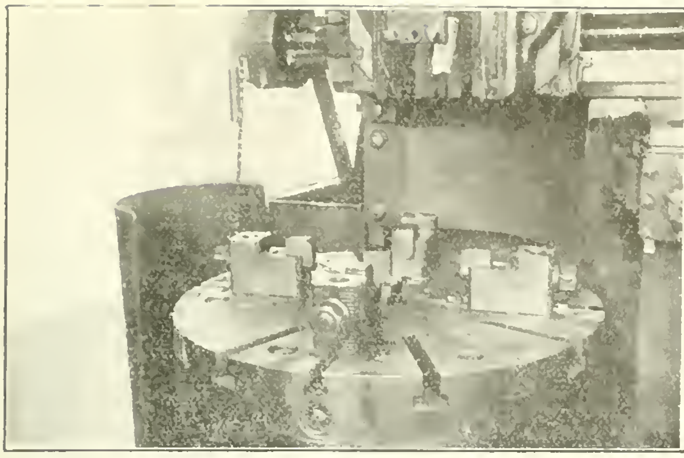


Fig. 1—Combination Chuck for Holding Packing Pot

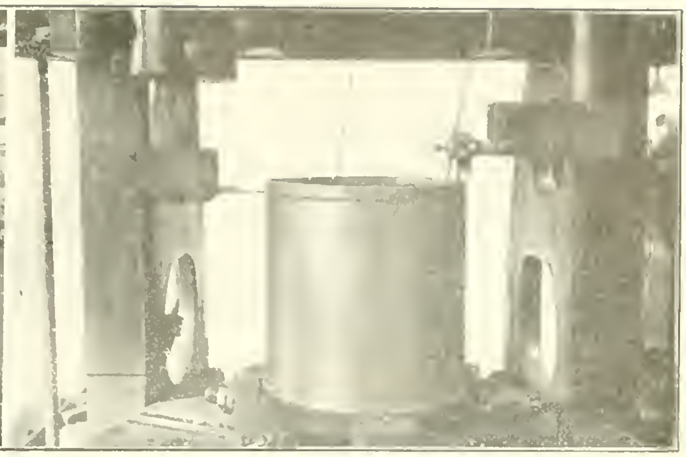


Fig. 3—Forming the Offset and Cutting Off a Ring

Machining Valve and Cylinder Packing

Outline of Machining Practice Followed at the Huntington Shops of the Chesapeake & Ohio

By E. A. Murray
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

SEVERAL articles descriptive of different methods of machining valve and cylinder packing have been printed recently, and since the methods of performing these important operations at Huntington shops are somewhat different from those previously described they will be of interest to at least a few of the many readers of the *Railway Mechanical Engineer*.

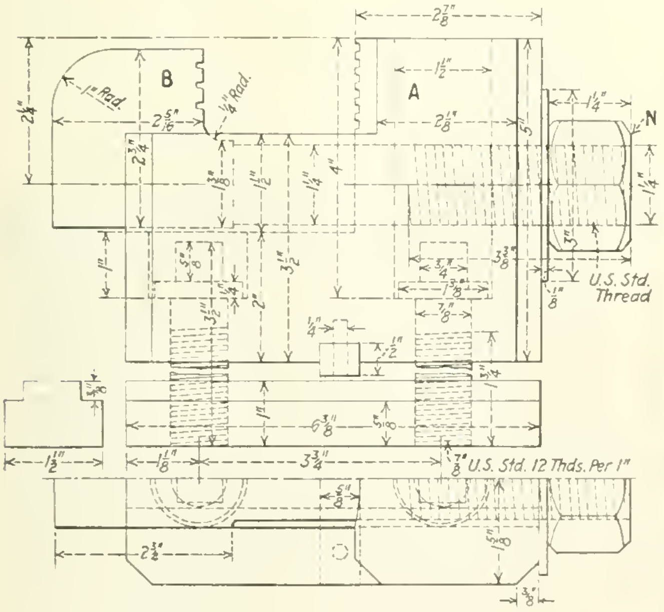


Fig. 2—Drawing of Special Chuck Jaw Shown in Fig. 1

The following is the practice adhered to in machining valve packing rings:

First Operation—The packing pot is chucked in a combination boring mill chuck illustrated in Fig. 1. Owing to the design of this chuck, it is not necessary to have clamping lugs cast on the packing pot, and the pot can be used to within 1½ in. of the bottom. The chuck jaws bear on the inside as well as the outside of the casting, preventing it from slipping or being clamped out of shape. Greater cutting feeds and speeds can be used without danger of pulling the casting out of the chuck; there is a saving of materials; there is less danger of the last few rings being defective owing to excessive outside pressure of the chuck jaws.

A drawing of this special chuck is shown in Fig. 2, from which the simplicity of the design will be evident. The solid jaw *A* is held in the correct position on the chuck to suit different diameters by means of two square-headed ⅞-in. tap bolts which are threaded into the 6⅜-in. tee bar, the latter being an accurate fit in the body of the chuck. A ½-in. by ⅝-in. key holds jaw *A* positively against radial movement except with the tee bar. Sliding jaw *B* is an accurate fit in a slot of the proper dimensions in jaw *A*, being tightened by means of the 1¼-in. nuts, gripping the casting on the inside and holding it far more firmly than is possible with ordinary methods.

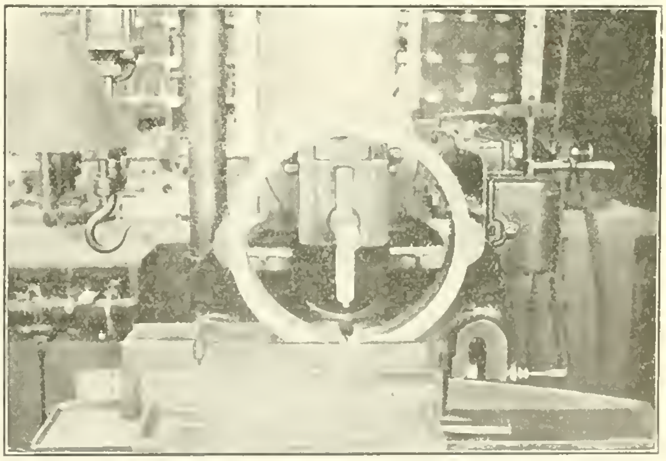


Fig. 4—Four Rings Are Held in a Special Shaper Chuck and Cut at One Time

Second Operation—The packing pot is machined on the inside and outside, using both heads at the same time. The outside diameter is made 1/8 in. larger than the finished size, which allows the ring later to be cut, compressed, and turned to the finished size.

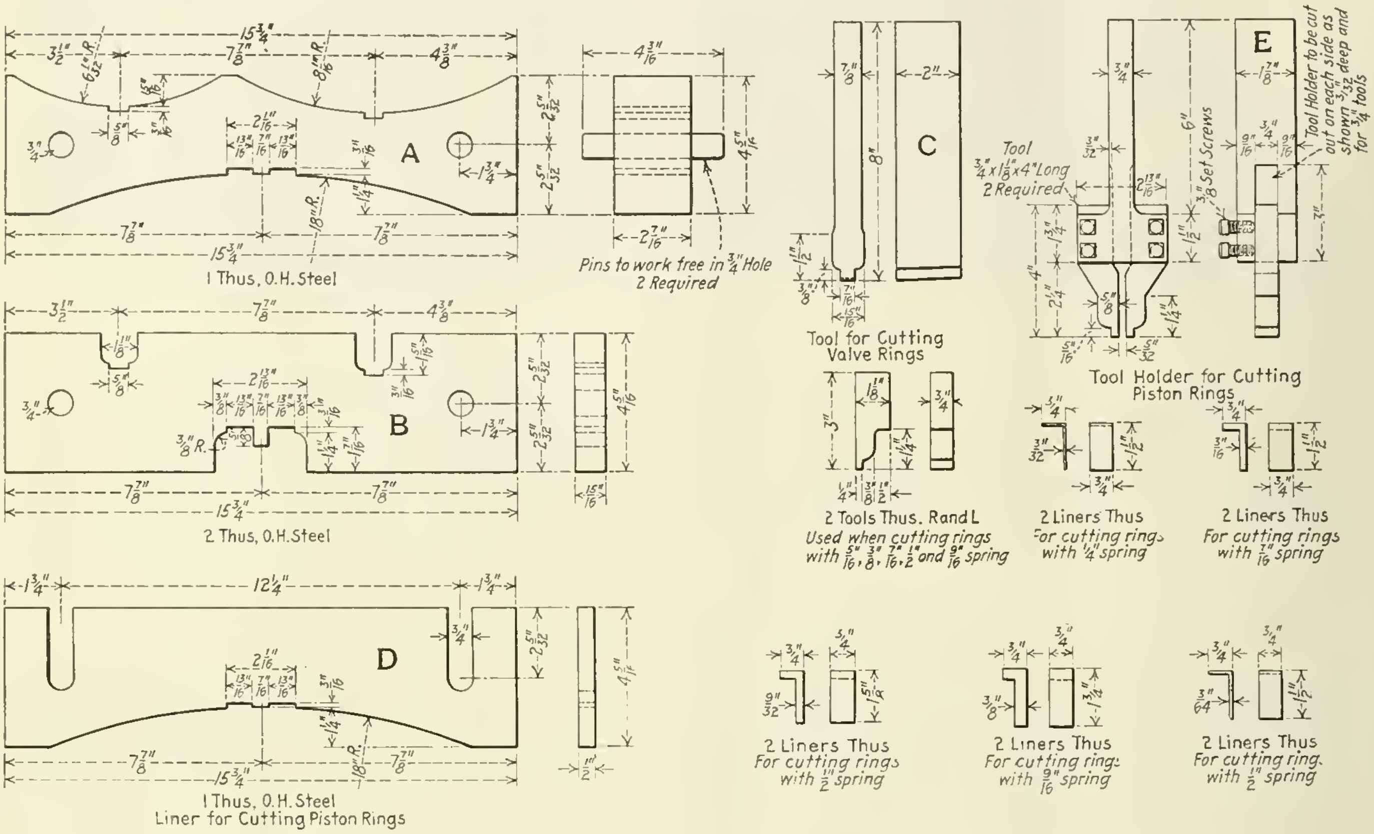

A
1 Thus, O.H. Steel
Pins to work free in 3/4" Hole
2 Required
B
2 Thus, O.H. Steel
D
1 Thus, O.H. Steel
Liner for Cutting Piston Rings
C
Tool for Cutting
Valve Rings
2 Tools Thus. R and L
Used when cutting rings with 5/16", 3/8", 7/16", 1/2" and 9/16" spring
E
Tool
3/4" x 1 1/8" x 4" Long
2 Required
3/8" Set Screws
Tool Holder to be cut out on each side as shown 3/32" deep and for 3/4" tools
Tool Holder for Cutting
Piston Rings
2 Liners Thus
For cutting rings with 1/4" spring
2 Liners Thus
For cutting rings with 7/16" spring
2 Liners Thus
For cutting rings with 1/2" spring
2 Liners Thus
For cutting rings with 9/16" spring
2 Liners Thus
For cutting ring with 1/2" spring

Fig. 5—Details of Special Chuck and Tools for Cutting Valve and Cylinder Packing Rings

Third Operation—The offset in the packing ring is machined, as shown in Fig. 3, using a forming tool in the right tool post while the ring is being cut off with a cutting-off tool in the left tool post. The top of the ring is finished, allowance being made in cutting off for truing the ring on the plain side.

Fourth Operation—The packing rings are chucked individually in a lathe and faced off, using a snap gage to get the correct thickness.

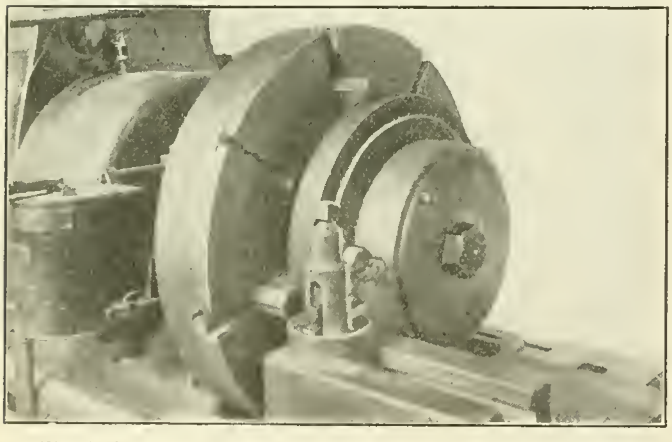


Fig. 6—Turning Mandrel, and Roller for Compressing Rings

Fifth Operation—The rings are placed in a special chuck on the shaping machine, four rings being cut at one chucking, as shown in Fig. 4. Details of this chuck and the cutting tools are given in Fig. 5. Referring to Fig. 5, *A* is the filler block which supports the packing rings, two end plates *B* holding the rings firmly when compressed between the chuck jaws in the shaper. Plates *B*, correctly alined with the filler block by two dowels, are cut away to allow special shaper tool *C* to cut the required slot in the rings. This slot is 7/16 in. wide and is the allowance made for spring. It will be noted that filling block *A* is provided with two radii 6 1/32 in. and 8 1/16 in. respectively to accommodate rings of different diameters.

Sixth Operation—The packing rings are chucked four at a time for final turning in an engine lathe in the special mandrel shown in Fig. 6. This mandrel is so designed that the rings are held between a base plate in the lathe chuck and a follower plate, the latter being tightened with sufficient pressure to retain the rings in compression by friction between the sides. The rings are first placed in the mandrel and the follower plate tightened slightly. By revolving the mandrel and using the hardened roller illustrated in the lathe tool post, the rings can be gradually compressed until

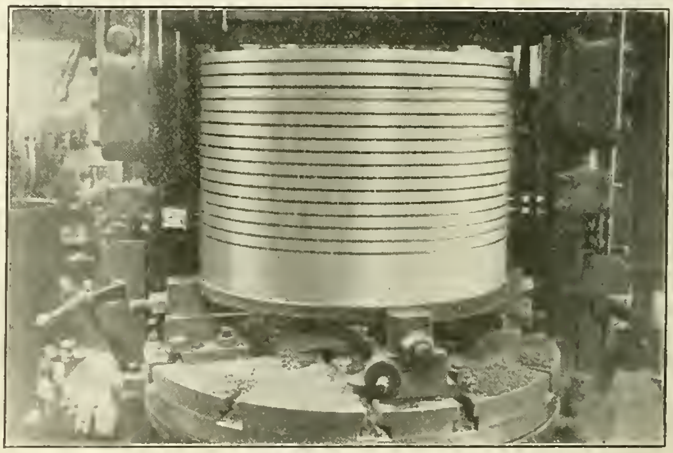


Fig. 7—Cylinder Packing Pot Being Grooved with Two Cutters on Each Side

the ends come together. The roller is then removed from the tool post, replaced by a lathe tool, and the rings turned to the exact diameter of the valve chamber bushings.

By this method of machining, the packing rings have a full bearing in the valve chamber bushings and do not bear at three points as would be the case if the rings were turned larger than the diameter of the bushings and cut so as to get the proper tension against the bushings. Moreover, a great many of the old packing rings can be reclaimed by using this method. Rings which have been removed from larger valve chambers are turned down and trued for smaller ones, being then practically as effective as new rings.

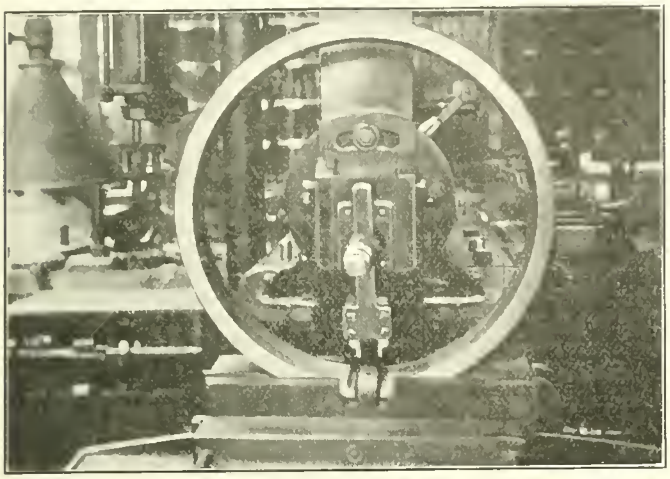


Fig. 8—Valve Packing Chuck Inverted and Used for Holding Cylinder Packing

The problem of providing cylinder packing for locomotives on any of the larger roads is a difficult one. Unless the proper material is used and correct methods of machining, the life of the packing will be limited and power will be lost, due to steam leakage by the rings. In view of the large number of packing rings used annually, the rings should be produced on a quantity basis with the most careful attention to methods of machining.

Methods of Machining Cylinder Packing

The following practice is adhered to in machining cylinder packing at the Huntington shops:

First Operation—The packing pot is chucked on a vertical boring mill table, using special jaws of the same design as those previously described for holding valve packing rings. The inside and outside of the casting is then machined in accordance with the usual practice, using both heads of the machine at the same time. The inside diameter is made small enough to provide sufficient metal to hold the rings intact while the casting is grooved, after which the rings are bored off.

Second Operation—The entire casting is grooved as shown in Fig. 7, using a double tool in either head. The experience at Huntington shops has shown this method to be much better and quicker than when using four cutting off tools in one head.

Third Operation—The packing rings are faced off on the upper side using one head, the second head being used in boring off the rings.

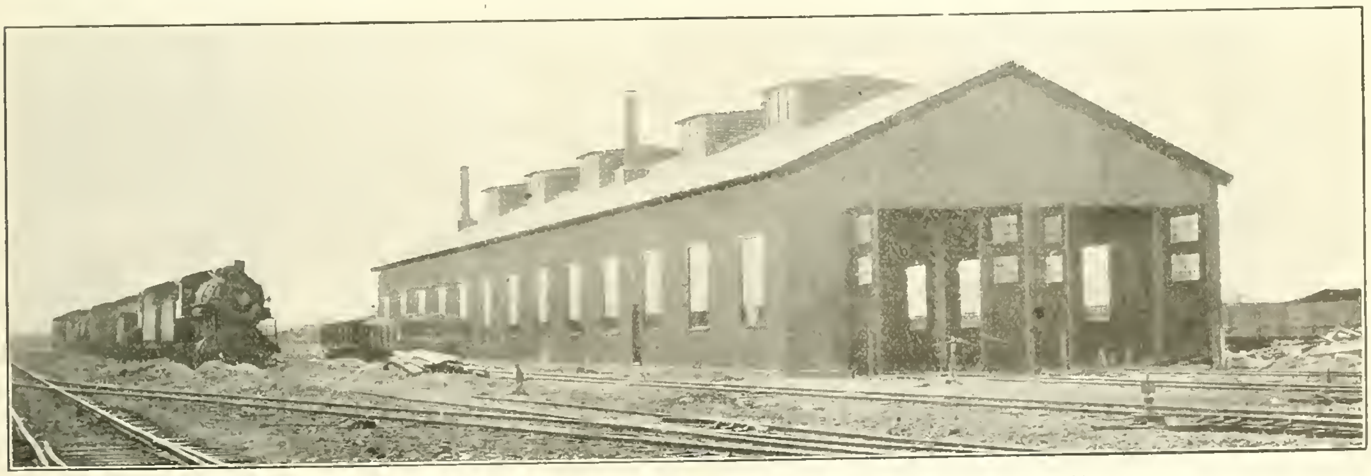
Fourth Operation—The packing rings are then clamped to the boring mill table and faced off one at a time on the unfinished side.

Fifth Operation—The packing rings are placed in a special chuck, after being cut, and machined to suit dowels in the piston head as illustrated in Fig. 8. It will be noted that the chuck in Fig. 8 is the same one shown in Figs. 4 and 5 inverted. Referring to Fig. 5, by inverting block *A*, the large 18-in. radius is brought to the top for holding cylinder packing rings. Liner *D*, used to allow for variations in packing ring width, has the same radius on the bottom as filling block *A* and the two ¾-in. slots allow it to slip on over the dowels and between the end plates *B*. End plates *B* are cut out as shown, so as not to interfere with toolholder and cutting tools *E* as they cut the packing rings.

Particular attention is called to tool holder *E* and the means provided for adjusting the cutting tools. In Fig. 5 the tools are shown in position for cutting 21/32 in. out of rings with 3/16 in. spring. The tools shown are also used for cutting 27/32 in. out of rings with ¼ in. spring by using two of the small 3/32 in. liners illustrated. The liners afford an easy and accurate means of adjusting the cutting tools in toolholder *E*. Two special tools, as shown in Fig. 5, are used when cutting rings with 5/16 in., ⅜ in., 7/16 in., ½ in. and 9/16 in. spring.

Firing-Up Shed

THE firing-up shed illustrated is a new structure recently completed by the Boston & Maine at its locomotive repair shops, North Billerica, Mass. In that latitude climatic conditions are such that cold weather, snow and rain frequently hinder outside work. It was formerly necessary to put the finishing touches on locomotives, fire them up, and make minor changes outdoors after the trial runs, and, in order to protect the men and expedite the work, this firing-up shed was constructed.


New Firing-Up Shed Recently Completed for the Boston & Maine at Billerica Shops

The shed is 209 ft. long by 47 ft. wide, covering two tracks, and holding four locomotives of the largest class with [illegible] compressed air, water and electric light are provided. The building is fireproof throughout. It is proposed to install a small motor-driven lathe, a drill, a small planer, also a blacksmith fire, and this equipment will save countless steps and much time formerly spent running back and forth between locomotives which are being finished and the main machine shop which is located at some distance. Arrangements have been made for smoke jacks to remove the smoke, and electric light extensions in place of smoking oil torches heretofore used will also aid greatly in handling the work. Lockers and toilets are provided for the men and every attempt has been made to provide good working conditions.

Washing Out Locomotive Boilers

By A. Wrench

Crewe, England

BOILER washing is an important branch of locomotive maintenance, which if neglected will impair steaming and cause waste of fuel. The water spaces of locomotive boilers, being narrow and transversed with a large number of stays, soon get blocked up if neglected, especially those parts which are difficult of access or which form a ledge for the accumulation of scale and sediment. Parts situated behind driving wheels are frequently inaccessible for efficient washing out, and it is in these parts where sediment is most likely to collect.

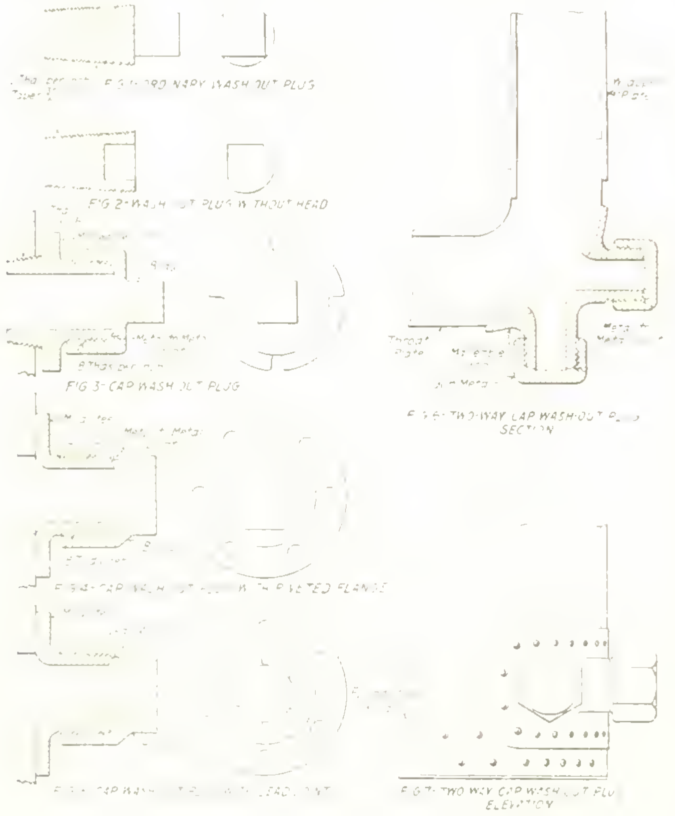


FIG 1—ORDINARY WASH OUT PLUG
FIG 2—WASH OUT PLUG WITHOUT HEAD
FIG 3—CAP WASH OUT PLUG
FIG 4—CAP WASH OUT PLUG WITH RIVETED FLANGE
FIG 5—CAP WASH OUT PLUG WITH LEAD JOINT
FIG 6—TWO-WAY CAP WASH-OUT PLUG SECTION
FIG 7—TWO WAY CAP WASH OUT PLUG ELEVATION
Throat Plate
Metal to Metal

Various Types of Washout Plugs and Caps

Scale and sediment also form among the tubes, causing them to leak, become overheated, and collapse. While inspecting boilers in the Ypres sector during the war, the writer found a boiler in which several brass tubes had fused owing to the extremely hard deposit which had been allowed to collect in the boiler.

In most locomotive boilers, washout plugs are placed in difficult positions, the boiler washer having to operate through the spokes of wheels, behind cranks, under foot plates, behind steam and blast pipes and between superheater element tubes. These positions are largely inseparable from locomotive design, but sufficient consideration is often not given to washout facilities.

The use of various shaped nozzles and a good pressure of water is necessary to keep the firebox water spaces clean, but usually it is necessary to remove tubes periodically to keep the barrel clean. A blow-off cock underneath the barrel about two feet from the throat plate will assist in keeping the spaces between the tubes clean if regularly used. Two washout plugs at the bottom of the smokebox tube plate will keep the boiler bottom clean. Some designers fit a washout plug in the firebox tube plate, but the head of this plug soon burns away and renders it useless. Judging from experience on many types of locomotives of American, British and French make, the writer is of the opinion that washout plugs should be distributed as shown in Fig. 8, which will enable the water spaces to be cleaned and inspected. The use of an electric globe fitted to the end of a wire rod and a mirror is useful when examining water spaces.

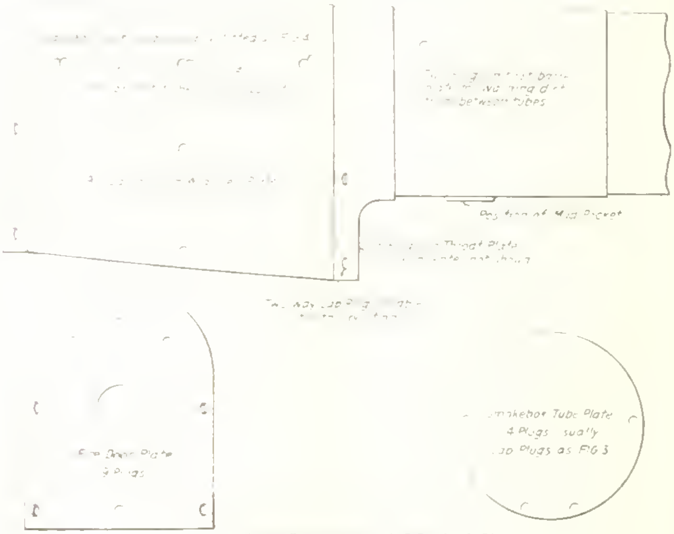


FIG. 8—POSITION OF WASH OUT PLUG HOLES

Recommended Distribution of Boiler Washout Plugs

Generally handholes are not in favor in locomotive practice, plugs being used in preference. The screwed plug is most extensively used but owing to wear on the threads of the hole caused by the use of the washing out rod, screwed plugs are constantly leaking and have to be refitted. The cap washout plugs overcome this trouble and rarely leak. They are more expensive to make, but cheaper in upkeep. They are usually fitted to the wrapper or covering plate above the inner firebox crown since steam blowing from plugs in this position is conspicuous when the locomotive is in the station and would be a hindrance to the engine driver on the lookout for signals. Cap washout plugs are not usually fitted to the lower firebox parts, but if space allowed, they could be fitted there with advantage as it is on these holes that most wear from using a rod occurs. A disadvantage of this type of plug from a boiler inspector's point of view, lies in the fact that it is more difficult to examine the water spaces through them, than through the screwed hole. The Hunslet Engine Company fitted a two-way washout cap plug to the bottom throat plate positions of the locomotive boilers supplied to the British government during the war, which overcomes the foregoing objection. A sketch of a two-way plug is shown in Figs. 6 and 7.

The pressure of water necessary for running shed washing out purposes is about 60 lb. per sq. in. The hose should be applied in a systematic manner, washing out the highest parts of the boiler first and finishing the operation by washing the mudring. The water spaces should be inspected by a competent person after washing out is completed. Large locomotives on express service are washed out twice a week after about 700 miles running, but where the blow-off cocks are systematically used, the boilers are washed out weekly.

Boring Mallet Hinge Castings

By J. H. Hahn
Machine Shop Foreman, Norfolk & Western,
Portsmouth, Ohio

THE illustrations show the details of a portable boring bar, designed by A. B. Gift, tool room foreman, for boring the bushing holes in hinge castings on Mallet articulated compound locomotives. Quite a few methods are employed at different shops for boring these castings for application of new articulating pin bushings, but the bar, illustrated in Fig. 1, is one of the best for this purpose that the writer has ever seen, and can also be used for other work such as boring tail bars, deck castings, etc. Much time and labor can be saved by the use of this device.

When boring the holes in hinge castings two five-foot pieces of rail are placed directly under the castings, leveled, and the bar placed in position for boring. The four screws are then run down tight against the rails holding the bar rigid. The bar is then lined central with the bore, the tool set for the size of the hole, and motor attached in the usual manner.

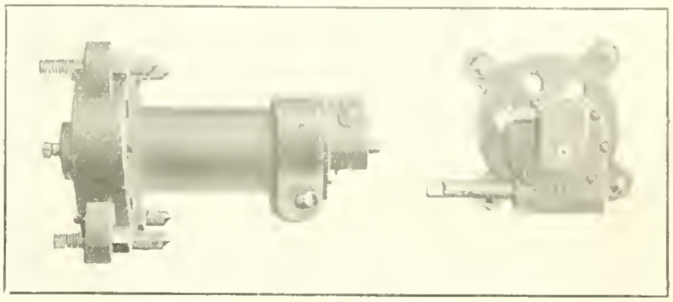


Fig. 1—Side and End Views of Portable Air Motor Driven Device for Boring Mallet Hinge Castings

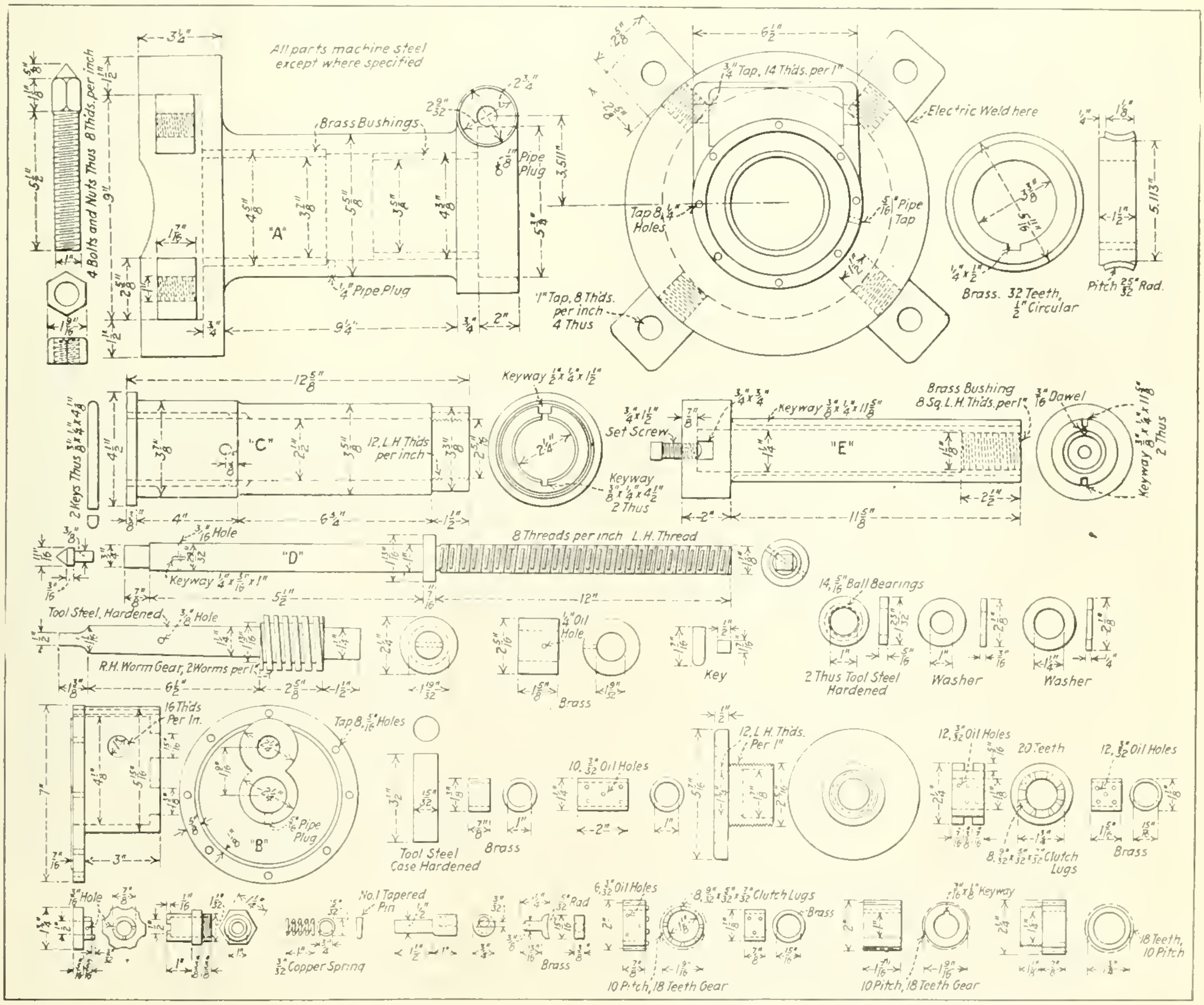


Fig. 2—Details of Portable Boring Bar Used on the Norfolk & Western for Boring Mallet Hinge Castings

Referring to Fig. 2, the body "A" is made of a steel forging, machined as shown. Spindle "C" is machined to fit inside the housing, or body "A." Feed screw "D" works in the brass bushing in the end of boring bar "E," this bushing having a square thread, eight threads per in. Feed screw "D" is driven by a worm drive from the main drive with suitable gears as shown in the drawing. Boring bar "E" has 2 slots milled at 180 degrees for the entire length of the bar to receive a ⅜-in. by ¼-in. key on each side, allowing the bar to slide freely on spindle "C" which revolves within the body "A." The feed arrangement on this machine is of a novel and original design, and is entirely automatic in operation. The feed is put on or started by the small hand wheel shown in Fig. 1. This hand wheel operates a small eccentric which puts the feed gears in mesh, causing the boring bar to slide through the spindle on the two keys.

A tool, made of ¾-in. by ¾-in. square high-speed tool steel, is used in the boring bar and is held in position by the set screw shown. No pilot or guide is used with this machine as the rigid construction of the bar makes this unnecessary. The boring bar is driven by an air motor of proper size and has a speed of about 10 rev. per min., depending of course upon the size of the air motor. The rate of feed with this speed is 1/32 in. per rev.

Feed Control and Drive Arrangement

The illustrations show plainly the construction and arrangement of this machine; also the arrangement of the feed control, drive and the screws used for setting up the machine. The machine is supplied with the required number of oil holes which are plugged by the use of ¼ in. pipe plugs to keep out the dirt, grit, etc. Ball-bearing thrust bearings are also provided.

The gear case and other parts are applied with suitable gaskets to prevent the loss of lubrication. The gear casing, etc., is applied to the body by means of cap screws as shown. All parts are machined all over with limitations of .001 in. to insure accurate fits. All parts are hardened except where otherwise specified, thus reducing the amount of wear to a minimum. Holes are drilled to allow the chips to pass out through the bottom, and this also decreases the weight of the machine considerably. All gears and other moving parts are encased. This bar, with the boring bar shown in drawing, will bore holes through 6-in. castings and by the use of longer bars any desired range may be secured. This machine will prove a valuable addition to any shop handling Mallet type locomotives. It can be constructed in the average railroad shop tool room.

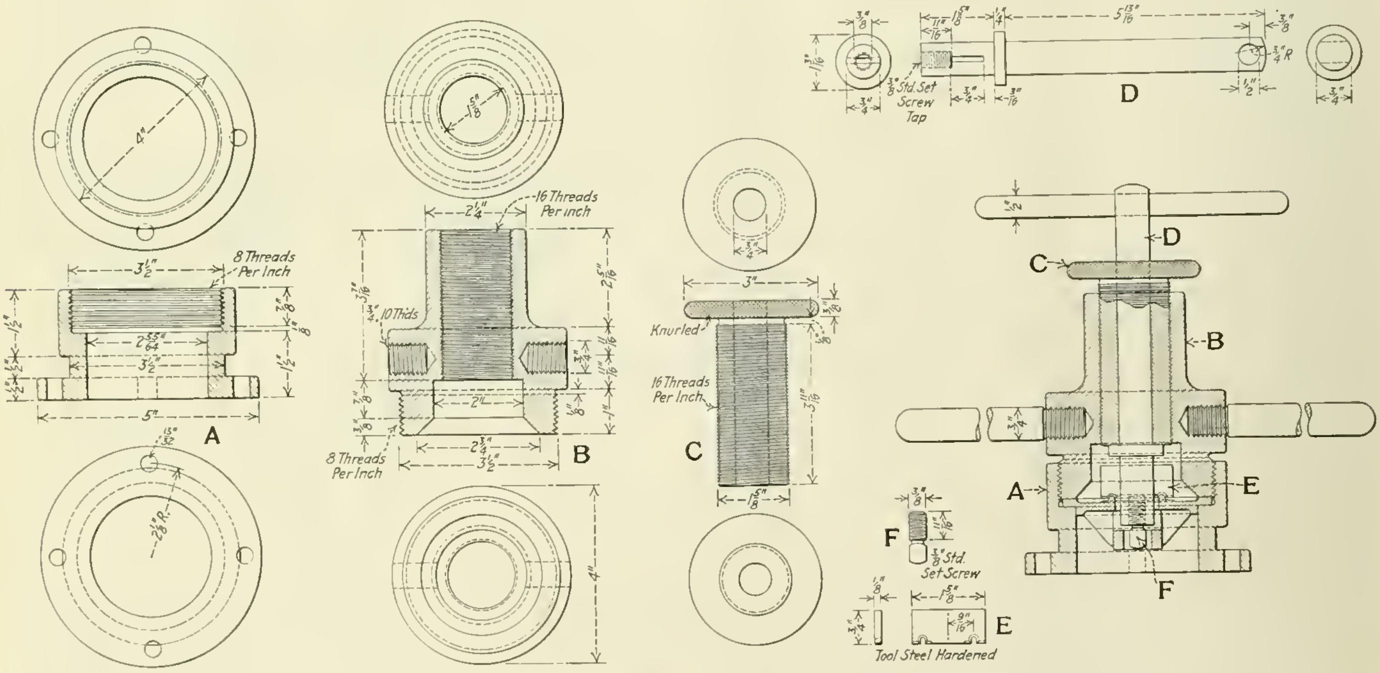
Emergency Seat Refacing Tool

By J. D. Flinner

Supervisor of Air Brakes, Monongahela, Brownsville, Pa.

A TOOL designed to reface the brass emergency valve seats of Westinghouse triple valves is shown in the illustration. This tool can be used for both passenger and freight triple valves in which the emergency valve seats have become worn or cut by long service, causing them to leak. The tool not only refaces worn valve seats but, in the case of some of the older types of valves having flat seats, the seats can be changed, by using the cutter shown, to the new semi-circular section, making a better seat for the rubber-faced emergency valve. It takes only a fraction of a minute to set an emergency valve part in this device and reseat it.

The arrangement and dimensions of the tool are shown in the illustration and, referring to the assembled view, the operation will be evident. The worn brass emergency valve seat is placed in base *A* which is bolted to a bench by four ⅜-in. bolts. The two ¾-in. handles shown enable part *B* to be turned down firmly, holding the emergency valve seat against turning. The feed screw is then run down by means of knurled collar *C* at the top forcing spindle *D* and double cutter *E* downward until the cutter comes in contact with the brass seat. Revolution of spindle *D* by means of its ½-in. handle, accompanied by a slight tightening of the knurled handle on the feed screw, will then cause cutter *E* to give a new, accurate contour to the emergency valve seat. Cutter *E* is removable by loosening set screw *F*. Part *B* should always be screwed down firmly on the seat before beginning the refacing operation.



Details and Assembled View of Tool for Refacing the Emergency Valve Seats of Triple Valves

In shops where many triple valves are repaired, a great deal of time can be saved by this tool, and valve seats which would otherwise have to be scrapped can be used over again. All parts of this tool are made of axle steel except the cutter *E* which is of tool steel hardened.

Examples of Toolroom Work at Readville

Importance of Adequate Toolroom Pointed Out—Effective Tools Made at Readville Toolroom of the New Haven

THERE are doubtless other factors more important in railroad repair shop output than the manufacturing toolroom—but not many. Even the most modern machine shop equipment is rendered largely ineffective without time-saving jigs, fixtures and small tools to provide short cuts, combine operations, and speed up machine work. Besides saving time and consequently the cost of machine work, these jigs and fixtures are incidentally an important factor in speeding locomotive parts through the repair shops and hence decreasing the time that locomotives are held out of service.

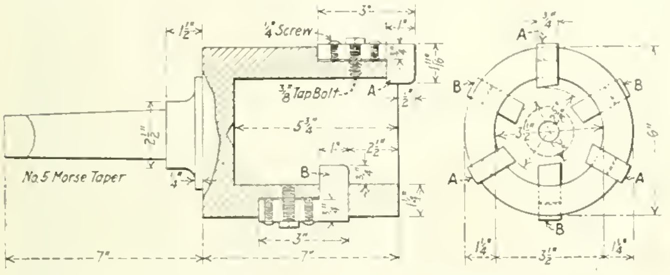


Fig. 1—Partial Section of Box Tool Showing Construction

In view of the above facts, it is important that railroad shops be provided with manufacturing toolrooms in which new jigs and fixtures can be designed and made as needed and old ones kept in good repair. Adequate machine equipment is required in the toolroom and also a personnel with sufficient initiative and resourcefulness to develop new tools as the need for them in various shop departments becomes evident.

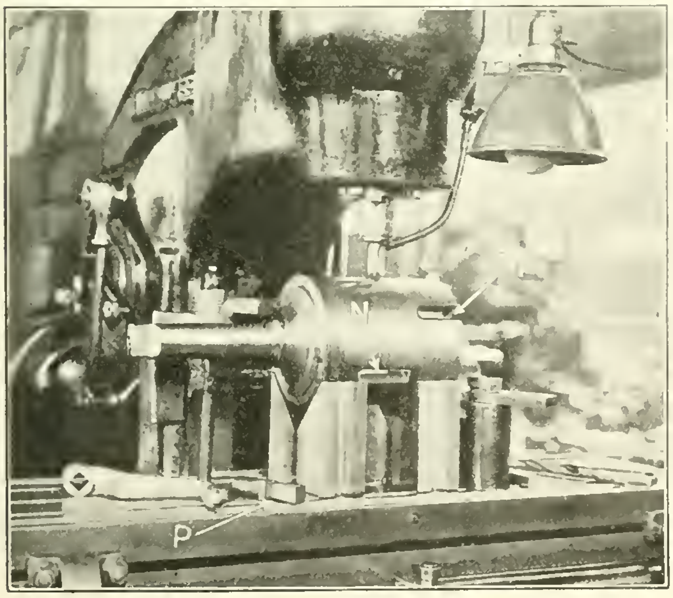


Fig. 2—Milling the Cutter Slots in a Box Tool

The toolroom of the New York, New Haven & Hartford at Readville shops, located in the balcony, is equipped with engine lathes, milling machines, drills, grinders and other standard tools commonly used in toolroom work. A general view of the toolroom is given in Fig. 5 which shows the arrangement of the machinery and the good light available for accurate work. In practically every department of Readville shops, time and labor-saving jigs and fixtures, made in this toolroom, are in daily use.

Box Tool for Turning Eccentric Crank Pins

One of the new tools just being developed is that illustrated in Figs. 1 and 2 for turning Walschaert eccentric crank pins. These pins are forged integral with the eccentric cranks which have a throw of about 19 in. A boring mill with a 38-in. or larger table is, therefore, required to turn eccentric crank pins from 2 to 3 in. in diameter. It is difficult, if not impossible to speed up the boring mill so as to get the required surface speed on the pin and, as a result, the operation takes considerable time besides tying up a heavy machine on a small job.

Realizing the inefficiency of this method, a new plan for machining eccentric crank pins has been developed at Readville whereby it is proposed to perform the entire operation on whatever drilling machine of the required power may be available. The three cutters *A* (Fig. 1) are designed to turn the pin bearing for the eccentric rod bushing and the three cutters *B* the outer end of the pin which is later threaded to receive the eccentric crank washer and nut. The two turning operations are performed simultaneously by the box tool which is then replaced in the drill spindle by a self-opening die for cutting the thread. It is obvious that the entire operation of machining the eccentric crank pin can be performed by this method in a fraction of the time formerly required.

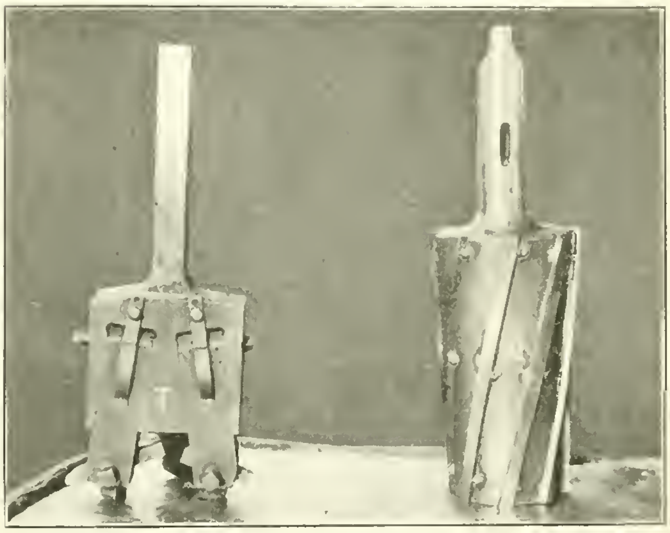


Fig. 3—Two Tools Which Have Proved Their Usefulness

Referring to Fig. 1, the construction of the box tool will be evident. The three high-speed cutting tools *A* are accurately fitted in slots milled in the body of the box tool. Cutting tools *B* are also made of high-speed steel and accurately fitted in their respective slots. All cutting tools have a slight adjustment by means of the ¼-in. screws, being held against outward movement by the ⅜-in. tap bolts illustrated. The cutters are relieved in two directions so that they can not only turn the outside diameter, but counterbore to give a good side bearing for the eccentric rod bushing. While this box tool was designed for an eccentric crank pin

3 in. long by 2⅝ in. in diameter and with a 2-in. threaded end, the design can be readily changed to suit any size of pin.

The method of machining this box tool may be of interest. In the first place, a forging of the required size was made in the blacksmith shop and turned to the 6-in. outside diameter, a No. 5 Morse taper being formed on one end. A hole was then drilled and bored 3½ in. in diameter and 5¾ in. deep as shown. Slots for the cutting tools were then drilled, milled and broached as shown in Fig. 2. One of the slots for the three cutting tools *A* is indicated at *M*; one of the slots for tool *B* at *N*. An end mill was used for the milling operation and broach *P*, employing the vertical feed of the milling machine, for getting square corners. One precaution should be observed in making tools of this type and that is to machine the slots accurately so that the cutters will not have undue play and work loose under heavy cuts.

Double Cutting Tool and Reamer

One of the operations in machining driving boxes which takes considerable time is what is called "cornering." This consists of machining the shoe and wedge ways slightly wider at the top and bottom than at the center, made necessary to provide for the locomotive rocking from side to side as it goes around curves or difference in the height of opposite wheels. Before "cornering," driving boxes, the shoe and wedge ways are first planed to the standard width, and then a line of boxes is set at a slight angle on the planer table, the required taper cut being taken from opposite ends. The boxes are reset to the same angle the other way and the operation repeated. In all, four cuts are usually taken and these can be reduced to two by means of the double cutting tool illustrated at *T*, Fig. 3. This double cutter was made in the Readville toolroom, the two tool holders consisting of 1½-in. square cold rolled steel in which the ½-in. high-speed steel tool bits are held by the set screws to prevent them from working out. It will be noted that the tool holders are set in the body at angles of 15 deg. so that on the back stroke of the planer they will swing outward, relieving the pressure on the cutting tools in two directions.

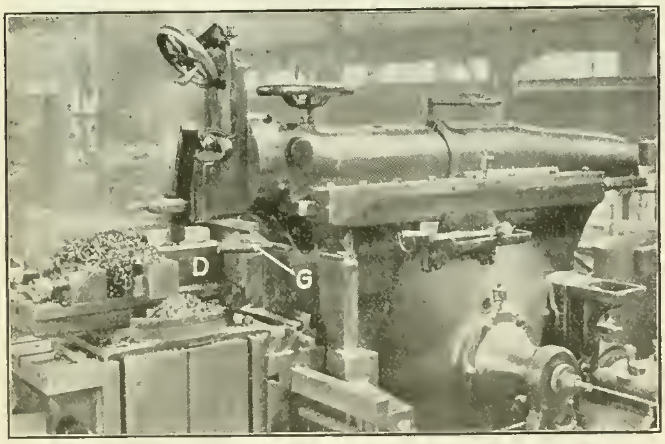


Fig. 4—Modern Shaper Machining Unannealed Die Block

The taper reamer *R* (Fig. 3) was made locally and has demonstrated its value for reaming taper knuckle pin holes in side rods. This reamer is 8 in. long, being 4 in. in diameter at the bottom and 5 in. at the top. It is made with a No. 5 Morse taper shank, having high-speed blades set in a body of soft steel by spot welding as indicated. The blades have the appearance of being spiral but, as a matter of fact, straight cuts were milled in the body of the reamer at an angle of 14 deg. (Obviously these cuts were deeper at the center than at the ends.) Soft high-speed blades were then inserted and the reamer turned in a lathe to give the blades the correct taper. The blades were then taken out, hardened and reapplied permanently by spot welding. The cutting blades were relieved by grinding, the tool then being ready for use and to all intents and purposes as solid as a one-piece high-speed steel reamer. Its cost was relatively much less. Should a question be raised as to the effect of spot welding on the blades, it may be said that the heat is localized and applied for such a short time that it has practically no effect on the heat-treated blades.

One of the machines which receives constant use in the Readville toolroom is the 32-in. heavy duty shaper illustrated in Fig. 4. This illustration is shown for the reason that the die block *D*, held between the chuck jaws, is made of a special die steel unannealed. This die block was to be used in forging spring gibs, one of which is shown at *G* in the illustration, and owing to uncertainty as to the exact analysis of the steel and the required heat treatment, it was decided to machine the die block without annealing. For the shaping operation, a rugged machine was needed and a special high-speed cutting tool had to be used. The shaper illustrated is used for many different operations and on die work the 32-in. stroke is a particular advantage, enabling large dies to be handled.

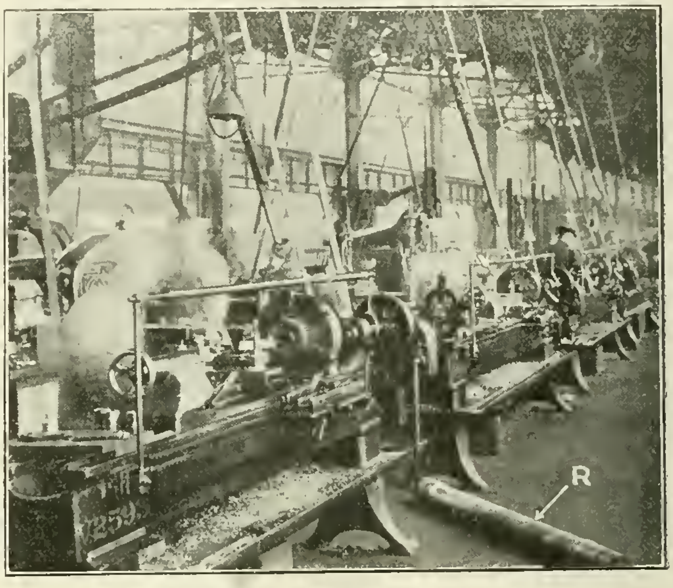
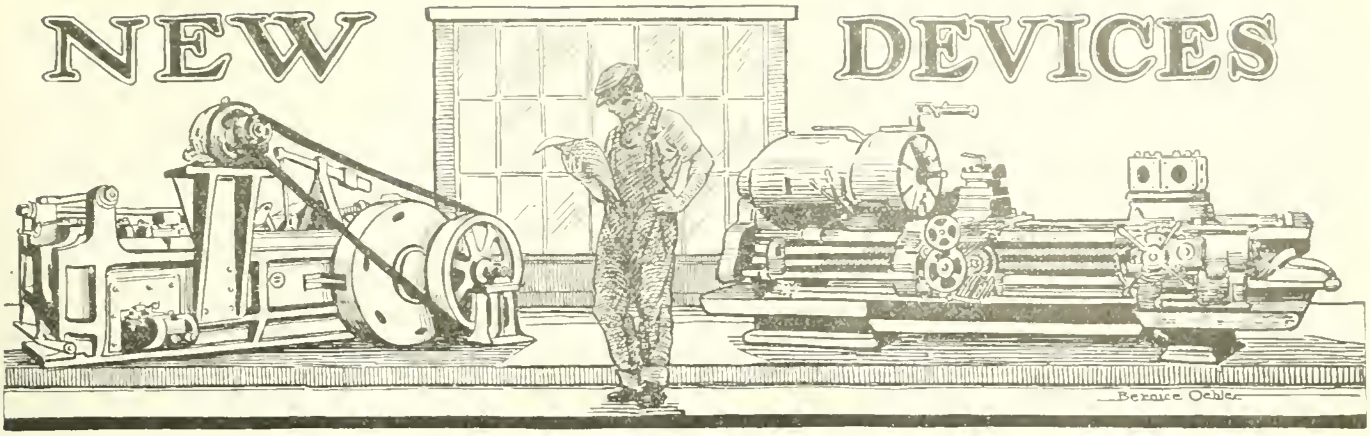


Fig. 5—General View of Toolroom at Readville

Milling Piston Rod Keyways

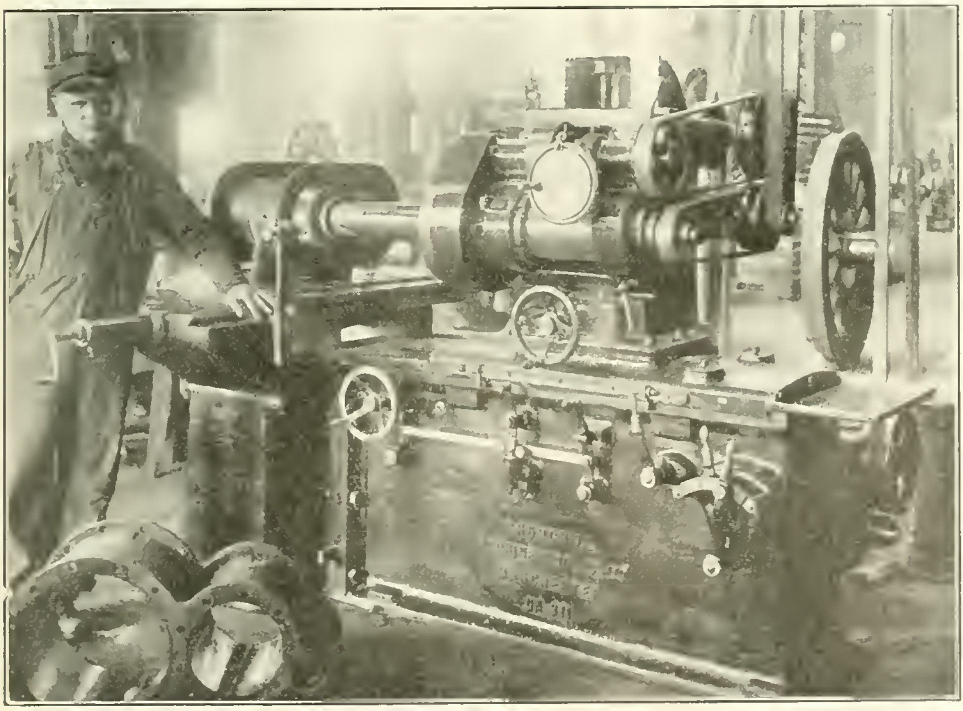
In addition to what can be classed as strictly tool work, quite a number of operations on locomotive parts are performed in the toolroom at Readville. For example, the piston rod *R*, shown in the foreground of Fig. 5, is one of a pair sent to the toolroom to have the crosshead keyways milled. This rod is 5 in. in diameter, has a keyway 1⅜-in. wide and 4 in. long. The time involved in drilling and filing this keyway, or even machining it with an end milling device, is unnecessarily long and special spiral milling cutters have been made so that the operation can be performed on one of the horizontal-spindle knee-type milling machines in the toolroom. It takes about 10 min. to set up the rod and 20 min. to drill and mill the keyway, one cut only being required. The spiral cutters are supported at both ends so that a relatively heavy feed can be carried. This method of machining keyways is only temporary, however, since it involves moving the piston rods to and from the toolroom. An old end-milling machine, designed especially for machining keyways, is now being rebuilt to drive a spiral milling cutter supported at both ends which is coming to be accepted as the best and quickest means of machining keyways. The rebuilt machine will be located in the machine shop near the piston rod job and thus save trucking new piston rods to the toolroom; also releasing the milling machine for other work.



Internal Grinder for Air Compressor Cylinders

THE internal cylinder grinding machine illustrated has been recently introduced in this country by the Churchill Machine Tool Company, Ltd., Manchester, Eng. It is installed in the Hornell shops of the Erie, being used for finishing cylindrical holes quickly, accurately and smoothly. These characteristics are particularly valuable in the case of air compressor cylinders which have to be rebored or trued frequently in order to insure high compressor efficiency.

By grinding new cylinders after rough boring, and retruing used cylinders by grinding only, it is anticipated that a much longer life and consistently higher efficiency will be secured. Bores so treated will prove serviceable for the full period between locomotive shoppings, thereby eliminating one of the causes of idle time in roundhouses, that taken by holding locomotives out of service while new cylinders are being fitted or the original ones rebored.


Churchill No. 2 Internal Grinder Truing Steam Cylinders of a New York Duplex Air Compressor

Precision grinding has in the past been largely considered an unnecessary refinement for railroad repair shops, but there is indisputable evidence that the example of the ground piston rod will soon be extended to other parts that are subjected to intensive local strain and wear. There has never been any serious argument against the regrinding method of resurfacing worn piston rods, and it is but logical to expect that the experience gained with this member will in turn be applied to others of a similar nature.

The illustration shows the grinding of New York duplex air compressor cylinders. In the case of the air cylinders shown on the floor in the foreground, the 8-in. by 12-in. cylinder was ground to a high finish removing .020 in. from the diameter in 20 min. The 14-in. by 12-in. cylinder was ground, removing the same amount of metal in 40 min., the finish and accuracy of the cylinders being greatly superior to the best that can be obtained by any other method.

Features of Churchill No. 2 Internal Grinder

The construction of the machine employed on this work is of considerable interest, as the design is more familiar to engineers on the other side of the Atlantic than to those in this country. The machine is designed, as its name implies, for the grinding of cylinders, bushings and holes in machine parts which, owing to their external shapes, cannot be rotated in the usual internal grinding machines. The machine is of a type that can be used for generating holes in exact relationship and at correct center distances from previously finished locating surfaces or slides thus insuring correct alinement with a minimum of correction by hand work. As the work for which this machine is intended may be of irregular outline, or with overhanging projections, the machine is designed with massive tables with cross adjustment for positioning the work only, the table remaining stationary during the actual grinding. The table is carried on a base reaching directly to the floor, and while coupled to the machine, the table is independent of it so that larger or smaller tables can be fitted to suit various classes of work, or if necessary the table can be removed altogether and a base plate substituted.

The grinding wheel spindle is provided with the necessary planetary motion, adjustable while grinding is going on, and is carried on a head vertically adjustable on the column. The column is mounted on a slide having automatic longitudinal movement on the bed, controlled by adjustable reversing dogs for varying the stroke to suit the length of hole to be ground. This slide is provided with various changes of speed for use while grinding, and on the Churchill No. 3 and 4 internal grinders there is a quick traverse, independent of the reversing dogs, which can be automatically operated for traversing at high speed over the chambered portions of long holes.

The main spindle on which the grinding wheel spindle is mounted, also has various changes of speed provided, which can be operated independently of the traverse speeds. The grinding wheel spindle is easily detached from the main spindle, and changed for a larger or smaller size in a few minutes. A full range of spindles is obtainable so that holes from the smallest up to the capacity of the machine can be ground.

The planetary motion of the grinding wheel spindle admits of very sensitive control, the controlling handwheel being provided with a dead stop. On the No. 1 and 2 machines the adjustment is obtained through double eccentric spindles controlled through a differential motion. In the larger sizes the adjustment is obtained direct on a slide mounted at right angles to the main spindle and operated through a screw and differential motion. This construction admits of a large range of adjustment to the grinding wheel, so that wheels considerably smaller than the holes to be ground can be used, thus reducing the arc of contact between the wheel and the work, and allowing a very considerable range of wear of the grinding wheel.

By means of the cross adjustment to the table and the vertical adjustment to the spindle, work having a large number of holes can be ground without disturbing the setting on the table. Within the capacity of the machine there is no limitation to the external shape of work to be handled.

The machine is entirely self-contained, and may be driven from a single overhead countershaft or direct-connected to a constant speed motor.

Donomarent Safety Tank Car Outlet Valve

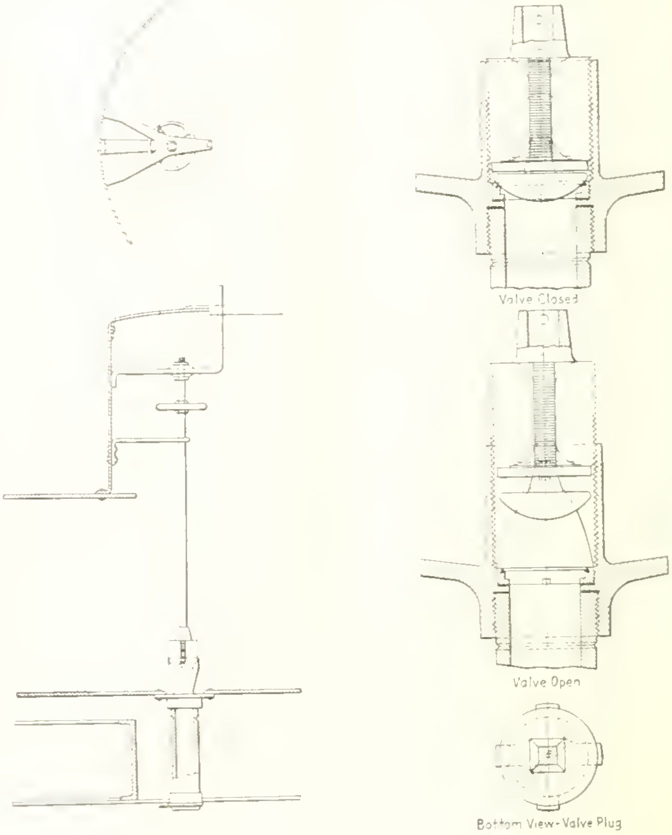
THE present A. R. A. standard type outlet valve and connection for tank cars, judging by the experience of several years, does not embody in its design all the desirable features that such an outlet should possess. Realizing the fact that the present design was faulty, the Bureau of Explosives has endeavored to arouse an interest that would lead to improvements. Several new valves have been brought out, among which is one known as the "Donomarent" outlet, designed by T. J. Entwisle, superintendent car shops, Southern Cotton Oil Company, New Orleans, La., which will apparently overcome several of the objections to the present design.

An ideal tank car outlet and valve is called upon to meet several difficult requirements, among which the following may be mentioned. The seat should be self-cleaning to insure a tight closure; it should be impossible to open the valve without removing the dome cover plate and breaking the seal to prevent pilfering the contents of the car; distortion or "breathing" of the tank should not cause the valve to leak or become wedged and preferably it should be possible to repair a broken outlet without removal of the contents of the car.

Referring to the illustration, it will be noted that the outlet flange is riveted to the bed sheet of the tank in the usual manner while the nozzle is a separate piece. By turning a groove in the nozzle near the end which is screwed into the flange, a point of weakness is provided at which a break will occur should a sufficient force be exerted. In this event, the valve would not be unseated or any of the contents lost. The remaining portion can be readily removed and a new nozzle applied. The flange not being damaged, it would not be necessary to pump out the tank to make repairs.

The separate valve seat is of brass and can be readily unscrewed for re-seating or renewal. The valve itself is of spherical shape without wings, thus insuring positive seating and eliminating the danger of cocking. On the upper side of the valve is a tapered square projection which fits into a corresponding socket in the valve plug. The valve plug has four wings, threaded to fit the inwardly extended portion of the flange. The bottom of the plug has a socket for the valve, as stated, the two parts being connected by a cotter or bolt passing through an oblong hole. The design provides a telescoping connection, the effect of which is to cause the valve to be rotated about two and one-half turns after it is seated and before it is locked shut and also as it is opened, before it is lifted from its seat. This will clean off gummy residue, grit or other substances from the seat, insure tight closure and keep the valve and seat in good condition for a long period.

The flanged portion on the lower end of the valve plug is screwed down tight against the valve after it has been closed and makes it impossible for anyone to lift the valve from the seat by a bar or turning tool. The valve can only be opened by breaking the seal and removing the dome cover, a safety precaution against robbery of considerable importance.



Donomarent Safety Outlet Valve for Tank Cars

The extended portion of the flange which forms the valve cage is provided with large openings which give unrestricted flow to the contents of the car and overcomes foaming. The position of the openings and the location of the valve seat insures complete drainage of the full contents of the car.

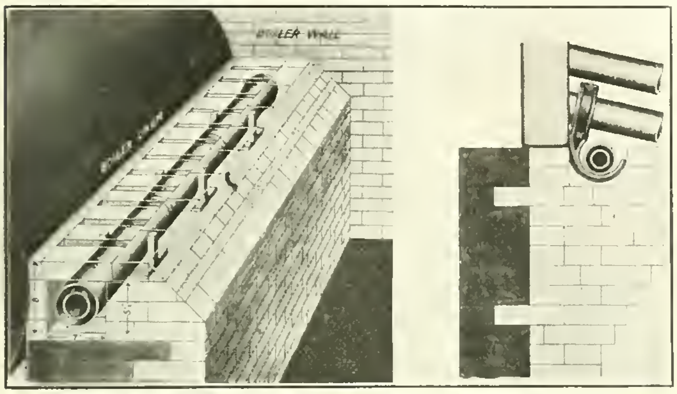
The upper part of the valve plug is extended to form a socket for the rod to which the hand wheel is attached. As the threaded connection is between the plug and the cage in the bottom of the tank, distortion of the tank by filling or "breathing" in service cannot cock the valve or wedge it, nor distort or bend the rod. Neither vibration nor contraction and expansion affect the seating of the valve.

The hand wheel rod is extended above the wheel and a position indicating device attached which extends up into the opening of the dome in such a manner that the cover cannot be replaced until the valve is locked shut.

It is stated that these valves have proved entirely satisfactory during the few months that they have been in service and as a result additional valves are being applied to other cars.

Mechanical Soot Blowers for Stationary Boilers

THE value of mechanical soot blowers in increasing the efficiency of boiler operation has been amply demonstrated but certain mechanical difficulties are involved. After an extensive experience the Bayer Company, St. Louis, Mo., has developed a revolving soot blower element which overcomes temperature difficulties by the use of Monel metal and has other valuable features. It is designed to be sectionally air-cooled and non-warpable, thus insuring long life. A valve-in-head arrangement is provided.



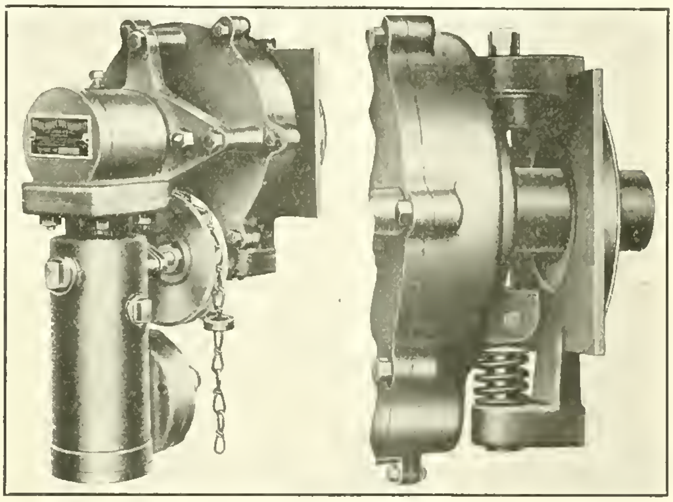
Showing Protected Position of Blower Element in Vertical Boiler (Left) and in Horizontal Water Tube Boiler (Right)

The interior steam element in the Bayer blower is securely locked in a central position within the outer or sectional Monel metal air tube so that both the interior steam element and the outer sectional air tube revolve as one element. This inner steam element is kept free and immune from the high furnace temperatures because it is insulated by a liberal circulating air space through which the high temperatures of the furnace cannot penetrate. Likewise, the outer air tube is kept at a comparatively low temperature due to the positive cooling effect of the circulating air passing through and within it.

The outer air tube is made of Monel metal for unusually high temperatures. Monel metal has been thoroughly tested in comparison with practically all other commercial metals at temperatures up to 1,030 deg. F. The results indicate the distinct superiority of Monel metal as regards both strength and resistance to corrosion.

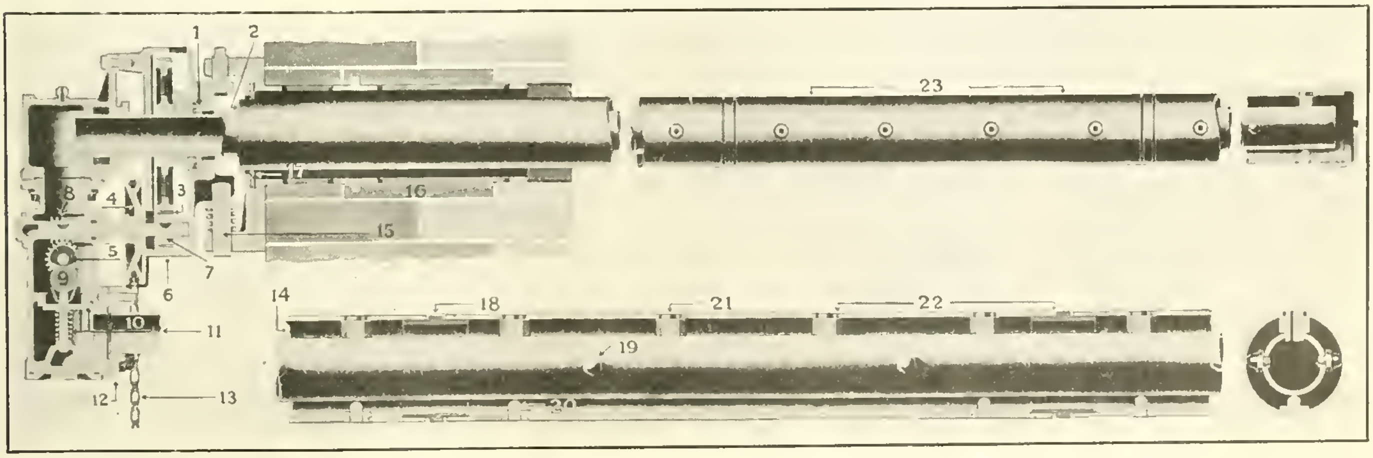
A sectional Monel protecting tube, as well as Monel metal nozzles, are used on this new blower, thus eliminating the danger of oxidation and corrosion of the air tube. To take care of expansion, ample space is provided for each nozzle where it projects through the outer tube.

An additional important feature is the valve-in-head construction of the blower. In this design the valve is in the head itself, as shown in the illustrations, and it automatically opens and closes at the proper points with the rotating of the element.



Bayer Valve-in-Head Geared (Left) Floating Air Shield with Universal Movement (Right)

It is claimed by the manufacturers that this valve cannot leak because it is so constructed that it will always seat per-



Principal Parts of Bayer Soot Blower Unit—(1) Roller and Thrust Bearing, (2) Air Inlet, (3) Gear, (4) Sheave, (5) Cam, (6) Gear Case, (7) Pinion, (8) Bronze Worm, (9) Disk, (10) Monel Metal Valve Parts, (11) Steam Inlet, (12) Flange Connection, (13) Operating Chain, (14) Live Air Space, (15) Full Floating Mechanism, (16) Wall Sleeve, (17) Air Excluding Shield, (18) Expansion Sleeves, (19) Spacers, (20) Studs, (21) Monel Metal Nozzles, (22) Expansion Space, (23) Monel Metal Section Outer, or Air Tube.

fectly. The valve stem does not extend through a stuffing box which might throw the valve out of alinement with its seat and thus cause leakage troubles. The valve is mechanically and positively controlled by a cam and worm gear. The valve also is made of Monel metal.

The elements are so made that they can be rotated in either direction, making it unnecessary to give the elements a second full revolution to repeat the blowing operation when a second revolution is not needed. Steam is thereby saved. Besides, the mechanism is so designed that no steam is wasted, the discharge or blowing of the jet being mechanically timed. The steam jets are blown within a predetermined arc, making it impossible to blow except where necessary and reducing the time required for the operation.

The entire head is "full floating," or in other words, is free to expand or contract with change in temperature and with the expansion and contraction of the boiler walls or the pipe lines. For this reason there is no straining or binding effect in the operating mechanism of the blower. Working parts are not exposed to the grit and dust of the boiler room, the entire blower head being encased. Parts can be oiled without danger of the oil collecting dirt.

A simple and efficient reduction gear makes it impossible to revolve the unit too rapidly. This permits the steam jets to work most effectively on the surfaces to be cleaned during a sufficient period of time. This gear, together with the roller and thrust bearings on which the element is mounted, make the element easy to operate.

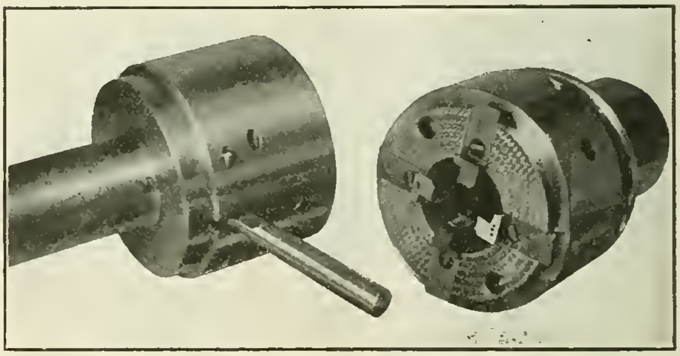
Simplicity and Strength Feature New Hardened Die

THE National Acme Company, Cleveland, Ohio, has added to its line of Namco dies a new hardened die made in revolving and non-revolving types as shown in the illustration. These dies are featured by simple, strong construction. The body and shank is made in one piece, also the cam and cup. The chasers bear directly against the solid cup cam, eliminating numerous small parts subject to wear and loosening. There are only ten parts used in the construction of this die (except for chasers) and there is no face cap to hold the chips and grit.

Special alloy steel is used throughout in the construction of this die and the cup wall is made unusually heavy. The chasers are fitted to hardened and ground plates, all parts being hardened and fully ground. Particular attention is given to the construction of the chasers, all chasers being hardened and lapped and ground on the bottom. The chasers receive full support, giving rigidity in cutting action. Projecting chasers permit threading close to a shoulder and provide freedom from chips.

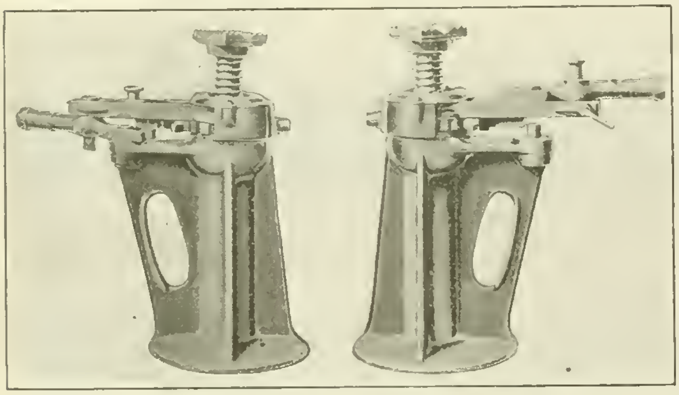
The shanks for dies are made either soft or hard as desired, a hardened plate for the screw being used with the soft shank. Inside trip can be furnished if desired.

In the revolving type die, five straight thread sizes from 3/16 in. to 2½ in. can be provided; also four sizes of pipe threads from ⅛ in. to ¾ in. In the non-revolving type, seven sizes of straight threads up to 3 in. can be furnished and pipe threads from ⅛ in. to ¾ in.


Namco Hardened Non-Revolving (left) and Revolving (right) Dies

A Two-Speed Ratchet-Operated Screw Jack

AN oscillating lever screw jack which may be operated either in direct or compound leverage, has been placed on the market by the Muelling Engineering Works, Racine, Wis. By the ribbed construction of the body an unusually light weight combined with strength is obtained.


Leverage of Four-to-One—Direct Leverage Position

In lifting, the nut is turned by means of a ratchet-connected lever which operates in a horizontal plane, while the screw does not revolve. The nut revolves on a ball thrust bearing set in a pocket near the top of the jack body. A working fit throughout the length of the body maintains the screw in alinement as the load is raised. This prevents the screw from binding in the nut and adds to the ease of operation.

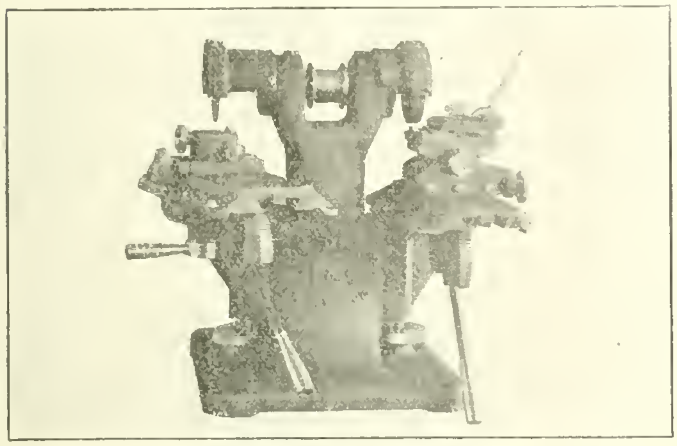
The illustrations show the two positions of the operating lever. With the handle socket placed on top of the ratchet lever the operator is provided with a one to one leverage ratio which gives a comparatively rapid lift for ordinary loads. For heavy loads the handle socket is placed below the ratchet levers, as shown at the left in the illustration. In this position the handle socket is fulcrumed on the jack body and operates the ratchet lever with a compound leverage of four to one ratio. The ratchet pawl, which engages with a notched flange on the top of the nut is reversed by a finger pull, which may be operated at any point in the stroke of the lever, since the pitch of the screw prevents any possibility of a kick-back.

The jack is also furnished with a combined foot lift and chain hook. Lugs on the back of either side of the lower end of the chain hook are provided for the attachment of hardened and polished tool steel rollers, which bear against the faces of the lateral ribs on the jack body. A large ribbed base which may readily be attached to the permanent base of the jack is provided for use with the foot lift attachment.

These jacks are made in two sizes, of five tons and 10 tons capacity. The smaller jack is 10 in. and the latter 12 in. in height, and they provide for a total raise of eight and nine inches, respectively. Not more than one-half of the rated load should be applied to the foot lift attachment. The two models weigh 20 lb. and 28 lb., respectively.

Grinder for H & G Die Head Chasers

THE Eastern Machine Screw Corporation, New Haven, Conn., has brought out a new machine for grinding chasers used in H. & G. self-opening die heads. The machine is designed as a bench machine, occupying a space of about 20 sq. in. and it stands about 18 in. high. It comes complete with a countershaft and two wheels and, when boxed ready for shipment, weighs approximately 240 lb. The machine has very substantial castings, a ball-bearing spindle and is well protected from abrasive.



Tool for Grinding the Chasers of H & G Self-Opening Die Heads

The left-hand wheel is for grinding the throats, or chamfers. Each chaser is located from a hardened pin that enters the cam slot on the chaser. This locates it just as it is located in the die head. An adjustable anvil provides for long or short chamfers as required. The table swivels to provide the proper curvature and the vise is also provided with an offsetting adjustment. This combination makes it possible to obtain just the right amount of clearance required at the throat.

At the right, the rake angle or angle of cutting face, is ground. Four chasers are held at once by means of a single cam-actuated clamp and the fixture may be tilted to the proper angle.

Too much emphasis cannot be laid on the importance of the proper grinding of tools. A grinder, such as this, reduces the time lost for grinding to a minimum, provides the most efficient grind with the least amount of stock removed from the chasers, and improves the quality of the threading.

Pump Valve Designed to Prevent Leakage

USERS of pumps will be interested in recent improvements in pump valve construction announced by the Worthington Pump & Machinery Corporation, New York. An entirely different form of valve has been designed to eliminate cutting and leakage, thereby increasing the average pump efficiency, decreasing the cost of pumping, and tending to maintain the capacity of the pump at its maximum point.

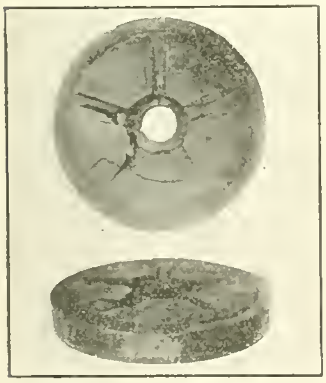


Fig. 1
Ordinary Hard Rubber Valve
After 3 Months' Service

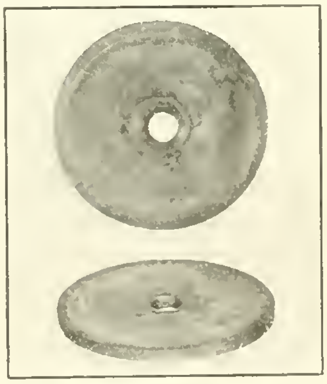


Fig. 2.
Worthington "Seal" Valve
After 12 Months' Service

The principal cause of pump leakage is traceable to excessive wear of the rubber valves which, while negligible in some cases, is often quite bad. Thus, Fig. 1 shows a photograph of a hard rubber valve after three months of particularly hard service. Cracks and cuts caused by the valve seat and by the radiating ribs are plainly visible. It is plain that the only way to positively prevent leakage with valves in this condition is to remove and replace them with new valves.

The new Worthington "Seal" valve, illustrated in Figs. 2 and 3, assures absolute tightness when closed, because the rubber used is flexible. It seats perfectly both at the hub and outer rim, its inner and outer seats, and so keeps tight. Age and continuous usage do not cut grooves or cause cracks, as demonstrated in Fig. 2 which shows a flexible rubber seal used for one year in this new type of valve. During the year there was no visible wear, leakage, and no cost for repairs.

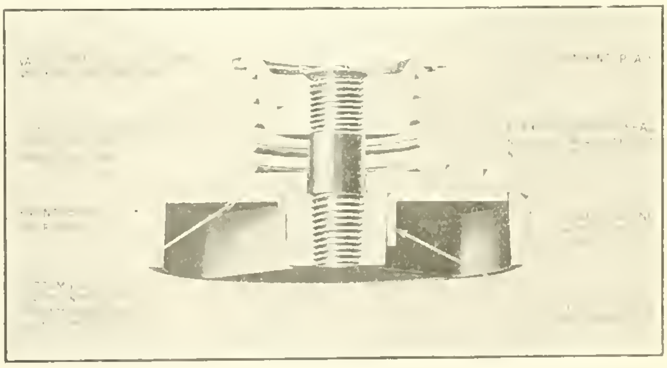


Fig. 3—Sectional View of Worthigton "Seal" Pump Valve

The ingenuity and simplicity of this valve are evident from Fig. 3. There are no screws, bolts, rubber rings, nuts, bushings, or rotating elements. The special new feature that makes this valve adaptable to hard service is the so-called bottom plate. This is in effect a middle seat for the rubber valve proper. When the valve is closed, this middle seat carries the entire load and prevents the rubber seal from cutting on the seats or ribs. This bottom plate moves up and down with the rubber, and so not only acts as a middle seat, but moves with the rubber and helps to keep the rubber valve in shape, even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts. The flexible rubber acts only as a seal against leakage. It will be noticed that even the top of the rubber seal is protected by a thin backing plate which keeps the rubber seal flat and prevents any possibility of wear from contact with the spring. All moving parts are light but rigid. The lightness assures a smooth, quiet-running pump. The rigidity prevents the distortion that results in leakage.

It is not anticipated that repairs or replacements will be often required, but the construction makes this easy when it does become necessary and the cost of any possible repairs will be low because of the simplicity and inexpensiveness of all parts. This valve is especially suitable for severe and unusual pumping conditions. It has a proportionately longer life under ordinary conditions.

Blow Torch Designed for Safety and Efficiency

The Master blow torch, illustrated, is now being marketed by the Turner Brass Works, Sycamore, Ill., and embodies a number of novel and useful features. A safety valve, located at the end of the horizontal pump cylinder, is fitted with a diaphragm accurately proportioned to give away automatically at 40 lb. air pressure. As torches operate at 18 to 20 lb. pressure, this valve will not come into action until about double the normal pressure is present. A thumbnut on this valve permits the operator to release the air pressure after his work is done, or to decrease the pressure as desired during the operation of the torch.

Another valuable feature is the fact that there is but one opening in the tank. This opening is at the top, above the fuel line, and is sealed by the screw thread filler-plug. By eliminating such soldered connections as burner inlet and upper and lower pump brackets, a frequent cause of leakage trouble is removed.

The pump is equipped with a pump leather that spreads like a parachute on the work-stroke and closes on the return stroke. This leather is automatically lubricated from a reservoir of vaseline in the brass washer at the end of the pump rod.

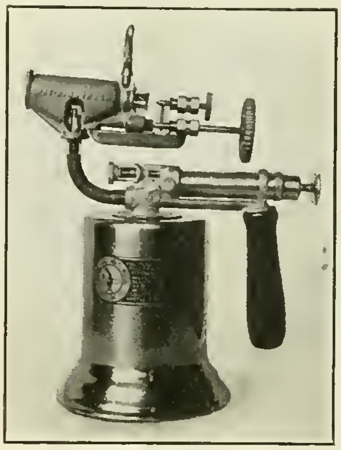
The fuel, in its journey from the tank to the combustion chamber, passes through the interior of a solid bronze baffle in the head, called the "Hot Spot Hump." This baffle is located near the outlet of the burner tube in the path of the flame. It very soon becomes white hot, the intense heat vaporizing the fuel into a hot, dry, highly-inflammable gas. Kerosene or the leanest grade of gasoline can thus be burned.

Efficient combustion means not merely the total consumption of the fuel without unburned residue, but also the maximum admixture and combustion of oxygen from the air. Instead of depending upon a multitude of holes in the burner-tube for oxygenation of the fuel, the Turner Master torch admits air through a flared inlet in front of the needle valve. This inlet is a bell-shaped nut, turned from brass screw-stock and threaded so that the operator with thumb and finger, can screw it into or out of tube, thus regulating the distance from the needle-valve, and consequently, the volume of air admitted.

Air is also admitted through a long slot at the top of the burner tube, immediately above the "Hot Spot Hump," previously referred to. This supplementary air inlet performs two functions; it deflects the flame downward upon the baffle or "Hump," and it provides additional oxygen to insure complete combustion at this point. The absence of holes in the sides of the burner tube is cited by the makers of this torch as one of the reasons why it cannot blow out in a gale of wind.

In blow torches, a very common source of trouble has always been the enlarging of the fuel orifice by strong arm work at the hand-wheel. To checkmate that form of abuse, the shut-off valve is separated from the fuel-control valve, the latter being placed above the shut-off. For the same reason the needle valve has only a small thumb-nut control so as to make it practically impossible for the operator to exert enough pressure to enlarge the orifice. The larger wheel has only one use—that of opening or closing the fuel line. As its valve has a positive seat, there is never any occasion to use force on this wheel.

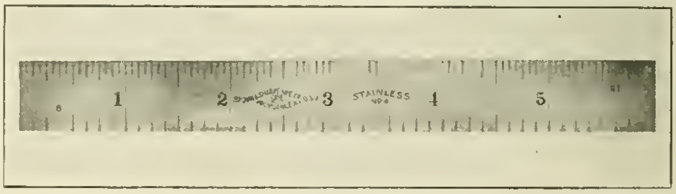
The Master torch has a wooden pistol-grip handle hung at an angle that balances the torch and at the same time gives ample room for the largest hand so that the knuckles do not nearly touch the tank. The use of a single length of curved steel tubing to carry the fuel from tank to torch eliminates all soldered or threaded joints and connections.



Master Blow Torch

Stainless Steel Rule

A STAINLESS STEEL rule of special interest to mechanics, as well as a great number of foremen and other shopmen, has just been placed on the market by the Browne & Sharpe Mfg. Co., Providence, R. I. This new rule is made of stainless steel so that it is rustproof and will not stain or discolor. Every shop man will appreciate the advantage of a rule which always retains its bright finish and thus eliminates the difficulty experienced in reading graduations on rules that have become rusty or blackened from use. The rule is made in 6-in. and 12-in. sizes and is graduated in 8ths, 16th, 32nds and 64ths of an inch.



Brown & Sharpe 6-In. Stainless Steel Rule

GENERAL NEWS

The Canadian National will before long establish a pension system for superannuated employees, according to an announcement made by G. P. Graham, Acting Minister of Railways, in Parliament on April 9.

The Atchison, Topeka & Santa Fe announces that employees may become stockholders in the company through a new plan recently adopted. Stock will be purchased in the market by the road and held for employees, who may pay for it at the rate of $10 a month. The limit of stock which may be bought on this plan is 10 shares, either common or preferred.

The use of oil fuel in the locomotives of the Adirondack division, required by New York State law as a precaution against forest fires, costs the New York Central $255,600 yearly, which is about $118,000 more than the probable cost of coal for the same service; and the road has asked the Public Service Commission to modify or suspend the requirements of the law.

A silk banner has been presented to the employees in the Albina (Oregon) shops of the Union Pacific for having made the best safety record in 1922. Only nine injuries were recorded, which was at the rate of 3.72 injuries for each million man-hours of work. This surpasses all other shop records on the Union Pacific and is believed to be one of the best records ever made in a large shop in the United States.

Chinese Road Buys Locomotives in Japan

The Kirin-Changchun Railway, China, has ordered two Mikado type locomotives from the Kawasaki Shipbuilding Yards, Kobe, Japan.

A Tunnel Through Mont Blanc

A new railway line is planned from Oex, Switzerland, on the Bellgarde-Chamonix line, to Aosta, according to the Times (London). The work involves 13 tunnels and 13 bridges. The longest of the tunnels, 15,700 yards, will be through Mont Blanc and will require four or five years in its completion.

Finland to Build Own Railway Equipment

The Finnish State Railways will build 200 open goods wagons and 50 passenger coaches in their own shops, according to advice from Helsingfors to the Times (London) Trade Supplement. In addition 18 locomotives are to be acquired, but whether these will be built in the company's shops or purchased from builders in other countries has not yet been decided.

The "Right to Work Act"

The "Right to Work Act" is the name given to a law which has just been passed by the legislature of Utah, and approved by the governor. This was a bill introduced by Assemblyman A. J. Stookey, and it aims to guarantee to all citizens the right to work, and to prevent other workmen and all agencies from intimidating lawful workers.

Mechanism of Boiler Scale Formation

At the Pittsburgh, Pa., experiment station of the Bureau of Mines, a study is being made of the mechanism of scale formation in steam boilers, including the effect of temperature, pressure, character of surfaces, and concentration of the water. At the present time a continuous test is being conducted on a commercial boiler in actual operation, in which a part of the suspended matter is being continuously removed by an external filter through which the boiler water is circulated. A complete record and account of the scale forming constituents is being kept and the influence of added constituents is being noted.

Mechanical Division Issues Program for June Meeting

The regular annual meeting of the American Railway Association, Mechanical division, will be held at Orchestra Hall, 220 South Michigan avenue, Chicago, on Wednesday, Thursday and Friday, June 20, 21 and 22, 1923. The program is of exceptional interest. In addition to the reports of the committees a number of individual papers have been prepared and the meeting will be addressed by R. H. Aishton, president, American Railway Association; W. W. Atterbury, vice-president, Pennsylvania System; C. H. Markham, president, Illinois Central; W. B. Storey, president, Atchison, Topeka & Santa Fe, and Sir Henry Thornton, president, Canadian National. A list of the individual papers follows:

The Development of the Locomotive by Samuel Vauclain, president, Baldwin Locomotive Works.

The Development of Railway Cars, by E. F. Carry, president, The Pullman Company.

Increasing Locomotive Mileage, by C. F. Giles, superintendent, machinery, Louisville & Nashville.

Training of Apprentices and Supervising Foremen, by John Purcell, assistant to the vice-president, Atchison, Topeka & Santa Fe.

Reports from the following committees will be presented for discussion:

General Committee
Nominating Committee
Arbitration Committee
Committee on Brakes and Brake Equipment
Committee on Car Construction
Committee on Couplers and Draft Gears
Committee on Design of Shops and Engine Terminals
Committee on Electric Rolling Stock
Committee on Loading Rules
Committee on Locomotive and Car Lighting
Committee on Locomotive Design and Construction
Committee on Prices for Labor and Material
Committee on Safety Appliances
Committee on Specifications and Tests for Materials
Committee on Tank Cars
Committee on Wheels

In addition to the committee reports it is planned to provide an opportunity for a free discussion of the following general subjects:

Co-operative Research
Economies from Modern Shop Machinery
Handling of Material on Car Repair Tracks
Modern Repair Track Facilities
Possibilities for Increased Efficiency of Modern Locomotives
Shop Management Problems of Today

All day sessions will be held on each of the three days.

Locomotive Shipments Largest Since 1920

Shipments of railroad locomotives from the principal manufacturing plants increased to 282 in March, and were the highest since December, 1920, according to figures published by the Department of Commerce from compilations of the Bureau of Census. Unfilled orders continued to increase and made a new high record at 2,316 locomotives, an increase of 96 during the month. Unfilled foreign orders increased for the first time since last October.

Wage Increase in the East and West

The Boston & Maine has made an advance in the wages, said to be 3 cents an hour, of about 4,000 trackmen. The Pennsylvania has made advances ranging from 1½ cents to 3½ cents to common laborers in the Northwestern region and certain other sections; but announces that no general increase has been made. The Wheeling & Lake Erie has made advances to large numbers of shopmen, amounting to about 7 cents an hour. Most of these shopmen will now enjoy rates about equal to those enforced before the Labor Board made its reduction. The Illinois Central has granted increases in pay averaging two cents an hour to the mechanics, helpers and apprentices in the company's shops. The increased rates are retroactive to April 1. Carmen assigned to passenger and freight car truck work are not included in the increase. The Cleveland, Cincinnati, Chicago & St. Louis has announced its intention of increasing the wages of its maintenance of way employees, but has not yet made public the amount of the advance. Section foremen, section laborers and mechanics are included in the increase.

Coupling Devices for South Australian Railways

An important market for coupling devices for the South Australian Railways may be opened in a few months, according to Commerce Reports. The use of heavier engines and heavier trains which the new railway commissioner, who recently was placed in charge of the state railways, plans to introduce during 1923, will require a much stronger and up-to-date coupler than that now in use. As the couplings which will be required when the heavier trains are put into operation are not manufactured in Australia, American manufacturers may have an opportunity to obtain a share of this trade, according to Consul Henry H. Balch, Adelaide, in a report to the Department of Commerce.

Inspection Bureau Finds Defective 64.3 Per Cent of Locomotives Examined

Of 5,368 locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during March, 3,453 or 64.3 per cent were found defective and 733 were ordered out of service, according to the monthly report of the commission to the President on the condition of railroad equipment. During the same month the Bureau of Safety inspected 109,950 freight cars and found 8.9 per cent defective, and 1,735 passenger cars, of which 2.1 per cent were found defective.

Western Maryland Shops Damaged by Fire

The car shops of the Western Maryland at Hagerstown, Md., were damaged by fire on April 1 to the estimated extent of $300,000. Two large three-story brick buildings, with contents, were practically destroyed. This establishment, employing about 900 men, has been operated for the past year by the Dickson Construction & Repair Company, a contract having been made by the railroad and the construction company following a strike of railway shopmen. A public meeting was held recently in Hagerstown which was described as an observance, by the strikers, of the first anniversary of their walkout.

Chilean Railway Operates First Electric Train

The first electrically-operated train on the Chilean State Railways made a successful trip from Santiago to Tiltil and return on Tuesday, April 17, according to a cablegram received by the Westinghouse Electric & Manufacturing Company. The train was operated by President Alessandri of Chile, as engineman, and the American Ambassador to Chile, was carried as a passenger.

The distance between Santiago and Tiltil is about 30 miles and constitutes the eastern end of the electrified line of 144 miles from Santiago to Valparaiso. When completed, 33 electric locomotives will be used on the electrified section.

Get-Together Banquet on the Central of Georgia

The Metal Trades and Carmen's Associations of the Central of Georgia shops at Savannah, Ga., held a banquet in Savannah on April 14 which was attended by 300 members of the two associations. The foremen and officers of the company also joined with the men, among those present being: L. A. Downs, vice-president and general manager; W. H. Fetner, superintendent motive power; W. H. Wright, superintendent Savannah division, and S. A. Whitehurst, master mechanic. A message was read from President W. A. Winburn, and addresses were made by L. A. Downs, W. H. Fetner, and W. H. Wright. The representatives of the employees' organizations who spoke included W. J. Bice, president; J. C. Williams, vice-president; J. A. Bradford, of Macon shops, and D. F. Hagan, of Savannah shops.

German Diesel Locomotives for Russia

The chief of the Russian railway commission in Berlin is reported to have contracted with the Deutsche Werke for the construction of a number of Diesel-engined locomotives, according to Consul Richardson at Berlin. The first two, one with electric and the other with hydraulic transmission, must be delivered during the summer of 1923.

These new locomotives will cost approximately twice as much as steam locomotives, but they have the advantage, among others, of being capable of operation without water—a distinct improvement in a country where water is scarce. This feature will permit the extension of railways into sections of Russia where now they are nonexistent.

Court of Appeals Renders Decision in Patent Suit Involving Corrugated Steel Car Ends

The United States Circuit Court of Appeals for the Seventh Circuit has modified the decree of the District Court in the suit of the Pressed Steel Manufacturing Company, Chicago, and Walter P. Murphy, against the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., for patent infringement. The patents involved are the Murphy-Sisson patent No. 1,031,571, claims 11, 12, 14 and 15; Sisson reissue patent No. 14,434, claims 9, 12 and 43; Murphy patent No. 1,058,889, claim 5; Sisson patent No. 1,271,234, claim 1; and Sisson patent No. 1,254,860, claims 2, 3, 4, 5 and 6. In that suit the District Court decided in favor of the plaintiff that all of the claims of these patents involved in the suit were valid and had been infringed by the Mt. Vernon Car Manufacturing Company in equipping 1,000 box cars for the Baltimore & Ohio, with corrugated steel plate ends furnished by the Chicago-Cleveland Car Roofing Company, and issued an order for a permanent injunction and an accounting as to profit and damages against the defendant company. The decision of the Circuit Court of Appeals modifies the decree of the lower court by relieving the defendant from the injunction and accounting under the disputed claims of patents No. 1,058,889, No. 1,271,234, and Claims 9 and 12 of reissue patent No. 14,434. So modified, the decision of the lower court is affirmed. The Court of Appeals says: "Each side shall pay one-half of the costs in this court."

Railway Construction in Colombia

Work is progressing on the extension of the Ferrocarril del Pacifico (Pacific Railroad) northward from Buenaventura, Colombia, to Cartago, department of El Valle del Cauca, according to Vice-Consul McEnelly at Buenaventura. The length of the line already in operation is 190 miles, and an extension of 127 miles is planned for the next two years. The railroad is of 3-ft. gage and is owned and operated by the Colombian government, under the direction of the ministry of public works.

The ministry has fixed as the equipment necessary for each 25 miles of the Pacific Railroad 4 locomotives, 8 passenger cars, 10 box cars, 2 live-stock cars, 8 flat cars, 2 gondolas, and 5 dump cars. According to the chief engineer of the railroad, the present rolling stock consists of 25 locomotives (16 of the Mogul type), 40 passenger cars, 60 box cars, 13 live-stock cars, 60 flat cars, 32 gondolas, and 50 dump cars. Provided the extension planned for the next two years is completed, the following equipment will be needed: 27 locomotives, 64 passenger cars, 70 box cars, 13 live-stock cars, 44 flat cars, and 15 dump cars.

Consolidated Equipment Repairs for Short Line Association

Negotiations have been concluded through the efforts of J. W. Cain, manager of the purchases of the American Short Line Railroad Association, between the association's banking interests and the Midwest Engine Corporation of Indianapolis, Ind., covering an extensive rebuilding program for used locomotives and freight cars. The program will call for the general overhauling of 108 locomotives and the rebuilding of 3,600 freight cars each year for the next five years. The plan is an outcome of the investigation of the feasibility of building several thousand cars of standard design which could be financed on a consolidated basis and allocated to the individual lines of the American Short Line Railroad Association.

The freight cars will be financed on a basis of approximately 25 per cent cash and the balance by car trust notes extending over five years. Locomotives will require one-third cash and the balance will extend from one to two years. When the requirements of a road are not sufficient to justify the economical handling of an individual issue a grouping will be made and the total equipment will be covered by one general trust agreement. Equipment will be rebuilt in a manner satisfactory to the banking syndicate as suitable collateral.

Where conditions warrant freight cars are to be rebuilt with steel center sills or draft arms, friction draft gear, outside metal roofs and other specialties. Locomotives will be superheated or otherwise equipped with fuel saving devices. Parts of the plant of the Midwest Engine Corporation will be devoted to freight car and locomotive repairing. The freight car repairing is expected to start within 60 days. Locomotive repairing will start July 1. H. C. May, formerly superintendent of motive power of the Monon and the Lehigh Valley, has been elected president of the new company. A. J. Canfield, formerly of the Canadian Car & Foundry Company, will be in charge of the car department. Ferdinand Barnickol, president of the Indianapolis Drop Forging Company, has been elected chairman of the board of directors, other directors are A. Rosenthal, H. C. Purdy, L. M. Rappaport and J. Wood.

American Electric Locomotives for Spain

Three of the six 100-ton, 3,000-volt d. c. electric locomotives, comprising part of the $1,500,000 contract for the electrification of 40 miles of the Spanish Northern Railway, were shipped by the International General Electric Company on the S. S. Florinda (Garcia & Diaz, agents) on April 9 from South Brooklyn, N. Y., in the presence of a party of engineers and officials, including the Spanish consul general and his staff.

The electrification for which this equipment is supplied will be carried out by the Sociedad Iberica de Construcciones Electricas of Madrid, Spanish representatives of the International General Electric Company, and is of particular interest because it is the first 3,000-volt direct current road to be installed in Europe. It is known as the Pajares Grande division.

These locomotives are of particular interest, since they are a somewhat novel design, using three axles instead of the usual two-axle trucks. They are of the swivel truck type and each is equipped with six 400 hp. motors, giving a capacity sufficient to handle a full tonnage train up the 2 per cent grades at 22 miles per hour. On the return trip the trains will be held by the regenerative braking.

In addition to the locomotives, the contracts placed with the Spanish company include equipment of two 300 kw. substations and material for overhead distribution for the entire electric zone. Shipment of this latter equipment has already been made and is being installed by the Spanish company.

Italy Plans to Lease Railways to Private Concerns

The Italian government is planning the details of the contracts under which the railways are to be turned over to private concerns, according to Rome dispatches to the New York Times.

The fundamental principles are that private enterprise will take the roads on leases lasting for a number of years, agreeing by contract with the government how much capital must be set aside as a guarantee of the solvency of the companies, or buying reserve material and for general expenses. Private enterprise is to get 7 per cent interest on this capital and to divide everything over 7 per cent with the government in a ratio to be decided upon.

The roads will pass to private enterprise completely. Private companies will not merely administer them for the government, but must assume full responsibility. This leads to the necessity that the roads be ceded for long terms of years, so that private enterprise may have a sufficient period to run them under normal conditions after the inevitable period of transformation and settling down. It will be possible for private enterprise to denounce the contracts if the economic conditions on which they are based prove to be fallacious.

The government will hand over the railroads in their present state. Private enterprise will have to see to upkeep and rolling stock and to return the roads at the end of the contract period in the same condition. There will be full liberty to run the railroads in whatever way private enterprise thinks best, and it will have the right to decide on the number of the personnel to be employed. The government, therefore, breaks its present contract with its employees, but private enterprise must choose nine-tenths of the employees from the present railroad staffs. There will be full liberty in regard to wages to the employees, provided there is a guarantee of wages for five years and of stable employment to all specialized workmen. The approval of the government must be obtained for proposals as to the juridical status of the employees

MEETINGS AND CONVENTIONS

Fuel Association Convention Papers

A well-rounded program of interest to railroad officers and coal operators has been arranged for the annual meeting of the International Railway Fuel Association to be held at the Hotel Winton, Cleveland, Ohio, May 21-24. The following list gives the addresses, papers and reports which have already been definitely arranged. The invocation will be delivered by Rev. John G. Hindley, pastor of the East Cleveland Congregational Church. T. K. Maher, president of the Maher Collieries Company, Cleveland, will deliver the address of welcome, which will be followed by the opening address by Julius Kruttschnitt, chairman of the executive committee of the Southern Pacific. Mr. Kruttschnitt has chosen as his subject Railway Fuel—A Reducible 13 per Cent of Operating Expenses. H. M. Griggs, manager of the Ore & Coal Exchange, Cleveland, will address the convention on Lake Coal Handling, and C. E. Maurer, president of the Glens Run Coal Company, will deliver an address on a subject to be selected later.

The subjects of the individual papers and the authors are as follows: Extension of Locomotive Runs, C. B. Peck, western mechanical editor, Railway Age; Economic Aspects of the Fuel Oil Situation, C. E. Beecher, acting chief petroleum technologist, U. S. Bureau of Mines; Incentives for Promoting Fuel Economy, O. S. Beyer, Jr., consulting engineer; Classification of Coals, Geo. H. Cushing, publisher, Cushing's Survey; The Fuel Saving Aspect of Boiler Water Treatment, C. R. Knowles, superintendent water service, Illinois Central; The Effect of Tonnage Rating and Speed on Fuel Consumption, J. E. Davenport, superintendent fuel and locomotive performance, New York Central; The Other Ten Per Cent, R. S. Twogood, assistant engineer, Southern Pacific; The Superheater—Its Use and Abuse from a Fuel Economy Standpoint, Bard Browne, service engineer, the Superheater Company; Refractories for Oil-Burning Locomotives, J. C. Martin, Jr., vice-president, Ætna Combustion Company; Economy in the Heating of Stations and Buildings, R. W. Noland, professor of heating and ventilating, Purdue University; Value of Individual Performance Record, L. G. Plant, editor Railway Review.

The following standing committees will also present reports: Firing Practice (Chairman S. H. Bray, Southern Pacific); Fuel Accounting, Distribution and Statistics (Chairman B. A. McDowell, Baltimore & Ohio); Fuel Stations (Chairman W. E. Dunham, Chicago & North Western); Front Ends, Grates and Ash Pans (Chairman Prof. E. C. Schmidt, University of Illinois); Boiler Feed Water Heaters (Chairman E. E. Chapman, Atchison, Topeka & Santa Fe). The Committee on Storage Coal, of which the late Prof. H. H. Stoek was chairman, will also present a report.

Papers for Purchases and Stores Meeting

The Purchases and Stores Division of the American Railway Association will hold its fourth annual meeting at Chicago, May 15-17, the headquarters being at the Hotel Sherman. The sessions will be held in the convention hall of the hotel, convening at 9.30 a. m., city time, on Tuesday, May 15. The subjects of the committee reports and papers to be presented are as follows: Stores Department Book of Rules (Chairman W. D. Stokes, Illinois Central); Classification of Material (Chairman W. L. Hunker, Chicago, Rock Island & Pacific); Reclamation and Conservation of Discarded Material and Classification of Scrap (Chairman A. S. McKelligon, Southern Pacific); Material Accounting and Office Appliances (Chairman G. A. Secor, Chicago & Alton); Forest Products (Chairman W. A. Summerhays, Illinois Central); Stores Department Buildings and Facilities for Handling Material (Chairman R. C. Harris, Pennsylvania System); Workable Rules in Connection with the Carrying Out of the Provisions of Section 10 of the Clayton Anti-Trust Act (Chairman E. A. Clifford, Atchison, Topeka & Santa Fe); Supply Train Operation and Line Delivery of Material (Chairman O. Nelson, Union Pacific); Joint Committee on Fuel Conservation (Chairman S. Porcher, Pennsylvania System); Joint Committee on Joint Inspection of Standard Material (Chairman M. J. Collins, Atchison, Topeka & Santa Fe); Unit Piling of Material and Numerical Marking System (Chairman J. L. Sullivan, Union Pacific); Purchasing Agents' Office Records and Office Organization (Chairman C. E. Walsh, Pennsylvania System); Committee on General Accounting (Chairman H. H. Laughton, Southern Railway); Store Delivery of Material to Users at Shops (Chairman H. R. Duncan, Chicago, Burlington & Quincy); Nominating Committee (Chairman F. A. Bushnell, Great Northern); Most Economical Method of Handling Repairs to Typewriters, Calculating Machines and Other Office Appliances, W. W. Griswold, stationer, Chicago, Rock Island & Pacific; Reclamation of Grain Doors, Oliver Maxey, general supervisor claim prevention, Chicago, Rock Island & Pacific; Savings to Be Effected in the Handling of Paints, Oils and Similar Products by the Use of the Metal "One Time" Shipping Container, J. C. Kirk, assistant general storekeeper, Chicago, Rock Island & Pacific; The Railway Stores Catalogue, C. D. Young, general supervisor of stores, Pennsylvania System; The Need of Apprentices in the Storehouse Organization, J. W. Gerber, general storekeeper, Southern Railway.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nelis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, May 1 to 4 inclusive.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting, Orchestra Hall, 220 South Michigan Ave., Chicago, beginning June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923. Annual meeting, Hotel Sherman, Chicago, May 15, 16 and 17, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 30 Church St., New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, Chalfonte-Haddon Hall Hotels Atlantic City, N. J., beginning June 25, 1923.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting May 8. Annual meeting election of officers, Grand smoker and entertainment.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting May 10. Paper on The Modern By-Product Coke Oven and Its Application will be presented by C. Ramsburg, vice-president, Koppers Company, Pittsburgh. Film pictures and lantern slides.

Cheif Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Next meeting May 8. Paper on Automatic Train Control will be presented by W. Gordon Fisher. Luncheon.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next meeting, May 21-24, 1923, Cleveland, Ohio.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Annual convention, Hotel Fuller, Detroit, Mich., May 22 to 25 inclusive, 1923.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting May 8, Copley-Plaza Hotel. Paper on Use of Compressed Air in Track Maintenance and Construction will be presented by W. H. Armstrong, manager sales, Ingersoll-Rand Company. Illustrated by moving pictures.

New York Railway Club.—H. D. Vought, 26 Cortlandt St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hocbgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Annual meeting May 21 at 5:00 p. m. Election of officers and directors.

SUPPLY TRADE NOTES

W. J. Hyman has been appointed a vice-president of the International Equipment Company, Ltd., Montreal, Quebec.

The Chicago Railway Equipment Company has moved its general sales office to 500 Railway Exchange building, Chicago, Ill.

Charles A. Maher, vice-president of the National Car Wheel Company, Cleveland, Ohio, died in a hospital in that city on April 7.

The Indianapolis Steel Products Company will construct a one-story plant, 100 ft. by 200 ft., at Palestine, Ind., to cost approximately $100,000.

The Pullman Company will construct a one-story car shop at Cottage Grove avenue and One Hundred and Third street, Chicago, to cost $40,000.

Clifford F. Messinger for the past three years general sales manager of the Chain Belt Company, Milwaukee, Wis., has been elected second vice-president.

The corporate name of the Fairmont Gas Engine & Railway Motor Car Company has been changed to Fairmont Railway Motors, Inc., Fairmont, Minn.

The General Electric Company will build a five-story building at Third and Antoinette streets, Detroit, to be used for general mechanical and operating service.

The Kirby-Bonner Lumber Company, Houston, Texas, has removed its eastern sales offices from 120 Broadway to room 2612 Grand Central Terminal, New York City.

C. S. Williamson, formerly vice-president of the Meade-Morrison Manufacturing Company, Chicago, died at his home in that city on March 31, from pneumonia.

A. W. Berghoefer has again become associated with the Gifford-Wood Company, Hudson, N. Y., and will be located at the company's New York City office, 50 Church street.

The Standard Railway Equipment Company and the Union Metal Products Company have removed their New York City office from 347 Madison avenue to 247 Park avenue.

W. J. Roehl has been appointed representative in the southwest territory for the Locomotive Lubricator Company, with headquarters in the Railway Exchange building, St. Louis, Mo.

Dr. C. W. Gould, western manager of the Gould Coupler Company, died at his home in Chicago on February 19. He had been connected with the Gould Coupler Company for the past 30 years.

Percy M. Elliott, president of the Camel Company, Chicago, and vice-president of the Ryan Car Company, died at the Henrotin Memorial Hospital, Chicago, on April 18 after a prolonged illness.

E. W. Stone, signal foreman on the Southern Pacific at Oakland, Cal., has been appointed construction engineer of the National Safety Appliance Company, with headquarters at Chicago.

Francis L. Bullard, formerly treasurer of the Hinckley Locomotive Works and later of the Rhode Island Locomotive Works, died on April 2, at his home in Wellesley Hills, Mass., at the age of 87.

E. H. Mattingley has resigned as general car foreman of the Baltimore & Ohio and Baltimore & Ohio Chicago Terminal and is now in the service of the Chicago-Cleveland Car Roofing Company.

F. E. Sheehan, representative at St. Louis, Mo., of the Texas Company, Houston, Texas, has been appointed assistant district manager of the Western district, with headquarters in the Arcade building, St. Louis.

W. H. Marshall, chairman of the board of Consolidated Machine Tool Corporation of America, New York, has been elected president, to fill the vacancy caused by the sudden death of C. K. Lassiter on March 3.

J. E. Johnson, manager of the Pittsburgh, Pa., branch of the Garlock Packing Company, Palmyra, N. Y., has been appointed general sales manager, with headquarters at Palmyra, succeeding John N. Todd, resigned.

W. A. Day has been appointed manager of sales for the territory north of the Ohio river for the Casey-Hedges Company, Chattanooga, Tenn., manufacturers of boilers, with headquarters in the Marquette building, Chicago.

C. B. Flint, formerly sales manager of the railroad department of the Paige & Jones Chemical Company, New York City, has been made first vice-president in charge of the railroad department, with headquarters in New York City.

Carl H. Peterson has been appointed Eastern sales representative of the Standard Stoker Company, with headquarters at 5054 Grand Central Terminal, New York City. He served from 1892 to 1904 as engineering representative at Chicago for the Safety Car Heating & Lighting Company, and with the Pressed Steel Car Company in the engineering and sales departments from 1904 to 1905, at Chicago. From 1905 to 1919, he was with the Baldwin Locomotive Works and Standard Steel Works Company as assistant manager at Chicago, Southwestern representative at St. Louis and Western representative at Chicago. Since 1919 Mr. Peterson has been engaged in consulting work, specializing along sales engineering and production lines.

C. H. Peterson

Fred W. Stubbs has been appointed mechanical engineer of the Standard Stoker Company, with headquarters at Erie, Pa. He was born in Western Pennsylvania and received his technical training at Case School of Applied Science, Cleveland, O. He served as machinist apprentice from 1887 to 1888 on the Union Pacific and then to September, 1891, at the Brooks Locomotive Company, Dunkirk, N. Y. From June, 1896, to November, 1898, he was with various contracting companies in Cleveland as a draftsman and subsequently served as draftsman with the Brooks and the American Locomotive Companies and the New York Air Brake Company. In September, 1904, he went with the Industrial Works, Bay City, Mich., and in May, 1905, went to the Wellman-Seaver-Morgan Company. He later served with the Bartlett & Snow Company and the American Machine Company. In May, 1906, he was appointed leading locomotive man in the mechanical engineer's office of the Lake Shore & Michigan Southern. From April, 1911, to January, 1923, he was mechanical engineer of the Chicago Great Western at Oelwein, Iowa. He also served as a member of the Iowa Board of Examining Engineers, resigning as chairman of the board to go to the Standard Stoker Company.

F. W. Stubbs

Thomas C. deRosset, manager southern sales of the T. H. Symington Company, with headquarters at Baltimore, Md., died suddenly in that city on April 7. Mr. deRosset was born in Wilmington, N. C., on September 7, 1875. He entered the sales department of the T. H. Symington Company, Baltimore, in 1905, and was appointed manager Southern sales in 1910, his services in this capacity extending over a period of 13 years. Mr. deRosset was well known throughout the railway and supply field.

The Charter Gas Engine Company, Sterling, Ill., has bought the entire Mietz oil engine (also known as Mietz and Weiss) business, heretofore carried on in New York City by the August Mietz Corporation and the Reliance Oil Engine Corporation.

The Inland Steel Company is preparing plans for the enlargement of its No. 2 plant at Indiana Harbor, Ind., which will include four additional open hearth furnaces, which will increase the steel making capacity approximately 25 per cent.

Hunter Michaels, advertising manager of the Union Metal Products Company, with headquarters at Chicago, has been appointed sales agent of the Railway Steel Spring Company, with the same headquarters, succeeding D. B. Fulton, resigned.

G. W. Wagner, general purchasing agent of the Detroit United Railway, has entered the employ of the I. M. Jacobson & Sons Company, and has been placed in charge of the steam and electric railway sales division with headquarters at Detroit, Mich.

W. O. Ashe, assistant engineer in the equipment engineering department of the New York Central with headquarters at New York, has been appointed mechanical engineer of the Commonwealth Steel Company, with headquarters at St. Louis, Mo.

A. H. Talbot has opened an office at 237 Railway Exchange building, Chicago, under the firm name A. H. Talbot-Railway Equipment to deal in railway locomotives, cars and rails. A. M. Talbot, formerly secretary and treasurer of J. T. Gardner, Inc., Chicago, will be in charge.

O. L. Chapman and W. H. Chapman, formerly with the Davis Boring Tool Company, St. Louis, have been appointed secretary and treasurer, respectively, of the Firmhill Machine Supply Company, Detroit, Mich., succeeding C. C. Firmin, who is no longer identified with the company.

At a recent meeting of the stockholders of the American Boiler Tube Thimble Company, Providence, R. I., the following officers were elected: President, William J. Greene; vice-president, Thomas P. Himes; treasurer and general manager, J. D. Cameron; secretary, M. E. Murray.

The United States Electrical Tool Company, Cincinnati, Ohio, has recently opened a new district office at 430 North High street, Columbus, Ohio, with E. M. Beeler as manager; also a new district office at 412 First street, National-Soo Line building, Minneapolis, Minn., with Thomas H. Caley as manager.

The Metal & Thermit Corporation, New York City, has appointed C. F. Lederer as general supervisor of rail welding in charge of all technical work in the field. This company will move its Pittsburgh branch into a new shop completely equipped with new facilities and located at 1514 Fayette street, N. S.

The Gibb Instrument Company, Bay City, Mich., manufacturers of electric welding equipment, has opened a sales office in Cleveland, Ohio, at 2104 East Superior avenue in charge of W. O. Little, also one in the General Motors building, Detroit, Mich., in charge of F. M. Luchs, formerly chief engineer for the company.

Howard E. Boardman, for the past seven years engineering assistant to the general valuation counsel of the New York Central lines at New York, resigned on March 31 to become president and treasurer of Foster, Merriam & Co., Meriden, Conn. The latter firm is an old established manufacturer of cabinet hardware.

The William E. Kelly Company, dealer in railway specialties, MacCormick building, Chicago, Ill., has been appointed railroad representative of the Van Dorn Iron Works Co., Cleveland, Ohio, for the western, southwestern and northwestern territory, handling that company's complete line of heavy forgings, steel office furniture and equipment.

The Combustion Engineering Corporation, Ltd., New York, and the Uehling Instrument Company, Paterson, N. J., have recently entered into an agreement whereby Uehling interests in the Dominion of Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with offices in Toronto, Montreal, Winnipeg and Vancouver.

The Equipment Specialties Company, Chicago, has been organized to manufacture and sell railway car specialties. The company will be located at 166 West Jackson boulevard, Chicago. The officers of the company are: L. L. Cohen, president; George A. Hull, vice-president; W. R. Gillies, secretary; and C. Mosier, treasurer. The company will be under the active management of Mr. Hull.

Charles D. Jenks

Charles D. Jenks has resigned as president and a director of the Damascus Brake Beam Company, Cleveland, Ohio, and has been appointed a vice-president of the Chicago-Cleveland Car Roofing Company, with headquarters at Chicago. Mr. Jenks was born in Philadelphia, Pa. He entered railroad service with the Pennsylvania Railroad, with which road he was employed in the freight and operating departments at Philadelphia for nine years. He then resigned to enter the employ of the Atlantic Refining Company, Philadelphia, in the engineering and construction department. In 1900, he became assistant to the vice-president of the Pressed Steel Car Company, with headquarters at Pittsburgh, Pa., and later was promoted to sales agent, with headquarters at Chicago, which position he held until 1910, when he was appointed western sales manager of the Standard Coupler Company, with headquarters at Chicago. From 1912 to January 31, 1918, he was general manager of Edwin S. Woods & Company and from the latter date until February 28, 1923, he was president and a director of the Damascus Brake Beam Company, Cleveland, Ohio. In June, 1922, he was elected vice-president of the Railway Supply Manufacturers' Association.

Robert F. Eissler for the past two years assistant to the vice-president of the Chicago Pneumatic Tool Company, New York, has been appointed district manager at Pittsburgh. Nelson B. Gatch, district manager at New York, has been appointed assistant to vice-president, with headquarters at New York, succeeding Mr. Eissler, and William C. Straub has been appointed district manager at New York, to succeed Mr. Gatch.

The Service Motors, Incorporated, a new Delaware corporation, has taken over the business of the Service Motor Truck Company, Wabash, Ind., and will continue to build service motor trucks and service railroad motor coaches. Paul Moore, Wabash, Ind., is president and general manager of the new company; C. W. Folds, Chicago, vice-president; Charles Guernsey, Wabash, vice-president; G. L. Gillam, Wabash, vice-president, and E. L. Mock, Wabash, secretary-treasurer.

E. M. Speakman, formerly machine shop foreman of the Virginian Railway, and B. O. Yearwood, formerly chief inspector of the U. S. Railroad Administration at the Richmond Works of the American Locomotive Company, are now in the service of the Franklin Railway Supply Company, Inc., New York, as inspectors at builders' plants, and A. M. Meston has been appointed service engineer on the Pacific Coast. Mr. Meston resigned recently as district road foreman of engines of the Southern Pacific.

Edward C. Waldvogel, general manager of the Yale & Towne Manufacturing Company, Stamford, Conn., has been elected a vice-president. His title in the future will be vice-president in charge of sales superseding the former title of general manager. He entered the service of the Yale & Towne Manufacturing Company as a traveling salesman in 1905. In 1910 he was transferred to New York as assistant to the general manager. In 1912 he was appointed assistant general manager and since 1916 served as general manager.

The Curtain Supply Company has just moved into its new quarters at Elkhart, Ind. The location comprises about four acres of land on which a modern, one-story, concrete and steel, fire-proof building occupying an area of approximately 79,000 square feet has been built. The general offices of the company are located at Elkhart, where T. W. Holt, second vice-president and general manager, has his headquarters and the company has an office in Chicago at 355-361 West Ontario street, where Holmes Forsyth, president, and W. W. Willits, first vice-president and treasurer, are located.

Harold Rosendahl of the sales department of the Mahr Manufacturing Company, Minneapolis, Minn., has been promoted to district manager with headquarters at Pittsburgh, Pa. J. O. Connelly has been appointed eastern representative with headquarters at New York succeeding W. H. White resigned and will be assisted by R. G. White. E. F. Piea has been placed in charge of the Philadelphia office. Jacob Ebert has been placed in charge of the Baltimore office. J. L. Scanlon has been placed in charge of the Buffalo office. A. D. Fishel has been placed in charge of the Cleveland office.

Vinton E. Sisson, mechanical engineer and patent engineer of the Union Metal Products Company, with headquarters at Chicago, has been promoted to patent counsel in which position he will be in charge of the patent department. Mr. Sisson has been associated with the Union Metal Products Company for the past 12 years, prior to which time he was employed by the American Car & Foundry Company in the engineering department. He has also been employed in the engineering department of the Pressed Steel Car Company. Mr. Sisson has also patented several designs for steel ends, centering devices and buffer springs.

Ground has been broken for the construction of a new plant unit for the DeVilbiss Manufacturing Company, Toledo, Ohio, makers of the DeVilbiss spray-painting system, which will call for an expenditure of $1,000,000, including equipment. This new unit of fireproof brick and concrete construction with four stories will be 580 ft. long by 80 ft. deep. The structure is the first of two similar buildings to be constructed on the company's 55-acre factory plot to afford more adequate plant room and improved production facilities for the rapid and substantial expansion of the business. The DeVilbis Company expects to occupy the new building within six months.

The American Tool & Manufacturing Works, Chicago, has been organized to design and manufacture special machinery, dies, jigs and fixtures and to manufacture screw machine and punch press products. A. B. Cochrane, formerly district sales manager of the Steel & Tube Company of America, with headquarters at Chicago, is president and Robert Hofstetter, formerly an engineer with the Illinois Tool Works, Chicago, and the Nash Motors Company of Kenosha, Wis., is manager. Mr. Cochrane was employed by the American Sheet & Tin Plate Company in various positions previous to 1909, when he resigned to become assistant traffic manager of the Mark Manufacturing Company, with headquarters at Chicago, and was later promoted to traffic manager. On September 6, 1917, he enlisted in the United States Navy and was made chief petty officer in charge of transportation in the ninth, tenth and eleventh Naval districts. He was discharged from the navy on March 15, 1919, and returned to the Steel & Tube Company of America, formerly the Mark Manufacturing Company, as district sales manager, with headquarters at Chicago. In August, 1922 he resigned and on March 1, 1923, organized the American Tool & Manufacturing Works.

A. B. Cochrane

Major Abram J. Gifford, formerly in charge of the transportation department of the General Electric Company, Schenectady, N. Y., for many years, died on March 20 at his home in Schenectady. He was born at Hudson, N. Y., in 1849. He became connected with the Northeast Thomson-Houston Company at St. Paul in 1891 and in 1894 he was transferred to the transportation department of the General Electric Company at Chicago. In 1899 he was placed in charge of the transportation interests of the company and moved to Schenectady. On March 1, 1920, he gave up his active duties, which were taken over by M. C. Fitzgerald, but he continued in an advisory capacity.

Winslow Blanchard, president of the Blanchard Machine Company, Cambridge, Mass., died at his home in Waban, Mass., on April 7. Mr. Blanchard was born in Dorchester, Mass., September 24, 1865, and was a graduate of the Institute of Technology. In his early professional life he served on the engineering staff of the Boston Heating Company but for more than 20 years he had been associated with the company of which he was the head. He had held all the chief executive offices of the Boston branch of the National Metal Trades Association and at the time of his death was one of three honorary members. He was treasurer of the Associated Industries of Massachusetts and first vice-president of the National Machine Tool Builders' Association.

W. W. Darrow

W. W. Darrow, vice-president of the Camel Company, with headquarters at Chicago, has been promoted to president, succeeding Mr. Elliott. Mr. Darrow was born on August 29, 1882, at Ft. Atkinson, Wis., and in July, 1901, he entered the employ of the Camel Company as a bookkeeper. In 1903 he was promoted to secretary, which position he held until January 1, 1918. On the latter date he was promoted to vice-president. Hugh E. Creer, assistant to the vice-president in charge of sales, with headquarters at Chicago, has been promoted to vice-president. Mr. Creer was born on August 10, 1874, at Hardin, Mo., and entered railroad service in 1898 in the car department of the Missouri Pacific. In 1905, he entered the employ of the Pere Marquette, where he remained until 1910, when he returned to the Missouri Pacific. In 1911, he entered the employ of McCord & Co. as a salesman. In 1916 he entered the employ of the Camel Company in the same capacity, and in May, 1917, he was promoted to assistant to vice-president in charge of sales. A. B. Wegener, secretary, with headquarters at Chicago, has been appointed secretary and treasurer. Mr. Wegener was born at St. Paul, Minn., and entered the employ of the American Bridge Company, with headquarters at Chicago, in 1900 and in 1908 was promoted to credit manager. He entered the employ of the Camel Company as a salesman in 1912, with headquarters at Chicago, and on January 1, 1916, was promoted to general manager of sales. He was promoted to secretary in 1917, which position he has held until his recent appointment.

V. Villette, mechanical expert, Pacific district of the Westinghouse Air Brake Company, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company of the same district, with office at San Francisco, Cal. A. C. Layton, a locomotive engineman on the Los Angeles division of the Southern Pacific, succeeds Mr. Villette as mechanical expert. Raymond Boiselle, mechanical expert, Westinghouse Traction Brake Company, St. Louis, Mo., has been transferred to Wilmerding, Pa., as representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company, Pittsburgh district. F. C. Young, industrial representative, Pittsburgh district, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company for the same district. S. B. Schrontz, chief clerk, Pittsburgh district office, has been appointed industrial representative, Pittsburgh district, assisting Mr. Young, and E. H. Weaver, industrial representative, Pittsburgh district, has been transferred to the Chicago office as inspector for the Westinghouse Air Brake Company.

TRADE PUBLICATIONS

Overhead Carrier System. The Chisholm-Moore Manufacturing Company, Cleveland, Ohio, has issued a new circular featuring its Atlas Carryall overhead carrying system; also a 16-page booklet describing in detail the steps necessary in making Carryall installations.

Grinding Machines.—Various types of hole grinding machines, link grinding machines, plane surface grinding machines, crank-pin grinding machines and abrasive wheels are illustrated and described in a 15-page catalogue recently issued by Beyer, Peacock & Co., Ltd., Gorton, Manchester, England.

Gasoline Rail Cars.—The International Motor Company, New York, has issued a catalog describing Models AC and AB rail motor cars now in service on a number of railroads. A brief description is given also of the new Model AH which is 55 ft. long and contains a baggage compartment in addition to provision for 51 passengers.

Production Tools.—Scully-Jones & Co., Chicago, has issued Catalogue 33 outlining the advantages and adaptability of each of its Wear-Ever production tools, which include chucks, milling cutters, special tool holders, collets, etc. Practical suggestions for improvements in machine shop practice, reference data, charts and tables have also been included in this 40-page booklet.

Pipe Threading Machinery.—The Landis Machine Company, Waynesboro, Pa., has recently issued catalogue No. 24 in which its line of stationary pipe die heads, pipe threading and cutting machines, rotary pipe and nipple threading die heads, pipe and nipple threading machines, automatic die heads and chaser grinders are illustrated and described in detail. The catalogue is carefully prepared and printed, containing 75 six-inch by nine-inch pages.

Internal Combustion Engines.—The Stover Manufacturing & Engine Company, Freeport, Ill., has issued a 24-page booklet describing its line of internal combustion engines. The engines listed range from 1 to 30-hp. capacity and include both the make-and-break type for gasoline and kerosene fuels and the semi-Diesel type for fuel oil. Halftone illustrations are given of the various models and specifications of each type are included with the descriptive matter contained.

Gas Engines.—The Noble Company, Lansing, Mich., has issued a folder illustrating and describing its line of internal combustion engines in various combinations for various kinds of work. Illustrations show various kinds of pumping combinations, both portable and stationary, in which the engine is shown adapted to operating centrifugal and plunger pumps as well as the diaphragm pumps. Illustrated descriptions of the various kinds of hoists are included and some attention is given to the use of air compressor combinations.

Unarco Products.—The United Asbestos & Rubber Company, Chicago, has recently issued catalogue No. G-22, which is a 111-page, cloth bound book containing a complete list of its line of packings, belting; roofings; car insulation; electrical insulation; mechanical rubber goods, including air brake hose, signal hose and injector suction hose, and asbestos and magnesia materials. The various classes of goods, which are well illustrated and described, are listed in five groups under separate section headings and the catalogue contains a complete alphabetical index.

Machine Tools and Cranes.—In a large, well illustrated booklet entitled, Recent Developments in Machine Tools and Cranes for Railroads, Manning, Maxwell & Moore, Inc., New York, describes improvements in some of its more important products used by the railroads. Comparatively dull years since the armistice have been used in changing designs and patterns so that with the improved equipment shopmen can obtain maximum production with minimum physical effort. First position in the booklet is given to the Putnam wheel lathes which are followed by heavy duty car wheel borers, axle lathes, boring mills, slotters and other standard tools handled by the company. Several pages are devoted to shop cranes, steam hammers, wheel presses, punches and shears, flue welders, staybolt threading, radius grinders and other shop machines.

EQUIPMENT AND SHOPS

Locomotive Orders

The Kansas City Southern has ordered 10 2-8-8-2 Mallet type locomotives from the American Locomotive Co.

The Wabash has ordered 30 2-8-2 type locomotives and 20 switching type locomotives from the American Locomotive Company.

The Florida East Coast has ordered 15 4-8-2 type and five 0-6-0 switching locomotives from the American Locomotive Company.

The Carolina, Clinchfield & Ohio has ordered 10 2-8-2 type locomotives and 12 Mallet (2-8-8-2) type locomotives from the American Locomotive Company.

The Lehigh Valley has ordered 40 2-8-2 type locomotives from the American Locomotive Company. This road will place orders shortly for 10 4-6-2 type locomotives for passenger service.

The Pacific Electric has placed an order with the Westinghouse Electric & Manufacturing Co., for two 43-ton electric locomotives and will build in its own shops eight electric locomotives weighing 60 tons.

The Canadian Pacific has placed an order for 29 2-8-2 type (P-2) locomotives, to have a tractive effort of 56,100 lb., with the Montreal Locomotive Works. An order has also been placed for 6 steel snow plows to be built in the railroad company's shops at Angus.

Freight Car Orders

The Fruit Growers Express will build 2,000 refrigerator cars in its own shops.

The Denver & Rio Grande Western will build 100 narrow gage stock cars in its own shops.

The Atlantic Coast Line has ordered 450 gondola cars from the Virginia Bridge & Iron Company.

The Sun Oil Company, Philadelphia, Pa., has ordered 150 tank cars from the Standard Tank Car Company.

The Bertha Coal Company has ordered 300 hopper cars of 55 tons' capacity from the Pressed Steel Car Company.

The United States Fuel Company has ordered 500 hopper cars of 70 tons' capacity from the General American Car Company.

The Southern Pacific has ordered 350 steel ballast cars for 1923 delivery from the Mount Vernon Car Manufacturing Company.

The Duluth, Missabe & Northern has ordered 100 steel box cars of 50 tons' capacity from the American Car & Foundry Company.

The Roxana Petroleum Corporation, St. Louis, Mo., has ordered 359 tank cars of 10,000 gal. capacity from the Standard Tank Car Company.

The New England Oil Refining Company, Boston, Mass., is having 250 tank cars built in the shops of the General American Tank Car Corporation.

The Johnstown Coal & Coke Company, Johnstown, Pa., has ordered 150 hopper cars of 55 tons' capacity from the American Car & Foundry Company.

The Emmons Coal Mining Company, Philadelphia, Pa., has ordered 500 hopper cars of 70 tons' capacity from the American Car & Foundry Company.

The Virginian Railway has ordered from the Pressed Steel Car Company 1,000 120-ton all-steel gondola coal cars and has also ordered from the Standard Steel Car Company 500 all-steel 70-ton hopper cars.

The Erie has ordered 1,000 box cars from the Pressed Steel Car Company; 1,000 box cars and 1,000 gondola cars from the Standard Steel Car Company, and 1,000 gondola cars from the Youngstown Steel Car Company.

The New York Central has ordered 2,000 refrigerators cars for the Michigan Central from the Merchants Dispatch Transportation Company. In the April *Railway Mechanical Engineer* mention was made that 1,500 of these cars were under construction in the shops of the Merchants Dispatch.

The Boston & Maine has ordered 300 flat cars of 55 tons' capacity from the Magor Car Corporation, 200 refrigerator cars of 35 tons' capacity from the Merchants Dispatch Transportation Company and 100 Hart convertible ballast cars of 50 tons' capacity from the American Car & Foundry Company.

The Chesapeake & Ohio, reported in the April *Railway Mechanical Engineer* as having ordered 1,000 70-ton hopper cars from the American Car & Foundry Company and 1,000 from the Standard Steel Car Company, has increased its order 1,000 cars to each company, making a total of 4,000 cars ordered recently.

Freight Car Repairs

The Baltimore & Ohio will rebuild 1,000 coke cars in its own shops.

The Denver & Rio Grande Western is repairing over 1,000 freight cars in its own shops.

The Chesapeake & Ohio has let a contract for repairing 1,500 freight cars at the shops of the Richmond Car Works.

The Norfolk & Western is reported as having placed an order for repairs to 700 hopper cars with the Ralston Steel Car Company.

The Missouri Pacific has ordered repairs to 1,500 box cars from the Springfield Car & Equipment Company and repairs to 600 coal cars from the Mt. Vernon Car Manufacturing Company.

The Seaboard Air Line is inquiring for 25 caboose cars. This company is having repairs made to 1,000 box cars at the shops of the Richmond Car Works. Five hundred box cars are being repaired at Atlanta and some additional cars are being repaired at shops in Tampa.

The Illinois Central will have 1,000 gondola cars and 600 40-ton box cars repaired by the Ryan Car Company and 800 50-ton box cars, and 600 40-ton box cars repaired by the American Car & Foundry Company. Orders have also been placed for repairs to 300 36-ft., 40-ton box cars with the Midwest Engine Company, for repairs to 100 36-ft. steel box cars with the Pullman Company and for repairs to 150 automobile box cars with the Ryan Car Company.

Passenger Car Orders

The Pullman Company is building 100 sleeping cars in its own shops.

The Arms-Yager Railway Car Company has ordered 50 cars for passenger service from the Pullman Company.

The Illinois Central has ordered 6 horse baggage and 8 baggage cars from the Standard Steel Car Company; and 2 cafe lounge cars, 4 parlor cars, and 5 dining cars from the Pullman Company. This company has also ordered 25 60-ft. 6-in. steel suburban coaches from the Pullman Company.

The Louisville & Nashville has ordered 14 baggage cars and 10 70-ft. combination baggage and mail cars from the Pressed Steel Car Company; and 14 70-ft. baggage cars, five 61-ft. coaches, five 61-ft. middle room smoking coaches, two dining cars, and 10 coaches from the American Car & Foundry Company.

The Southern Pacific has ordered five 60-ft. chair cars, five 60-ft. coaches, fifteen 72-ft. coaches, fifteen 70-ft. baggage cars and one 72-ft. 6-in. combination coach and baggage car from the American Car & Foundry Company; sixty 72-ft. interurban coaches and ten 77-ft. dining cars from the Pullman Company; forty 70-ft. combination baggage and postal cars from the Standard Steel Car Company. All the above cars are to be of steel construction and all are for the Southern Pacific Lines except the one 72-ft. 6-in. combination coach and baggage car, which is for the San Diego & Arizona.

Machinery and Tools

The Pennsylvania has ordered equipment for three flue shops from Joseph T. Ryerson & Son, Inc.

The International-Great Northern has ordered one 120-ton wrecking crane from the Industrial Works.

The Louisville & Nashville has ordered one, 20-ton locomotive crane from the Browning Company.

The Norfolk & Western has placed orders for a car wheel borer, an axle lathe, a wheel press, a 36-in. planer; also for a number of other tools.

The Maine Central has placed orders for 2, 5-ft. radial drills, 2 bushing presses, a 36-in. planer; also some other tools, including one 200-ton locomotive hoist for use at Portland, Me., from the Whiting Corporation, and a 40-ton, 50-ft. boom locomotive crane from the Industrial Works.

Shops and Terminals

Pere Marquette.—This company has awarded a contract to the Arnold Company, Chicago, for the construction of a roundhouse at Grand Rapids, Mich.

Elgin, Joliet & Eastern.—This company has awarded a contract to the T. S. Leake Construction Company, Chicago, for the construction of a 20-stall roundhouse at Gary, Ind.

El Paso & Southwestern.—This company has awarded a contract to Anderson Brothers, El Paso, Tex., for the construction of a 10-stall addition to the roundhouse at El Paso.

Baltimore & Ohio.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a water treating plant of 25,000 gal. per hour capacity at Ivorydale, Ohio.

Chesapeake & Ohio.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of an addition to the store house at Huntington, W. Va., to cost approximately $80,000.

Chicago, Rock Island & Pacific.—This company has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for the construction of oil stations, to cost $15,000 each, at El Dorado, Ark., Haskell, Tinsman and Malvern.

Galveston, Harrisburg & San Antonio.—This company has awarded a contract to V. E. Ware, El Paso, Tex., for the construction of a locomotive erecting shop at El Paso. The structure will be 258 ft. long by 84 ft. wide with a height of 60 ft. and will cost $200,000, including cranes, pits, tracks and drainage. It will be of structural steel frame, brick walls, steel sash and concrete floors and equipped with one 200-ton and one 15-ton traveling crane.

Pennsylvania.—This company has awarded a contract to the Hughes-Foulkrod Company, Pittsburgh, for the erection of walls, roof, skylight and sash for its new shops at Juniata. The Wilson & English Construction Company have the contract for foundation and flooring and the McClintic-Marshall Company for the structural steel frame. The building will be 340 ft. by 690 ft. and will be equipped with two 250-ton cranes, four 50-ton cranes and 50 pits. The shop will have a capacity for heavy repairs to 100 locomotives a month.

Lehigh & New England.—This company has adopted plans for modern and adequate facilities for the handling of locomotives and trains in the Panther creek valley between Hauto, Pa., and Tamaqua, Pa., in which are located the anthracite collieries served by it. The plans provide for a new yard and engine terminal to be located near Tamaqua, Schuylkill county, Pa., at an estimated cost of approximately $465,000, and include besides track work a 10-stall roundhouse, an 85-ft. turntable, a 200-ton capacity coaling station, two ash-pits, an oil-house and equipment, a water tank, a car repair shop and a yard office building. A contract has been awarded to the H. Denburger Contracting Company, Bethlehem, Pa., for the grading, concrete masonry, drainage and track laying (including change of creek channel), excavating and the building of the concrete foundation for turntable, excavating and putting in ash-pit foundations, and building concrete abutments on new location of crossings of Panther creek by the railroad's tracks and a private road, at an estimated cost of $126,000.

PERSONAL MENTION

General

G. H. Langton has been appointed mechanical inspector of the Chesapeake & Ohio.

Alfred E. Calkins has been appointed superintendent of rolling stock of the New York Central Lines, Buffalo and East, with headquarters at New York.

C. K Woods, master mechanic of the Pere Marquette, with headquarters at Saginaw, Mich., has been promoted to assistant superintendent of motive power, with headquarters at Detroit.

M. C. M. Hatch, mechanical engineer of the Missouri-Kansas-Texas with headquarters at Parsons, Kansas, has been promoted to assistant to the executive vice-president with headquarters at St. Louis, Mo.

J. W. Senger, master car builder on the New York Central, with headquarters at Collinwood, Ohio, has been promoted to superintendent of rolling stock of the Lines West of Buffalo, with headquarters at Cleveland, Ohio.

J. F. Walker has been promoted to superintendent of the New Orleans division of the Yazoo & Mississippi Valley with headquarters at Vicksburg, Miss. Mr. Walker was born on November 21, 1877, at Paducah, Ky. He entered railway service on January 10, 1898, as a special machinist apprentice in the Paducah shops of the Illinois Central and two years later was promoted to journeyman. He was promoted to roundhouse foreman in January, 1901, and was subsequently promoted to machine shop foreman, in which position he served until September, 1906, when he was promoted to general foreman of the Evansville district, with headquarters at Princeton, Ky. He was transferred to the Paducah shops in May, 1907, and held this position until August, 1909, when he was promoted to master mechanic, with headquarters at East St. Louis, Ill. He was transferred to Paducah in May, 1910, and served in this capacity until the time of his recent promotion to superintendent of the New Orleans division.

J. F. Walker

H. Modaff, superintendent of shops of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been promoted to assistant superintendent of motive power, Lines East of the Missouri river, with headquarters at Chicago.

J. C. Bryan, superintendent of shops of the St. Louis-San Francisco, with headquarters at St. Louis, Mo., has been appointed mechanical assistant to the manager of purchases of the American Short Line Railroad Association, with headquarters at Chicago.

Wm. E. Barnes, whose appointement as superintendent of motive power of the Canadian National with headquarters at Moncton, N. B., was announced in the April *Railway Mechanical Engineer*, was born at Shediac, N. B., on July 24, 1879. He entered railway service in 1899 as a machinist's apprentice at Moncton. Three years later he was promoted to draftsman. For a short time in 1906 he served as a machinist and then again as draftsman. In 1907 he became a fitter and two years later was again transferred to the drafting room. In 1910 he was appointed enginehouse inspector; a year later as acting master mechanic. In 1912 he was promoted to master mechanic. In 1917-1918 he served as general master mechanic on the Lines East of Mont Joli. From that time until his appointment as superintendent of motive power he served as master mechanic at Moncton, N. B., at which point he has been stationed throughout his entire railway service with the single exception above noted.

W. G. Black, whose promotion to superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. was reported in the April *Railway Mechanical Engineer*, entered railway service in February, 1903, as a machinist on the New York, Chicago & St. Louis, at Stony Island (Chicago), Ill. He was promoted to foreman of the machine shop in July of the same year and served in this capacity until February, 1904, when he was promoted to roundhouse foreman at Ft. Wayne, Ind. He held this position until January 1, 1909, when he was promoted to master mechanic, with headquarters at Stony Island, Ill., in which position he was serving at the time of his recent promotion to superintendent of motive power, with headquarters at Cleveland, Ohio.

Master Mechanics and Road Foremen

C. A. Kimmel has been appointed terminal master mechanic of the Union Pacific at Pocatello, Idaho.

H. N. Seely, general foreman, locomotive department of the Illinois Central, with headquarters at Waterloo, Iowa, has been promoted to master mechanic, with headquarters at Centralia, Ill., succeeding C. M. Starke, transferred.

R. A. Reid, assistant master mechanic of the Pere Marquette, with headquarters at Saginaw, has been promoted to master mechanic, with the same headquarters, succeeding Mr. Woods. C. F. Willoughby, mechanical inspector, with headquarters at Detroit, has been promoted to assistant master mechanic, with headquarters at Saginaw, succeeding Mr. Reid.

H. G. Kastlin, master mechanic of the La Crosse division of the Chicago, Burlington & Quincy, with headquarters at Grand Crossing, Wis., has been transferred to the Creston division, with headquarters at Creston, Iowa. C. W. Robertson, master mechanic of the Creston division, with headquarters at Creston, Iowa, has been transferred to the La Crosse division, with headquarters at Grand Crossing, Wis., succeeding Mr. Kastlin.

Tracy C. Baldwin, whose appointment as master mechanic of the New York, Chicago & St. Louis at Stoney Island, Ill., was announced in the April issue of the *Railway Mechanical Engineer*, was born at East Springfield, Pa., on June 15, 1875. He entered the employ of the New York, Chicago & St. Louis in June, 1889, as a messenger and toolroom boy at Conneaut, Ohio. From November, 1892, to April, 1896, he was machinist apprentice; from April, 1896, to January, 1904, machinist and toolmaker, and from January, 1904, to May, 1905, machine shop foreman. From May, 1905, to May, 1910, he was roundhouse foreman at Buffalo, N. Y. In May, 1910, he returned to Conneaut as general machine shop foreman, and from April, 1915, until his promotion as noted above, he was superintendent of shops.

Tracy C. Baldwin

R. H. Flinn, master mechanic of the St. Louis division of the Pennsylvania with headquarters at Terre Haute, Ind., has been transferred to the Indianapolis, Louisville and South Bend divisions with headquarters at Indianapolis, Ind., succeeding T. F. Butler, retired. H. R. Voelker, assistant master mechanic of the Indianapolis division with headquarters at Indianapolis, has been promoted to master mechanic of the St. Louis division with headquarters at Terre Haute, Ind., succeeding Mr. Flinn. T. F. Haynes, assistant engineer of motive power, with headquarters at Columbus, Ohio, has been promoted to assistant master mechanic of the Indianapolis, Louisville and South Bend divisions with headquarters at Indianapolis, succeeding Mr. Voelker.

Car Department

Paul Maddox has been appointed superintendent of the car department of the Chesapeake & Ohio with headquarters at Richmond, Va.

E. H. Meckstroth, car foreman of the Baltimore & Ohio at Cleveland, Ohio, has been appointed general foreman with headquarters at Chicago, succeeding Mr. Mattingley, resigned.

Geo. E. McCoy, whose appointment as superintendent of car equipment of the Atlantic region of the Canadian National with headquarters at Moncton, N. B., was announced in the April *Railway Mechanical Engineer*, was born on January 8, 1886, at Moncton, N. B., and was educated in the public schools of that city. He entered railway service in 1900 as a machinist and draftsman apprentice with the Intercolonial Railway. In 1905 he was promoted to draftsman and served in that capacity until 1914 when he was appointed assistant chief draftsman for the Canadian Government Railways with which the Intercolonial had been merged. Two years later he was promoted to assistant master car builder. On December 20, 1918, he was advanced to master car builder of the Canadian National, Eastern lines, and held that position until the time of his recent appointment as superintendent of car equipment of the Atlantic region.

G. E. McCoy

James Reed has been appointed district master car builder of the New York Central with jurisdiction over the third district and headquarters at Collinwood, Ohio. A. Herbster succeeds Mr. Reed as district general foreman at Collinwood; C. J. Griswold succeeds Mr. Herbster as general foreman at Englewood, Ill.; and R. C. Salyor succeeds Mr. Griswold as general foreman at Elkhart, Ind.

Shop and Enginehouse

George Stroner has been appointed tool supervisor of the Chesapeake & Ohio.

S. M. Carroll has been appointed general master boilermaker of the Chesapeake & Ohio with jurisdiction over the entire system.

O. D. Brizzell and F. B. Harman have been appointed assistant superintendents of shops of the Atchison, Topeka & Santa Fe with headquarters at San Bernardino, Cal.

J. A. Carney, supervisor of fuel economy of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been promoted to superintendent of shops, with headquarters at Aurora, Ill., succeeding Mr. Modaff.

Purchasing and Stores

C. S. Finlayson has been appointed assistant purchasing agent of the Chicago, Milwaukee & St. Paul, with headquarters at Seattle, Wash.

The following appointments in the stores department of the Canadian National have been announced: A. E. Cox, general storekeeper, and D. Robertson, assistant general storekeeper, Western region, Winnipeg; E. J. McVeigh, general storekeeper, and E. D. Toye, assistant general storekeeper, Central region, Toronto; W. E. Logan, general storekeeper, Atlantic region, Moncton, N. B.

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Reporting the Mechanical Meeting

In previous years when the June Mechanical Conventions have been held at Atlantic City, the readers of the *Railway Mechanical Engineer* have had the benefit of getting a prompt and complete report of the meeting as the Railway Age, which is also published by the Simmons-Boardman Publishing Company, has brought out Daily issues which have been sent to subscribers to the *Railway Mechanical Engineer*. This year the Mechanical Convention will not be held, but in its place there will be a brief three-day meeting in Chicago. While there will be no Daily issues of the Railway Age, the *Railway Mechanical Engineer* will give all its readers a full and authentic account of the entire proceedings with complete reports of the addresses, papers, committee reports and discussions at the session. The complete account of the mechanical meeting will appear in the July number of the *Railway Mechanical Engineer*. In addition, there will be the usual variety of articles on locomotives, cars and shops, such as are published in each of the regular monthly issues.

Two Apprentice Competitions

The war, post-war conditions and the shopmen's strike all interfered greatly with the development of modern apprenticeship methods on the railroads. This is unfortunate because even on some of the most progressive roads much still remained to be done in pre-war days in perfecting the recruiting and training systems in the mechanical department. Fortunately many roads now seem to be awakening to the necessity of taking forward steps in these respects. It is significant, for instance, that hardly a week passes by but what one road which is noted for its apprenticeship training methods receives requests for information about these methods and practices and the results which are being obtained through their use. The Mechanical Division of the American Railway Association made a place on its June program for the consideration of shop apprenticeship.

A number of years ago we invited the apprentices themselves to tell us what they thought about apprenticeship—how it helped them and how in their opinion the methods could be changed or modified, or improved better to meet their needs. It is well to check up occasionally and to look at the whole question from the standpoint of the young men who are training to fit themselves for efficient service and larger responsibilities. The results from the above-mentioned competition were most refreshing and constructive.

We wish to announce a similar competition, with first and second prizes of $35 and $25, for the best articles received from regular apprentices now in service, along the lines above suggested. The prizes will be awarded on the basis of the practical value of the observations or suggestions which may be offered.

There are not a few college men who are now serving as apprentices (regular or special) on railroads in various parts of the country. We want to hear from these men, or from undergraduates who spent last summer or will spend the coming summer on the railroads in the mechanical department. A second competition is therefore announced, with first and second prizes of $35 and $25, for the best papers received from college graduates or college students, commenting upon the opportunities which are being offered to them by the railroads, and how the railroads can make the best use of the services of college men. No limit is placed upon the length of the contributions, but generally speaking, they should contain not more than one thousand words. Only contributions will be considered which are received in our office in New York on or before September 1, 1923.

In order to prevent any confusion please make clear in sending in your contribution which competition it is intended for.

Equipment for Engine Terminals

An examination of the machine tools and other equipment provided for many an engine terminal shop—not only at the small outlying points but also at important places where a large number of locomotives are turned each day—would lead one to form the impression that any old machine after having seen a long period of usefulness in some main shop and having been superseded by a modern type machine is considered amply good enough for the miscellaneous jobs that have to be done at a terminal shop. There may be a measure of correctness in this attitude as far as it pertains to the terminal where few locomotives are handled and where excellent shop facilities are available at the other end of the runs. There is, however, one important fact that should not be lost sight of. When the occasion arises in which a repair job involving machine work must be done at a locomotive terminal, the rapidity with which it is performed is often of the greatest importance. Locomotive terminals are built and operated solely in order that locomotives may be cared for, turned and delivered back to the transportation department in good order and as promptly as traffic conditions demand. Delays caused by engine failures on the road or on account of a terminal not having a suitable locomotive available whenever called for may seriously disarrange the movement of trains and be extremely expensive.

The fact that a machine would frequently be idle at a terminal shop while the same machine would be used a large part of the time were it located at a main repair shop does not prove that it would not earn fully as much for the railroad when located at the former point as at the latter. A correct valuation of service rendered involves consideration of interest on investment, attendant labor costs and the possible expenses resulting from delays caused by the length of time taken to do the work. Due to the importance of the time element at terminal shops, there is a tremendous incentive for the equipment of such points with modern tools that can be pushed to the limit when occasion arises. Such tools have the further advantage of enabling a man to do a far more accurate job than is possible with an old, badly worn machine and accuracy is of great importance in keeping locomotives in service without frequent attention from the shop forces. It is not the intention to belittle the need of better equipment for the back shop—for such need is all too apparent—but to point out the large part played by the terminal shop in the general performance of a railroad's activities and to direct attention to the importance of its claims for an adequate share of investments in betterments.

How Is Your Shop Laid Out?

The time required to do a certain job, and consequently the cost of the operation, is affected by a number of factors. When the subject is given consideration, attention is commonly directed first to the machinery provided and the skill or efficiency of the workmen. A large factor, however, although one frequently not given the full attention that it deserves, is the general arrangement of the shop and the layout of the machinery so that the work most frequently performed can be done with as few movements as possible and these in the most direct route to the erecting shop, enginehouse or whatever point the material is destined for. In manufacturing plants where detailed costs are known and form the basis of managerial control, the great importance of shop layout is well recognized and rearrangements of equipment are made when it is seen that by so doing the handling of work will be expedited. Railroad mechanical officers are somewhat prone to think that this may be essential in a strictly manufacturing plant devoted to turning out a limited line of products in large quantities, but does not apply to any great extent to railroad shops. In this connection it is interesting to note the attention given to the subject of layout in planning the shop for building steel freight cars of which a description is given in this issue. Not only were machines so placed that material would move progressively from the storage yard at the end of the building through to the erecting shop, but care was taken to prevent interference between different jobs and in order that there might be a minimum of delay due to waiting for crane service, ample provision was made for auxiliary jib cranes and other handling devices. The principles followed in the arrangement of this shop are general in their application and should serve to direct attention to a problem that is worthy of considerable thought. Take your own shop for example, would it not be possible to reduce trucking, save delays in handling, prevent interference between different jobs, decrease costs and add to capacity by some relatively inexpensive changes in layout?

Advantages of Short Repair Schedules

The possibility, and indeed necessity, of shorter repair schedules is indicated by the fact that many present railroad shops require from 12 to 15 or more days to repair a locomotive, whereas it has been demonstrated that heavy general repairs, including new flues applied, tires turned and general repairs to machinery, can be made in eight working days. True, the physical limitations of existing plants usually present more or less of a blank wall, but other factors than shop size and equipment enter into the problem and sometimes do not rceive proper attention.

The advantages of a short repair schedule are apparent In the first place, decreasing the time locomotives are in the backshop for repairs hastens their return to service in which they can earn revenue. In addition, fewer locomotives will be undergoing repairs at the same time, so that a given traffic can be handled with a smaller total number of locomotives. This means a smaller investment in motive power and also lower maintenance-of-equipment costs. A decrease in the number of locomotives in the shop at the same time will decrease the required shop space, reducing shop overhead expense. The number of repair parts going through the shop at one time will also be reduced, decreasing congestion and confusion in the shop and having a definite tendency to speed up the work and reduce unit costs.

The length of repair periods is dependent largely on the relative proportionate size and equipment of the various shop departments, and it is to be feared that in too many cases insufficient attention was given this matter when many of the present repair shops were designed. Obviously if the machine shop is weak, either through lack of space or machinery, locomotives will be delayed in the shop longer than necessary while waiting for machine parts. The machine shop is usually the limiting factor, although frequently heavy boiler jobs and new cylinder applications determine the minimum number of working days in which a locomotive can be repaired.

The space limitations in present shops are largely fixed by the original construction although in some cases additions can be made to existing plants at relatively small expenditure. By providing additional machine equipment, increasing the shop force, or working two shifts, however, the shop managements are in a position to strengthen weak departments and make sure that locomotives are being repaired in the minimum time consistent with good workmanship. The subject of proper department proportions in railroad shops is one of great importance and deserves close study by those interested.

Reducing Idle Time of Locomotives

On account of the heavy demand for motive power at this time, a great deal of attention is being given to methods for increasing the monthly mileage obtained from locomotives. In addition to lengthening runs, it is probable that many roads would find the practice of turning locomotives without putting them into the house to be helpful in attaining this object, particularly where outside inspection pits are available and where the roundhouse is congested.

It is not unusual to find terminals working at the maximum capacity when the time each locomotive can spend in the house is too short to permit thorough repairs to be made. The engines are placed on the roundhouse pit, inspected, cleaned and cooled down in preparation for repairs. Due to the necessity for keeping down the time spent in the house, the only work done is that which is absolutely necessary. Minor defects are passed by and the locomotives are allowed to run, wasting fuel and water, using too much time on the road and wearing out rapidly.

Back shop repairs to locomotives are always costly and roundhouse work should be done with the object of keeping the locomotive out of the shop as long as possible. Locomotives can be kept in efficient condition up to the limit of wear if repairs are not slighted. Most roads have rules for maintenance which, if observed, would insure efficient motive power, but too often in a mistaken attempt to reduce costs the workmen are not required to live up to the instructions.

The time which locomotives spend in the roundhouses is not only unproductive, it is a source of expense. Nevertheless it is not uncommon to find that on a large proportion of engines more money is spent in turning them than in repairing them while they are in the roundhouse. Inspection pits combined with work pits are very helpful in getting locomotives requiring only minor repairs back into service quickly and allowing the roundhouse forces to keep engines in need of heavier repairs on the pits long enough to do the work in a thorough manner. In view of the advantage to be gained by this practice, it is hard to understand why railroads do not adopt it more extensively.

What Our Readers Think

Excessive Weight of Reciprocating Parts

New York.

To the Editor:

In G. M. Basford's excellent paper entitled "As to the Locomotive—What Next?" presented before the Pacific Railway Club, March 8, 1923,* he says: "What do you think of reciprocating parts of a big freight engine that weigh 2,600 lb.? I call it brutality, not engineering." Mr. Basford, as usual, is right, and furthermore there is absolutely no excuse for the existence of such brutal practice.

As an example of what can be accomplished by skillful designing, even without resorting to the use of alloy steel, we may refer to the Pennsylvania Railroad class E6s, 4-4-2 type locomotive (built in 1914 and since slightly modified), weighing 243,600 lb. in working order, and developing 31,275 lb. tractive force, in which, although the maximum piston load is 89,000 lb., the weight of the reciprocating parts is but 1/240 of the total weight of the engine; 60.3 per cent of the reciprocating weight is balanced; the unbalanced reciprocating weight is but 1/604.5 of the total weight of the locomotive, instead of 1/400 of this weight as recommended by the American Railway Master Mechanics' Association in 1896; and at 70 m.p.h. the "dynamic augment" for any wheel is but 28.7 per cent of the static rail load.

Can any other heavy Atlantic type locomotive in this country measure up to these ratios? If not, is it because the Pennsylvania appreciates more fully than any other American railroad the vital importance of light reciprocating parts and correct counter-balancing? How much longer are a large number of our railroads willing to continue to plead guilty to the indictment of substituting brutality for engineering in the design of the reciprocating parts of their locomotives? Edward L. Coster.

Co-operation, Not Criticism Needed in Development Work

Chicago.

To the Editor:

As one having experience on both sides, I wish to comment on Entropy's essay on co-ordination in your May issue, and quote one paragraph that seems very unfair.

"Again, not a few railroad officers seem to be incapable of placing proper values on any new device brought before them and are not always willing to accept the advice of those most capable of giving a disinterested opinion. Hence we find they are very much impressed by so-called tests and comparisons always, of course, in favor of the device. Such tests are generally found to have been carried out under quite different conditions and so are valueless from an engineering point of view although no doubt useful as 'selling talk.'"

I would like to ask how many of the devices on railroad equipment are of railroad origin? True, practically all of them may be credited to railroad development as the test of service is the only real one in most cases; but, to bring them to trial and use, as a rule the manufacturer must expend time and means for several years before his device, possibly only usable on railroads, receives recognition and financial return.

All this is a hazard of business, of course, but why should the tests and "selling talk" of men just as earnest and deserving in prosecuting a life work as any railroad man be so severely discredited?

It is well known that from a business point of view many railroad practices are difficult to understand. They often buy and repair at peak prices of labor and materials and Entropy is not far wrong in describing some practices in equipment purchasing.

It is a fact, however, that the devices so originated and developed have built up railroad equipment in capacity, economy and efficiency through the co-operation of inventors, manufacturers and builders, with the railroads, and it is not difficult to imagine the status were such co-operation lacking. C. A. Seley.

Expanding Exhaust Nozzle for Locomotives

Dallas, Tex.

To the Editor:

In studying the problem of induced draft for locomotives, the merits of the exhaust nozzle shown in the illustration should receive consideration. As will be seen from Fig. 1, the nozzle follows modern turbine practice and is so constructed that the steam expands in the nozzle and the pressure is converted to velocity. The velocity through this type of nozzle is double that due to pressure alone when exhausting from a straight nozzle. Since the vacuum obtained in the front end is dependent on the velocity of the exhaust jet, it should be possible to obtain the desired draft with a considerable reduction of back pressure on the pistons. If the exhaust passages are joined at an acute angle as shown in Fig. 2, the exhaust from one cylinder will have an ejector action on the exhaust passage leading to the opposite cylinder, tending to still further reduce the back pressure in this cylinder.

If the back pressure was only reduced 5 lb. per sq. in., this would mean a considerable gain in power. As an example, a locomotive with 27-in. cylinders at 1,000 ft. per min. piston speed would show a gain of 173.4 horsepower. The exhausts are much softer with this type of nozzle and there is little danger of tearing holes in the fire when starting heavy trains; cinder losses would also be greatly reduced.

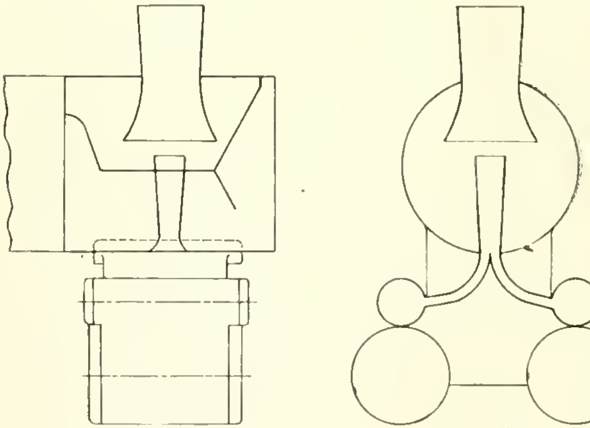

FIG. 1 FIG. 2

Proposed Expanding Exhaust Nozzle for Locomotives

This type of nozzle and the exhaust ejector principle have been applied to some recent unaflow locomotives in Germany and the results have been entirely satisfactory. It is claimed that a vacuum of 7 in. was obtained in the exhaust passages at certain parts of the stroke and a steam economy of 12 per cent was obtained at 45 per cent cut-off, decreasing the zero at 14 per cent cut-off. I believe that better results can be obtained with a counter-flow locomotive owing to the exhausts overlapping to a greater extent than is possible in the German engines.

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*Railway Mechanical Engineer, April, 1923, pp. 212-216.

Of course, to obtain the best results the exhaust passages and nozzle must be designed to give as unrestricted flow as possible to the exhaust steam. However, I believe that a properly designed nozzle of this type applied to existing locomotives will show considerable improvement over the present type.

P. D. Anderson.

New Books

Jigs and Fixtures. *By Albert A. Dowd and Frank W. Curtis. 293 pages, 6 in. by 9 in., illustrated, bound in cloth. Published by the McGraw-Hill Book Company, Inc., New York.*

There are very few railroad shopmen who do not have occasion from time to time to design jigs and fixtures. For all who are called upon to do such work, this book, which is written by men who have had long experience in practical tool engineering, should prove helpful. It furnishes information regarding the principles of design of tooling arrangements which has heretofore not been available in books. In manufacturing plants as well as in railroad shops tools are worked out more or less by using ideas in vogue in the plant where the work is being done and lack of familiarity with the principles which should govern the design or the various methods which can be used to accomplish a given object lead to improper design.

The book opens with a discussion of considerations in the design of parts to permit easy tooling. The features to be considered in the design of jigs and fixtures are taken up in detail and many helpful suggestions are given. The subjects discussed in this volume include jigs and fixtures for drilling and milling machines, vise jaws and vise fixtures, and broaches and broaching fixtures. Various types of jigs in each subdivision are taken up in order, the discussion of the design, details of attachments, such as clamps, indexing fixtures, etc., and the classes of work for which they are best adapted. A large number of illustrations are used throughout the book which are helpful in obtaining a clear understanding of the principles set forth in the text.

Fixtures for Turning, Boring and Grinding. *By Albert A. Dowd and Frank W. Curtis, 340 pages, 6 in. by 9 in., illustrated, bound in cloth. Published by the McGraw-Hill Book Company, Inc., New York.*

This is a companion volume to "Jigs and Fixtures" by the same authors, being a discussion of important factors affecting the design of tools and fixtures for turning, boring and grinding operations. A careful study of the book can hardly fail to accomplish the purpose of the authors in affording a thorough understanding of fundamental points in jig design so that the reader can establish a substantial foundation on which to develop his own ideas. The subject is treated in a clear-cut, concise method, greatly clarified by numerous well-chosen illustrations.

The opening chapter is devoted to a discussion of engine lathe tooling, other chapters of particular interest to railroad shop men relating to turning tools and attachments for turret lathes; also boring, facing and recessing tools. Special fixtures for holding irregular work in vertical lathes and boring mills are described at some length, and methods of laying out and developing tools for machining tapered and curved surfaces are described. The last chapter contains much valuable information regarding fixtures for grinding.

This book is written by two authorities on the subject in question and should prove of much practical assistance to railroad shop men. Railroad shops are greatly in need of more jigs and fixtures for facilitating machine operations and many of the jigs and fixtures now in use need to be redesigned in accordance with correct principles. This book should prove an important aid in giving a correct understanding of these principles.

Railroad Electrification and the Electric Locomotive. *By Arthur J. Manson, Manager Transportation Division—New York, Westinghouse Electric & Manufacturing Company. 332 pages, 6 in. by 9 in. 149 illustrations, 19 tables, bound in cloth. Published by Simmons-Boardman Publishing Company, New York.*

The early electrification projects might be considered as somewhat specialized in character but the success of the first experiments led to further extensions and the present trend of the development of economic as well as the purely mechanical features of railway operation indicates a constant tendency toward an increasing use of electricity as motive power. These facts make the specific information contained in this book, especially valuable to officials and employees of railway mechanical and electrical departments.

In a brief way, the author touches first upon some of the outstanding and most important advantages which may be expected to result from the electrification of existing steam railway facilities, either of an entire system or of certain sections of the line. Four chapters are devoted to explaining the underlying theory of common electrical phenomena, particularly those which relate to the application of electricity to railway operation. Five chapters are then given over to the explanation of the generally accepted types of motors used to supply power for electric locomotives. The principles of train operation are discussed and a comparison of the inherent advantages of electric and of steam locomotives is made.

The book contains an explanation of the various means used for accelerating and decelerating electrically operated trains. There are also included descriptions of the air brake equipment as applied to electrical locomotives and of the methods used for regenerative control. The principal features of electric locomotive design and the design of the transformer equipment are also discussed at considerable length. The last three chapters are devoted to the solution of an actual electrification problem dealing with the factors influencing the choice of an electric locomotive for an installation of a given character. Curves have been extensively utilized for illustrating the operating features and characteristics of motors, locomotives, and train service.

The book also includes an appendix which reviews briefly the history and salient features of various American electrification projects. Included in this section are eleven tables which show at a glance important characteristics and details of construction as applied to electrical operation of railways in every country where steam railways have been electrified, or where the initial installation was electrically operated.

The book does not discuss intricate technical details, but rather furnishes an outline which may serve as a basis for further study of these details. The information is of such nature and is presented in such a way as to be very valuable to those employees who are directly engaged in the maintenance of equipment on railroads which are already electrified or the employees of railroads which may be electrified in the near future.

A New Model of "couchette" sleeping cars for use on trains de luxe will shortly be introduced on the great international routes in Europe. Each carriage weighs 53 tons, and is entirely constructed of metal. The compartments contain only one berth each and are fitted with every modern convenience. A new type of second and third-class sleeping car for use on the French state railways has also been designed and will be run on the Paris-La Rochelle line.

The Cheyenne Erecting and Machine Shop, Looking from the Southeast

A Modern Medium-Size Shop at Cheyenne

Union Pacific Makes 15 Classified Locomotive Repairs a Month in New Plant Employing 570 Men

DURING a period of about three years prior to 1920, the Union Pacific carried out an unusually comprehensive program of engine terminal and shop improvements. A new 40-stall roundhouse was built at Council Bluffs, Ia., a new 35-stall house at Kansas City, Kan., and a new 14-stall house at Ellis, Kan. Fifteen additional stalls were built at Grand Island, Neb.; 28 at Green River, Wyo., and 20 at Junction City, Kan. Coaling stations, varying in storage capacity from 400 to 650 tons, were also included in the new terminal facilities at Council Bluffs, Ia.; Grand Island, Neb.; Kansas City, Kan., and Junction City, Kan. At Sidney, Neb., a new coaling station was the only extensive improvement made. With the coaling station at Council Bluffs is combined the cinder disposal plant, so that the same conveying system which handles the coal also elevates the ashes from the three ash pit tracks to a storage bin over the coal receiving track.

In addition to the facilities for turning and storing locomotives, the program included new machine and erecting shops at Council Bluffs, Ia., Green River, Wyo., Junction City, Kan.; Ellis., Kan., and Evanston, Wyo. The shop buildings at Council Bluffs, Ellis and Green River are each 70 ft. wide by 200 ft. long, with a machine bay 39 ft. wide and an erecting bay with one longitudinal track, 30 ft. wide, which is served with a 20-ton crane. The shops at Junction City, Kan., and Evanson, Wyo., are 108 ft. by 209 ft., and 100 ft. by 150 ft., respectively.

These shops have materially increased the independence of the terminals at which they have been built with respect to caring for heavy running repairs. To provide additional capacity for classified repairs, the program included two projects. The principal back shop at Omaha was increased from two buildings of similar cross section, with a combined length of 711 ft., to a single unit 1,011 ft. long, containing a three-pit erection shop of the longitudinal type, each pit having a length of about 700 ft. At Cheyenne, Wyo., was built a complete new erecting and machine shop. This shop is the transverse type, with 16 pits.

The Cheyenne shops are located at about the center of the road and, with a monthly output of 15 classified repairs, are designed to take care of the general repairs on about 240 locomotives of all classes operating on the west end of the main line. In addition to the back shop work, the machine shop also serves the Cheyenne roundhouse for all running repairs and takes care of the store order work for the two western divisions of the main line. Except for heavy firebox work and the finishing of locomotive cylinders, it is practically independent of the main shops at Omaha. A force of about 570 men is employed in the back shops.

The new shop building at Cheyenne is of steel frame, brick curtain-wall construction. It is 410 ft. long by 195 ft. wide and is divided into three bays. The pits are 23 ft. between centers and the erecting bay is 82 ft. wide. Adjoining this on the east is the heavy machine bay 70 ft. wide, with a light machine bay 40 ft. 7 in. wide along the east side of the building. In a brick lean-to, 31 ft. wide by 207 ft. long, built against the east wall of the main shop building, is located the office of the shop superintendent and general foreman, the toilet room, the fans for the hot air heating system and the locker and lavatory room.

The clear height under the roof trusses of the two west bays are determined by the requirements of crane headway. In the light machine bay the clear height is 20 ft. The heavy machine bay is served by two 20-ton Whiting cranes, operating on tracks 20 ft. 6 in. above the floor and the height under the roof trusses is 36 ft. 8 in. The erecting bay is also served by two 20-ton cranes, operating on tracks at the same height as those in the heavy machine bay, and in addition, is equipped with one Whiting 250-ton crane, the tracks for which are 44 ft. 6 in. above the floor. In this bay the roof trusses clear a height of 56 ft. 8 in. The roof over the erecting bay is of the monitor type with movable sash in the sides. Over the two machine bays the roofs are of the longitudinal saw-tooth type, providing three rows of windows over the heavy bay and two over the light bay, all facing the east.

The building is heated by the hot air system, using two 85-in. Bayley fans, each with a heating plant of five Chinook steam heater units. The hot air is distributed through conduits under the shop floor and delivered into the shop space through sheet metal outlets rising six feet above the floor level.

The fact has already been mentioned that the new building houses only the machine and erecting shops. One of the drawings shows the relation of the new to the old buildings still used to house other departments of the locomotive shops. Extending along the east side of the new building from near its north end is the old machine and erecting shop building, which is now connected with the new building by an annex at the north end. The tank shop utilizes the pits at the north end of the old building and the tin shop occupies the east half of the middle section of this building. The remainder is occupied by the boiler shop with the flue welding equipment laid out along the west side of the building at the south end. The annex between the two buildings is occupied by the air brake department.

In a wing extending out from the east side of the old shop are located the engine room, containing the transformers and switch boards controlling the distribution of electric power, which is purchased, the welding generator sets, and air compressors. Adjoining the engine room are a toilet and a tool room. In the east end of the building is the electrical shop. The blacksmith shop still occupies its old quarters in the easternmost building of the locomotive group.

The power plant contains eight 256-hp. and two 236 hp. Sterling boilers with La Clede chain grate stokers. The power plant is provided with Link Belt coal and ash handling equipment.

The new shop is provided with both alternating and direct current circuits. The alternating current power circuits are three-phase, 60 cycles at 440 volts. The direct current circuits, supplying the cranes and some of the heavy tools, are 230 volts. The shop lighting is taken from 220 volt, three-wire, alternating current circuits, using 115 volt lamps in the new shop and 230 volt lamps in the old shop.

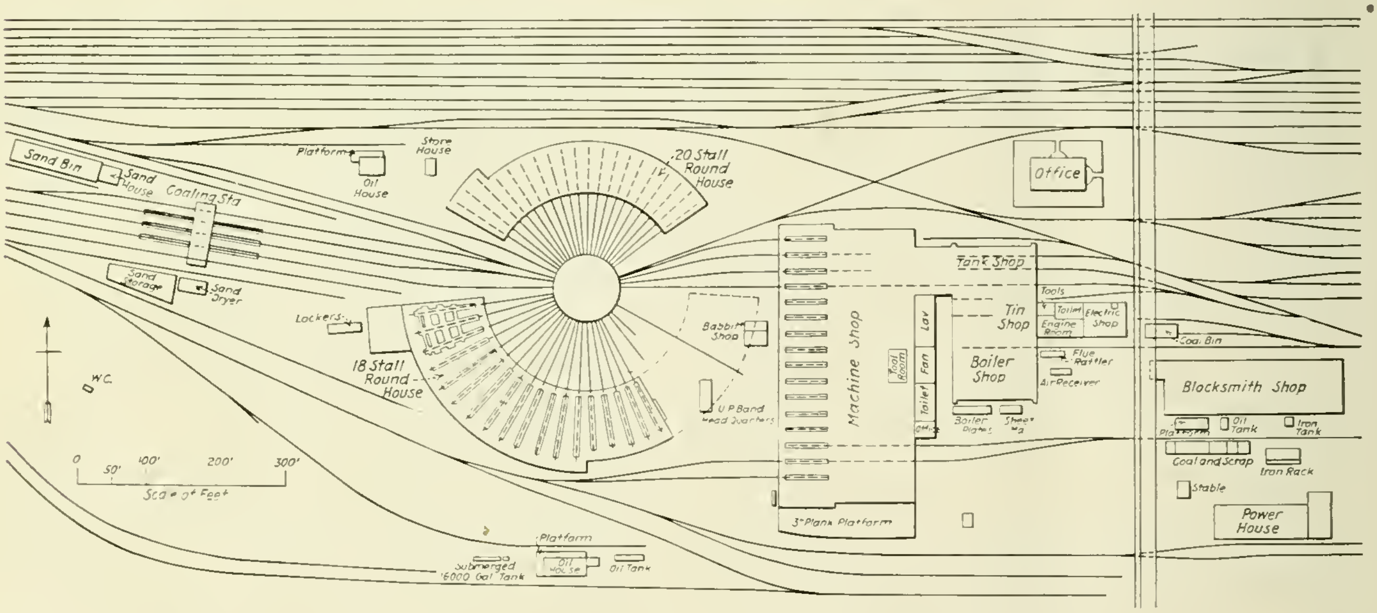
The welding equipment is located in the engine room adjoining the old shop building. It consists of two sets, each made up of a Westinghouse type CS 94-hp. induction motor, directly connected to a type KS 60-kw., 60-volt, 1,000 amp., d. c. generator. The two sets are used to relieve each other. The welding circuits for the machine shop terminate in four control boards located at columns between the erecting and heavy machine bay, each serving an additional outlet, thus giving eight points from which welding leads may be run. An additional control board is located in a room complete enclosed at the end of the shop in which all electric welding on portable work is performed in order to avoid the necessity of setting up temporary protection at each job.

The shop is also piped with acetylene and oxygen, the acetylene gas being supplied from a generator station in an outside building. Water, steam and gas connections are provided at alternate columns on both sides of the erecting bay with the locations on the two sides staggered. Air connections and two outlets for light cords are provided at each column on both sides of the bay and power outlets are located at alternate columns on the inside only.

The Erecting Shop

The erecting shop includes 16 transverse pits, which are operated without a transfer table. The pits are numbered consecutively from the north towards the south. The first four pits are fitted with doors and are connected directly to the turntable of the roundhouse, which adjoins the new shop building on the west. Only two of these tracks are regularly used, however. The second and third pits are kept open for stripping and finishing operations, and are not regularly occupied by locomotives undergoing repairs. A locomotive entering the shop on one of these tracks is stripped and then moved to its assigned pit with the 250-ton crane. The tracks from these pits extend across the heavy machine bay. The driving box work is done at this end of the shop and on these tracks the finished wheels are assembled and the boxes fitted. A track from the fourth pit extends completely across the new shop and through the annex into the north end of the old locomotive shop. One of the principal uses for this track is the transportation of flues to and from the boiler shop. Neither this nor the two through tracks near the south end of the shop are regularly used for locomotive movements.

The erecting shop force is organized into four specialized gangs, each in charge of a foreman. The stripping gang



Arrangement of Locomotive Shops and Roundhouse at Cheyenne removes all rods and motion work, the superheater units, air pumps, steam pipes, air drums and the cylinders and frames, where necessary. The gang is composed of about 20 men and the only mechanics included are an electric welder and a cutter. This gang cleans and distributes all parts to the points where repairs are to be made. The foreman then reports the new material needed to the general foreman, who, after receiving a similar report from the boiler foreman, furnishes the information to the store department. The frame gang does all work pertaining to the frames and their attachments, and applies the cylinders and guide yokes. This gang lays out and applies the shoes and wedges, takes care of the spring rigging, wheels the engine, leaving it in tram with the binders up, and puts up the brake rigging. The intermediate gang applies the steam pipes, superheater units, air pumps, main reservoirs and the front end and stack. It takes care of the dome work, including the throttle rigging. It also rebuilds and applies the engine trucks and trailers and looks after all boiler studs. The finishing gang bores out or applies valve chamber and cylinder bushings, grinds in cylinder heads, lines up the guides, applies the pistons and crossheads and sets the valves. It erects all motion work and applies the reversing gear and all cab fittings. The rod and link gang puts up its own side rods, but aside from this it does no erecting shop work. Requiring this gang to put up the rods has been found to lead to a keener sense of responsibility for corrections of tram than exists where this work is left to one of the regular floor gangs.

Machine Shop

The machine shop organization is roughly divided into a light and heavy machine department with a foreman in charge of each. The light machine department includes the tool room. In addition to these two general gangs, the rod and link gang occupies the south end of both machine bays and the driving wheel work at the south end of the erecting bay, and the driving box repairs at the north end of the heavy machine bay are also separately supervised.

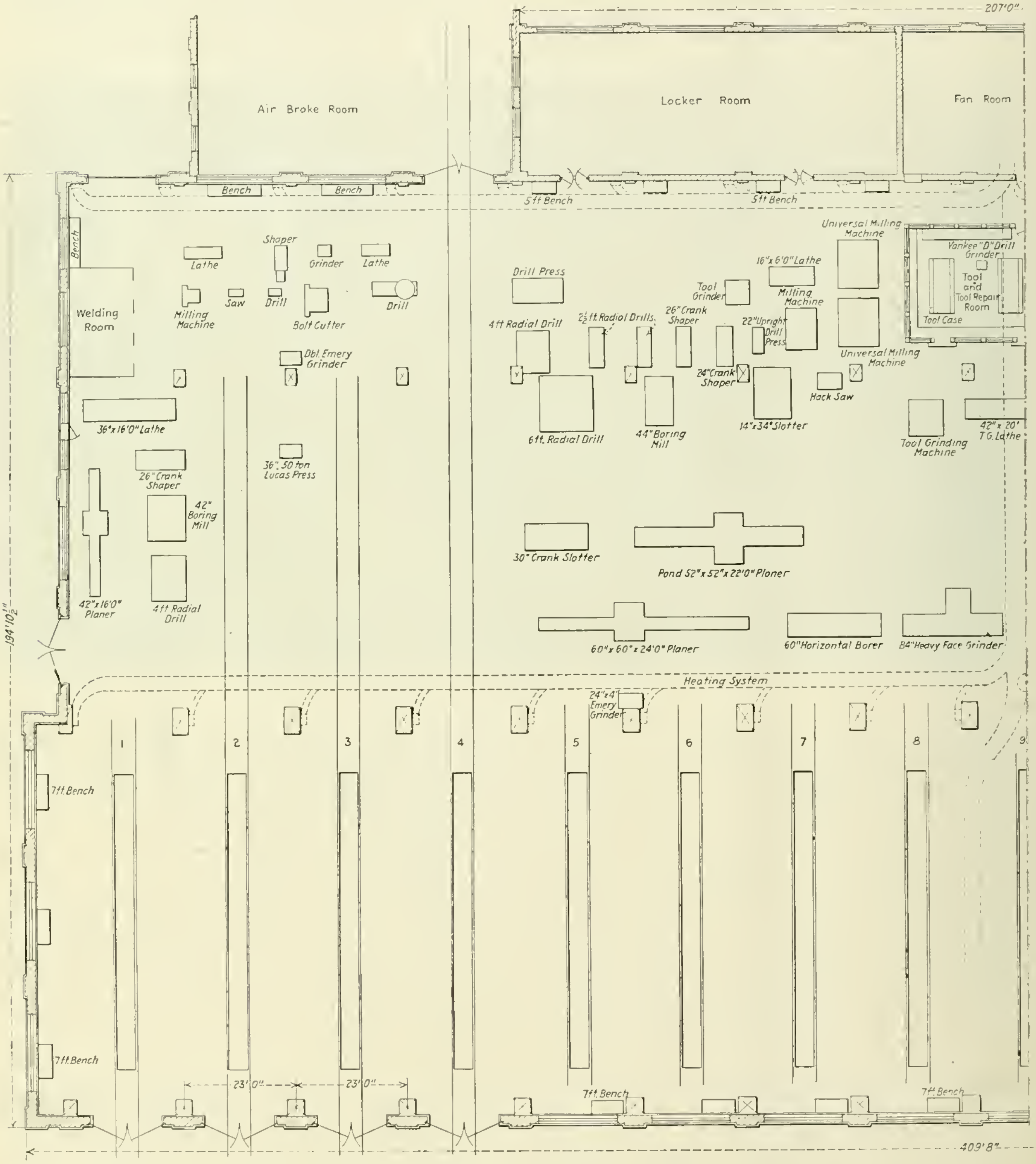
The general arrangement of the machine tools is shown on one of the drawings. The light machines are divided into two groups by the tool room, which is located in the light machine bay near the center of the shop. South of the tool room is a group of small engine and turret lathes, including two Jones & Lamson semi-automatic flat turret lathes. North of the tool room are two Brown & Sharpe universal millers, a 16 in. by 6 ft. engine lathe and a No. 13 Brown & Sharpe grinder, all employed in the manufacture of tools. The remainder of the tools in this group are made up of shapers and drill presses and an old horizontal milling machine. The latter machine has been fitted with a special boring bar and is utilized in boring out the babbit lined bearings in engine truck and trailer brasses. The group of tools at the north end of the light machine bay is used principally by the shop repair gang.

General View of the Heavy Machine Bay

The smaller planers are grouped in a battery at the south end of the heavy machine shop. Adjoining the planers is a group of tools largely employed on pistons and crank pins. In addition to four engine lathes, this group includes a Gisholt 24-in. turret lathe which is employed in roughing out and threading crank pins on store orders. A Niles horizontal double-head key seat drill is used for milling crosshead and piston rod key ways. Piston rods are finished by grinding on a Norton 18-in. by 96-in. plain grinding machine.

North of this group are located the heavy planers, a heavy slotter for driving box work, the guide grinder and a 60-in. horizontal boring mill. The largest of the planers is a new Niles 60-in. by 60-in. by 24-in. machine. The slotter, which was also installed new in the new shop, is a 30-in. Niles tool. The character of the work handled on this machine is shown on one of the illustrations.

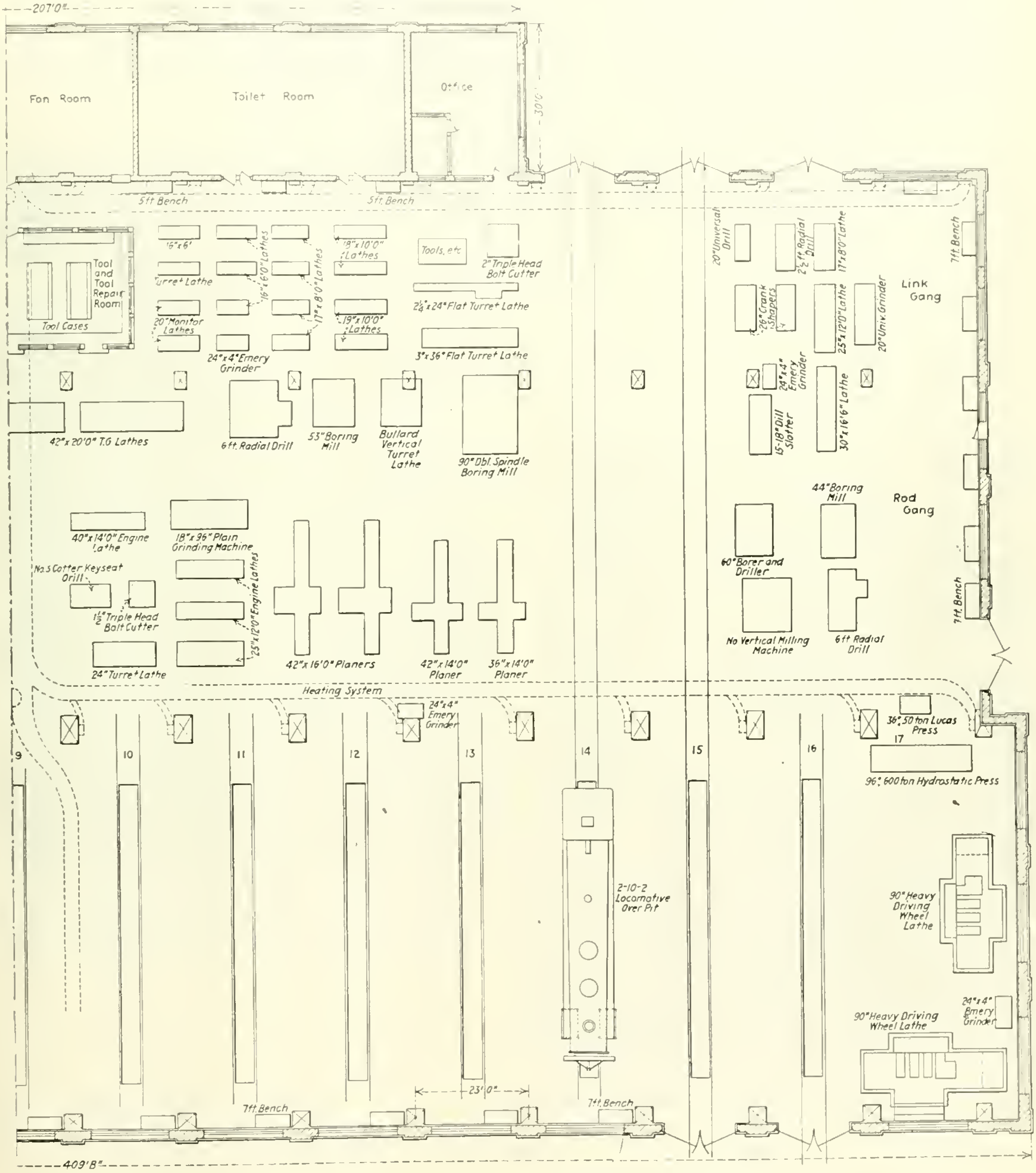
The horizontal boring mill is used principally in milling to size the port openings in valve cages. The method of performing this operation is shown in one of the photographs. A rose end cutter, the diameter of which is equal to the finished size of the port openings, is inserted in the end of the boring bar and the bushing is set up on the table of the machine. The cutter, adjusted to the proper height, is then fed successively into the ends of port opening sections and the cuts finished by rotating the table. By this method a port can be finished complete in from 13 to 20 minutes, the time depending more on the capacity of the cutter than on the operation of the machine itself.



Layout of the Cheyenne Machine and Erecting Shops—North End

On the east side of the heavy machine shop are located the boring mills, heavy lathes and heavy radial drills. Among the new tools in this group is a Niles 53-in. by 20-ft. lathe, a 6-ft. semi-universal radial drill and a Niles 44-in., double head boring mill.

The majority of the tools in the rod and link department are new. These include two 26-in. Stockbridge crank shapers; one 17-in. and one 25-in. LeBlond engine lathe, the smaller of which is portable; one 30-in. Morris radial drill; one Niles 6-ft. full universal radial drill; an 18-in. slotter; a Niles 44-in. double-head boring mill and a Niles, No. 10 vertical milling machine. The latter machine, shown in one of the photographs, is used in finishing the contour of rod ends, slab milling rods of rectangular sections and milling side rod jaws. The old Niles drill press, shown in another illustration, has been fitted with special boring cutters for finishing to size the inside of rod bushings and knuckle pin fits in side rod jaws. The set-up for boring out a back end main rod brass, clamped in place in the strap, is shown in the illustration. In addition to the rod and motion work for the back shop, this department handles a considerable volume of work for the Cheyenne roundhouse as well as on store orders.



Layout of the Cheyenne Machine and Erecting Shops—South End

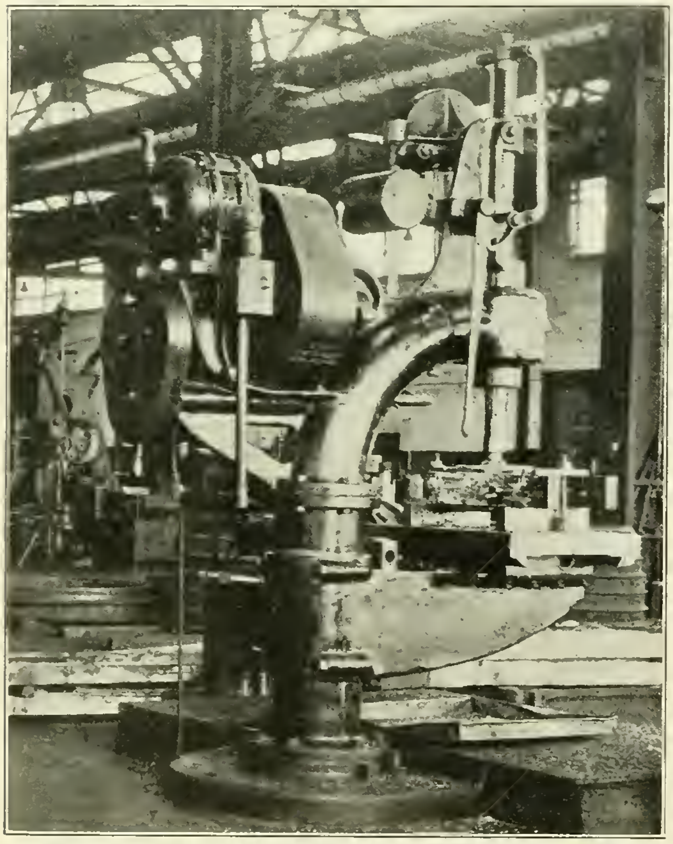
With the exception of one group of two old machines, neither of which is regularly used, every machine tool in the new shop is direct motor driven. Both alternating and direct motors are used. All of the planers, part of the shapers, the small lathes, grinders, bolt machines, boring mills and power presses are fitted with constant speed A. C. motors. Most of the heavy machines, including the large engine lathes and some of the shapers are driven by direct current motors. Variable speed, alternating current motors are used on the new Niles 90-in. wheel lathe and the new vertical milling machine. The wheel lathe is fitted with push button control with a contactor panel for regulating the speed. The vertical milling machine is equipped with a controller and resistance.

Flue Shop

The boiler shop occupies the southern portion of the western half of the old locomotive shop building, adjoining the tank shop and both the tank and boiler shop are served by a crane which travels throughout the length of the building on the west side. Since the principal shops of the Union Pacific at Omaha are equipped to take care of the heavy firebox work for the system, no provision for this class of work has been made in the Cheyenne boiler shop, and the most interesting feature of this department is the flue shop.

Referring to the general layout of the locomotive shops, it will be seen that a track enters the east side of the old shop building toward the south end, and that the flue rattler is located adjacent to this track just outside the building. This track adjoins the north end of the flue shop, which extends south to the end of the building, along the west side.

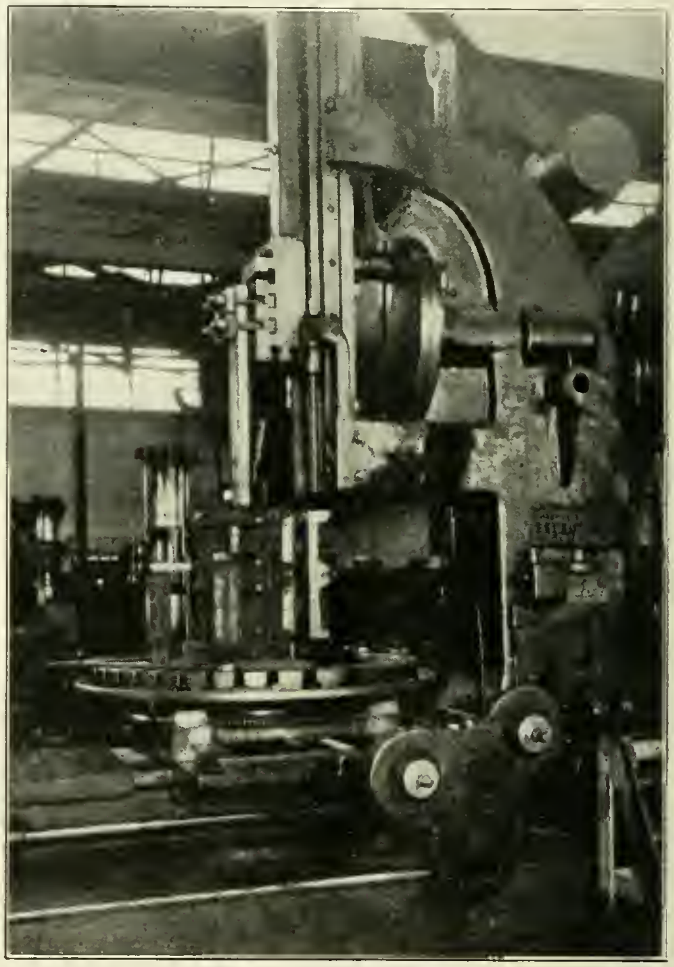
Tubes removed in the erecting shop are loaded in cradles of the usual form, which are handled by crane to the through track from pit No. 4 of the erecting shop. Here they are placed on a shop lorrie which is pushed through to the boiler shop where the sling is again moved by crane to the flue shop track, to be moved again by lorrie to the rattler. From the rattler the tubes are again loaded in a cradle and moved back under the crane in the flue shop where they are moved to the south end of the shop by the crane. They then progress northward with no conflicting movement, until they are completed ready for movement by crane to the through track near the north end of the building, on which they are returned to the erecting shop.



Old 60-in. Boring and Drilling Machine Used for Finishing Rod Bearings and Knuckle Pin Fits. Tools Are of the Milling Cutter and Reamer Types

At the south end of the shop are located the superheater flue welding facilities. These are of the usual type employing the Draper pneumatic welder. The equipment for safe ending the smaller tubes, which adjoins the flue equipment, in order of its location, consists of a combined tube cutter, reamer and grinder, a Federal electric safe end welder and an O'Neil roller. For swaging the back tube sheet ends, a Ferguson furnace and Draper pneumatic swaging hammer are provided. At the north end of the group is located the hydraulic tester.

The combined cutter, reamer and grinder is an effective shop-made device. It consists essentially of three spindles, two of which are driven from the same belt and the other separately driven from the motor shaft to provide for the relatively lower speed required by the reamer. The cutter is of the ordinary roller type fed down by a hand screw. The tube, after the end has been cut off, is passed through a pneumatically operated clamp in front of the reamer spindle. By pressing a foot lever, air is admitted to the clamp cylinder and the pipe fed against the cutter, which finishes the inside of the tube ready for the application of the safe end. If the condition of the tube so requires, it is then entered in the grinding head, the loose emery blocks in which are closed against the tube by a foot lever operated clutch. The tube and safe end are then clamped in the pneumatically operated copper electrode jaws of the electric welder and forced together by a hand lever. From 45 seconds to one minute is required for complete fusion and the weld is finished in the roller.



Driving Box Crowns Are Finished on a Niles 30-in. Crank Slotter

Along the side of the shop just back of the electric welder is an old turret lathe which has been fitted up for cutting safe ends. The tube, which is fed through the spindle of the machine, is cut off by a tool on the cross slide, the contour of which provides the required external taper on the end of the safe end. A tool on the turret is then set forward into the end of the tube to remove the wire edge produced by the cut-off tool.

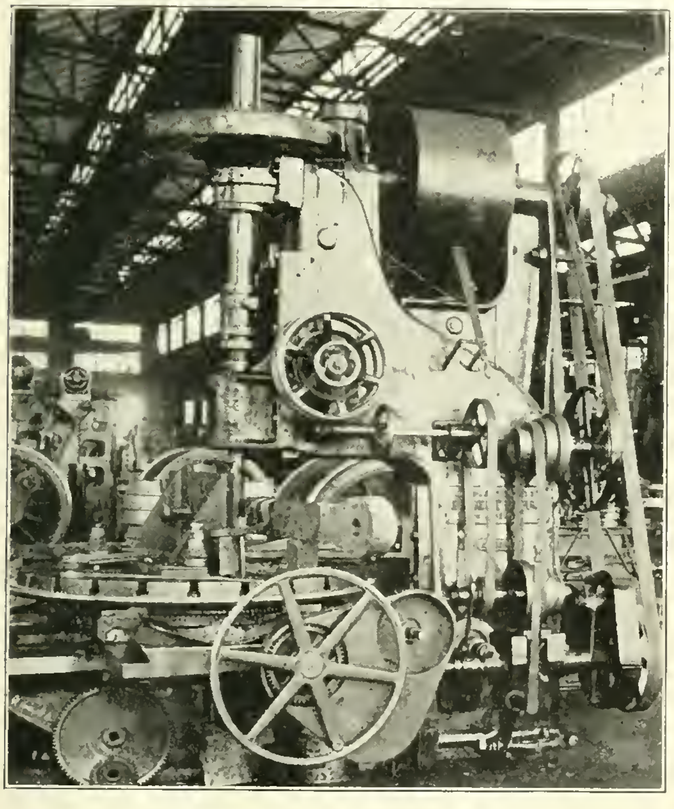
Not including the operation of the swaging hammer, the continuous operation of the plant, including the preparation of the tubes and safe ends, the safe ending and the testing requires six men.

Crane Signal System

Few shops ever have enough crane service. Whatever facilities may be provided, there are usually times when the demand for service is so heavy that more or less delay occurs, even though at other times the cranes may be idle. This condition has been encountered in the Cheyenne shop even though there are two cranes over the heavy machine bay and three over the erecting bay.

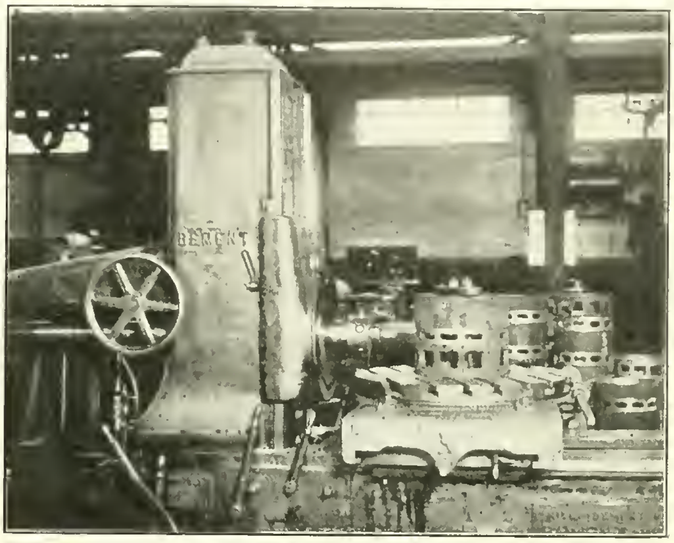
This led to a careful study of the service required at various parts of the shop in order that a means of more effectively utilizing the crane time might be worked out. As a result, what might be termed the center of density of the area served by each crane was determined and this point established as the station for that crane when not on call. This has eliminated a considerable amount of waste crane movement and materially speeded up the answering of calls.

To further systematize the crane service and avoid the confusion and loss of time of shouted calls or trips from various parts of the shops to personally advise a craneman that a job is waiting for him, a system of crane signals has been installed. These signals consist of red lights, one for each pit in the erecting shop and at approximately similar locations in the heavy machine shop. In the erecting shop the lights are located on the outside wall at the height of the crane operator's cage and are controlled by two three-way switches. When crane service is desired at a certain location in the shop, the light for that pit is turned on at the lower switch, which is accessible from the floor. When the crane operator responds to the call, he turns out the light at the switch accessible from his cage. This relieves the mechanic on the floor of further responsibility with respect to the signal after the crane has answered the call.



Niles No. 10 Vertical Miller Finishes the New Side Rods and Stubs

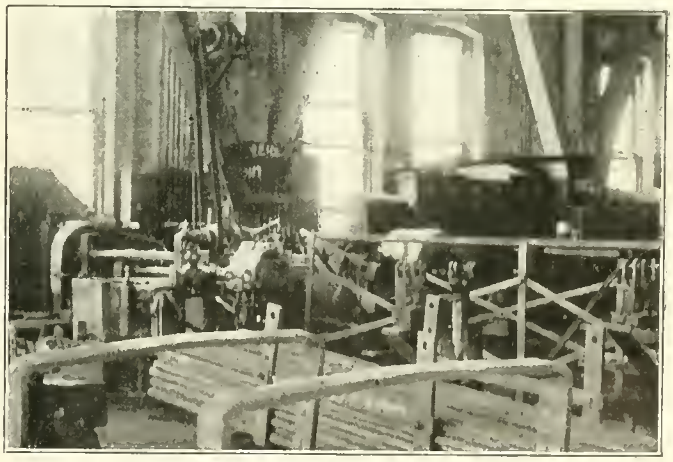
In the machine bay the signal lights have been placed at the top of the heavier machines, rather than at the higher location adopted in the erecting bay. This arrangement requires that the man who calls the crane must not fail to turn off the light as soon as he has been served. As the lights are within the range of vision of a man on the floor, however, this has not entailed any serious difficulty. In both cases the use of the lights has enabled the crane operator to keep clearly in mind the order in which calls are made and in case of two or more at the same time the foreman has an opportunity, if he so desires, to determine the priority of the service.



Horizontal Boring Mill Does a Quick Job of Finishing Bushing Parts

The "Red Cap" System

A simple and practicable system of communication between the various departments of the shops and the stores department, to facilitate prompt delivery of material, has been developed at the Cheyenne shops. This embraces not only the locomotive shop but also the roundhouse, the car shops and the freight car repair tracks. Small sheet metal pockets have been provided at 34 stations, in which the foremen can deposit their orders for material. These pockets are all painted red and numbered serially from 1 to 34, inclusive. A number of messengers assigned to this service, make the rounds of these stations once every half-hour, carrying the material slips collected from the pockets to the store house. In making out a material order the foreman notes on it the num-

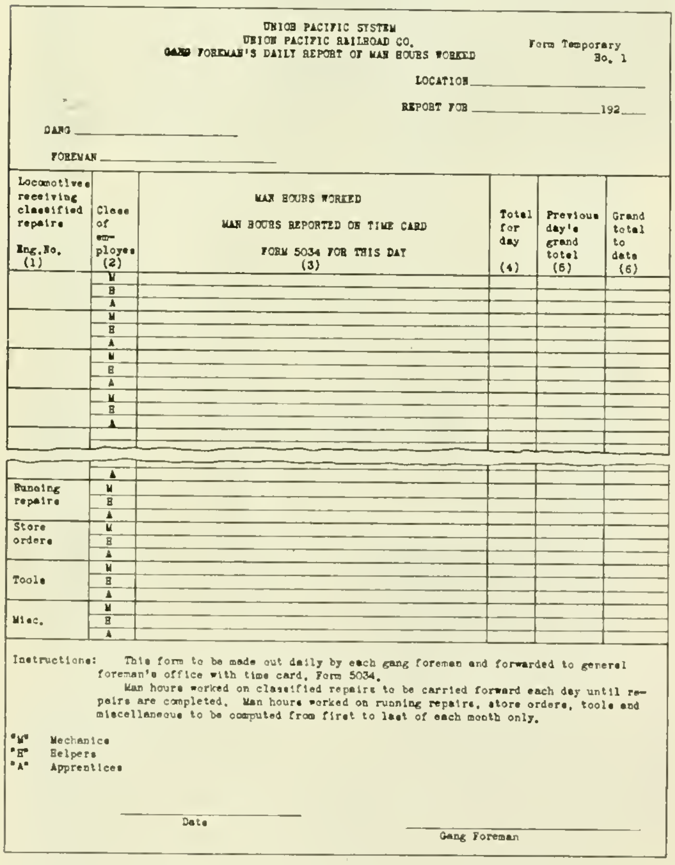


The Flue Cutter, Electric Welder and Roller With Safe End Machine at the Rear ber of the station at which he desires to have the material delivered. The orders are then sorted and filled, and the material called for and each is delivered by the store department to the designated station.

There are six stations in the new locomotive shop, three in the old shop, one in the electrical shop, two in the blacksmith shop and nine in the roundhouse. The remainder are located at various points in the car shops and on the repair tracks. This service is locally designated as the "red-cap" system because the plan ultimately contemplates providing the messengers with red caps in order that they may be readily accessible to the foremen as they make their rounds.

Man-Hour System for Determining Shop Efficiency

A simple man-hour system has been developed for comparing the overall efficiency of the locomotive shops, one period with another. Three forms are required for compiling the man-hours expended on each locomotive, running repairs, store orders or tools, and recording the results by locomotive classes. Form No. 1 is filled out at the close of each day's work by each gang foreman. On the three lines opposite the number of each engine in the shop at the time, he notes the time worked by each mechanic, helper or apprentice, as the case may be, and enters the sums of these amounts in the column headed "Total for Day." In an adjoining column headed "Previous Day's Grand Total," is contained the total man-hours already accumulated on the locomotive up to the current day. The sum of these two columns is entered in a third column entitled "Grand Total to Date," and before turning in the form the foreman enters this figure in the "Previous Day's Grand Total" column on his next day's form. The totals for locomotives receiving classified repairs are carried forward until the locomotive is turned out of the shop, irrespective of monthly periods. The totals expended on store orders, running repairs, tools and miscellaneous are accumulated by monthly periods only.



UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD CO.
GANG FOREMAN'S DAILY REPORT OF MAN HOURS WORKED

Form Temporary
No. 1

LOCATION ______________

REPORT FOR ______________ 192__

GANG ______________

FOREMAN ______________

Locomotives receiving classified repairs Eng. No. (1)	Class of employes (2)	MAN HOURS WORKED MAN HOURS REPORTED ON TIME CARD FORM 5034 FOR THIS DAY (3)	Total for day (4)	Previous day's grand total (5)	Grand total to date (6)
	M				
	H				
	A				
	M				
	H				
	A				
	M				
	H				
	A				
	M				
	H				
	A				
	A				
Running repairs	M				
	H				
	A				
Store orders	M				
	H				
	A				
Tools	M				
	H				
	A				
Misc.	M				
	H				
	A				

Instructions: This form to be made out daily by each gang foreman and forwarded to general foreman's office with time card, Form 5034.

Man hours worked on classified repairs to be carried forward each day until repairs are completed. Man hours worked on running repairs, store orders, tools and miscellaneous to be computed from first to last of each month only.

"M" Mechanics
"H" Helpers
"A" Apprentices

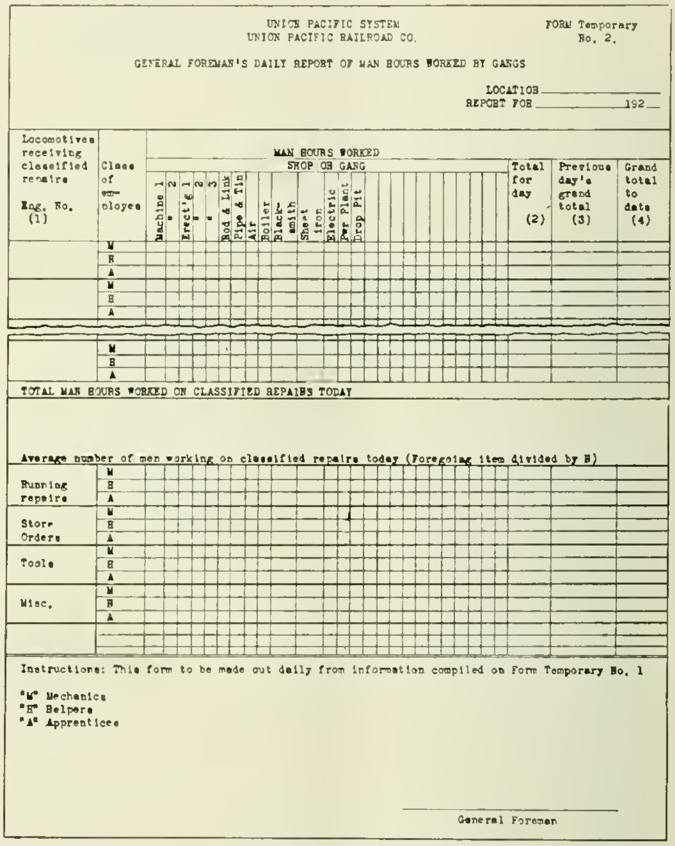
Date ______________

Gang Foreman ______________

Gang Foreman's Daily Man-Hour Report

It has been found that by having the foreman fill out these forms instead of having it done in the office, the foreman is enabled to keep a better check on just what each one of his men is doing, as well as on the accuracy with which they are filling out their time-cards. It also affords the foreman a constant reminder of the total number of hours worked by his men on each engine. This is of assistance in keeping his work on schedule as well as in maintaining a satisfactory relationship between the total number of man-hours that have been worked and the actual amount of work that has been accomplished.

The second form is compiled in the office from the reports turned in by the foremen, a column being provided for each gang in the shop. In the columns headed "Total for Day," "Previous Day's Grand Total," and "Grand Total to Date," show the totals for the entire locomotive department for the periods designated.



UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD CO.

FORM Temporary
No. 2.

GENERAL FOREMAN'S DAILY REPORT OF MAN HOURS WORKED BY GANGS

LOCATION ______________
REPORT FOR ______________ 192__

Locomotives receiving classified repairs Eng. No. (1)	Class of employes	MAN HOURS WORKED SHOP OR GANG: Machine 1	" 2	Erect'g 1	" 2	" 3	Rod & Link	Pipe & Tin	Air	Boiler	Blacksmith	Sheet iron	Electric	Pwr Plant	Drop Pit	Total for day (2)	Previous day's grand total (3)	Grand total to date (4)
	M																	
	H																	
	A																	
	M																	
	H																	
	A																	
	M																	
	H																	
	A																	
TOTAL MAN HOURS WORKED ON CLASSIFIED REPAIRS TODAY																		
Average number of men working on classified repairs today (Foregoing item divided by 8)																		
Running repairs	M																	
	H																	
	A																	
Store Orders	M																	
	H																	
	A																	
Tools	M																	
	H																	
	A																	
Misc.	M																	
	H																	
	A																	

Instructions: This form to be made out daily from information compiled on Form Temporary No. 1

"M" Mechanics
"H" Helpers
"A" Apprentices

General Foreman ______________

General Foreman's Daily Man-Hour Report

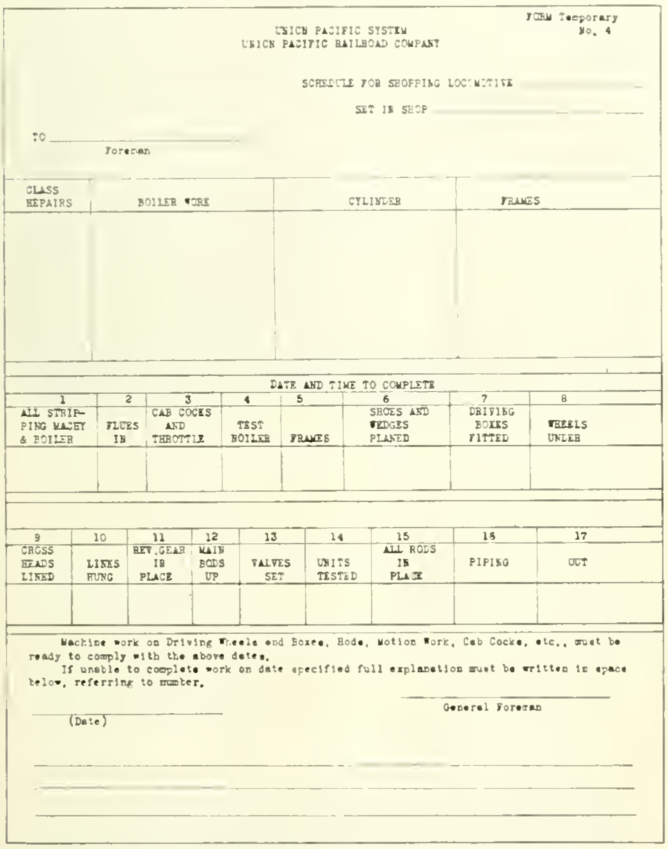
After the repairs on a locomotive are completed, the final total, taken from the second sheet for the day that the locomotive is turned out of the shop, are posted to a large sheet, one of which is provided for each class of locomotives. In addition to the total classified man-hours for each gang and the grand total, this sheet shows the dates in and out of the shop, the number of working days during the period and a notation of any unusual repairs which may have been included. It gives the shop superintendent in permanent form a detailed comparison of shop efficiency for various periods by comparing locomotives of identical construction with each other.

For overall comparison of one month or one year with another, the total man-hours expended on classified repairs may be compiled and checked against the aggregate tractive effort which is probably the most accurate unit available that eliminates all variations in the size and capacity of the locomotives that may have been turned out of the shop during the periods under comparison.

Shop Scheduling

A comparatively simple shop scheduling system is employed in the Cheyenne locomotive shops. Although not elaborate in detail, the system is highly regarded by the shop foremen and is considered to be better fitted to the comparatively small organization required by an output of approximately 15 locomotives per month than one requiring clerical service in its operation.

The control board, which is of the customary form with the engine numbers shown in the right hand vertical column with parallel columns headed by the various scheduled operations, is located in the general foreman's office and is filled out by him or the shop clerk from a master schedule as each locomotive enters the shop.



FORM Temporary
No. 4

UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD COMPANY

SCHEDULE FOR SHOPPING LOCOMOTIVE ________

SET IN SHOP ________

TO ________
Foreman

CLASS REPAIRS	BOILER WORK	CYLINDER	FRAMES

DATE AND TIME TO COMPLETE

1 ALL STRIPPING MACHY & BOILER	2 FLUES IN	3 CAB COCKS AND THROTTLE	4 TEST BOILER	5 FRAMES	6 SHOES AND WEDGES PLANED	7 DRIVING BOXES FITTED	8 WHEELS UNDER

9 CROSS HEADS LINED	10 LINKS HUNG	11 REV. GEAR IN PLACE	12 MAIN RODS UP	13 VALVES SET	14 UNITS TESTED	15 ALL RODS IN PLACE	16 PIPING	17 OUT

Machine work on Driving Wheels and Boxes, Rods, Motion Work, Cab Cocks, etc., must be ready to comply with the above dates.

If unable to complete work on date specified full explanation must be written in space below, referring to number.

____
General Foreman

____
(Date)

Foreman's Copy of the Shopping Schedule Furnished for Each Locomotive

In addition to this board, only two forms are used. The first of these is filled out in the office for each locomotive entering the shop and, in addition to a detailed description of the work to be done on the boiler, the cylinders, and the frames, it shows the completion dates of all operations listed on the control board.

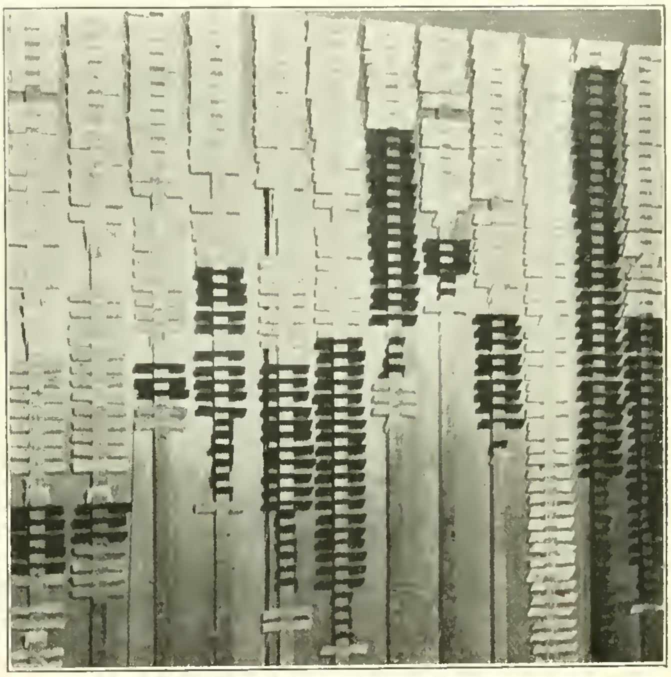
A copy of this form is furnished to each foreman, who thus has on file a record of the completion dates for his work and other work on which his own depends, for all locomotives in the shop.

The other form is a locomotive delay report which is filled out by the general foreman and sent to any foreman whose operations are behind schedule. The foreman receiving one of these slips is required to fill out the form at the bottom, showing the time that the delayed operation will be completed, and return it to the general foreman. In actual practice, this form is not used as a means of advising the general foreman when the operation will be completed so much as it is as a reminder to the foreman whose operations are behind that he is being watched.

Similarly, in a shop of this size, the control board finds its principal use as an aid to the general foreman in planning for changes in the schedule when unexpected conditions arise affecting the completion time of some particular locomotive, rather than in keeping track of the day to day progress of the work. When changes of this kind are made, each foreman receives a copy of the revised schedule for the locomotive or locomotives involved.

Visual Roster of Shop Employees

On the wall of the shop superintendent's office is a visual record of the entire force employed in the locomotive shop. By reference to the photograph it will be seen that it is a large wood panel on which are mounted 21 vertical raised strips, each containing about 50 slots wide enough to receive a heavy paper card. One of these cards is made out for each man employed in the shops, on which is shown his classification, the date he entered the service and his hourly or monthly rate. The names of all mechanics are entered on white cards, apprentices on blue cards, helpers on red cards and laborers on pink cards. Each vertical strip is assigned to a gang, with the foreman's card at the top, followed in order by the cards for the mechanics, apprentices, helpers and laborers. When an employee leaves the service his card is folded and reinserted on the board. When his place is filled, the folded card is removed and destroyed. By this means it is possible to tell at a glance the number of men in each classification employed in each gang and the number of vacancies in each classification in each gang.



A Section of the Visual Roster of Shop Employees

On a similar board located in the outer office where it is accessible to all employees, a duplicate set of cards are arranged by employment classifications in seniority order. The cards are two inches long and about three-quarters inch wide.

Eight Important railway lines have recently reported additions to their postal car equipment of 91 new steel cars for use as traveling railway post offices, according to an announcement made by the Post Office Department. The new mail cars constructed according to the latest designs, will facilitate the handling of mails where they are used and will also provide greater safety for clerks working in them. The following railroads have informed the department of the construction of new steel cars: Baltimore & Ohio, 8; Boston & Maine, 5; Chicago & North Western, 5; Chicago, Burlington & Quincy, 32; Colorado & Southern, 5; Fort Worth & Denver City, 4; Pennsylvania, 25; Southern, 25.

Grinding Air Cylinders

THE modern internal grinder, illustrated, has been recently installed in a prominent railroad shop and is used among other things for truing worn air compressor cylinders. Fig. 1 shows a general view of the machine with the air cylinders bolted to the right-angle knee bracket on the machine table. The grinding wheel of large diameter is being used in the 14½ in. low pressure cylinder to which the exhaust hood for removing metal and abrasive dust is connected. The cylinders are made of cast-iron and it takes about 10 minutes to line them up on the machine table. The average time required to finish grinding the large cylinder is one hour. Fig. 2 shows the grinding wheel in the 8-in. high pressure cylinder which can be ground in approximately 40 minutes, depending on the cylinder wear and the amount of metal which must be removed to produce a true cylinder. Fig. 3 gives some idea of the high finish secured by grinding and also shows the dust exhauster applied to the high pressure cylinder.

There is no question as to the value of grinding for this particular operation wherever a modern internal grinder of ample power and accuracy is available. Accurate, smooth, cylinders are vital to air compressor efficiency and no machining process has yet been developed which is equal to grinding as regards these two particulars, accuracy and finish. The grinding operation requires less time than other methods, and in addition, only enough metal is removed to true up the cylinders with a consequent increase in cylinder and bushing life.

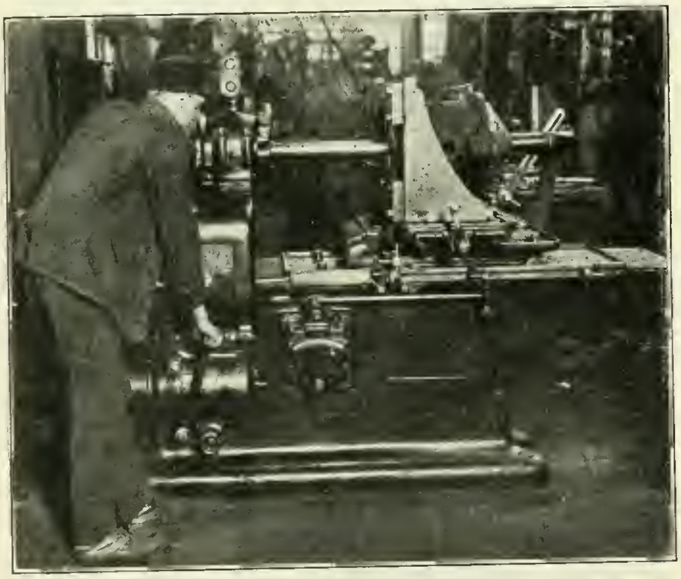


Fig. 1—Modern Internal Grinder Truing Low Pressure Air Cylinder

Comparison of Grinding and Boring

Substantiation of the above statements was afforded in a test recently made by truing worn New York 9½-in. by 12-in. air compressor cylinders on a modern internal grinder worth about $3,000 and on an up-to-date boring mill in good condition worth about $8,000. An all day run was made. The test showed that in the case of grinding, about 1/16 in. of stock was removed; the setting up time averaged 18 min. and the grinding time 45 min.; the finish was excellent. On the boring machine ¼ in. of metal was removed, the setting up time averaging 20 min. and the grinding time one hour and twenty minutes. The finish was not as smooth.

The boring mill removed ¼ in. of stock to get the cutting tool under the surface, whereas the grinder simply cleaned up the cylinder, removing only 1/16 in. of stock. This is a feature which is much appreciated since the cylinders can be trued more times by grinding than they can by boring before being bushed. Experience on the road in question also showed that the ground cylinders would run about twice as long as those which were bored owing to the superior finish. The relative values of the two machines also had a noticable effect on the cost of truing cylinders.

Internal cylinder grinders can be used for many other purposes besides grinding air compressor cylinders in railroad shops and some of these uses will be described in a subsequent issue. In all cases, railroad men should take advantage of the engineering service offered by the manufacturers in maintaining the grinders in the best possible operating condition and giving advice in case of difficulty and when undertaking new work.

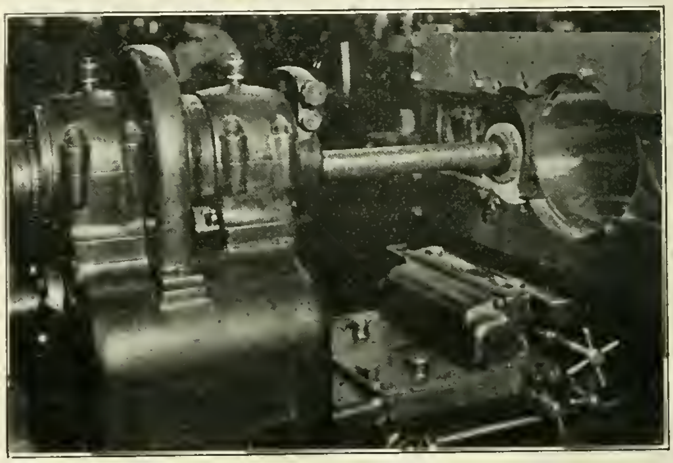


Fig. 2—View Showing Grinding Wheel in High Pressure Cylinder

In one case, for example, a cylinder grinder had been installed and was producing work entirely satisfactory as to quality but not as to production. Between four and five hours was required to grind a single 9½-in. by 12-in. air compressor cylinder, removing 1/16 in. of stock. On learning of this condition, the manufacturer immediately sent to the shop a representative who from long experience was soon able to locate the difficulty and show the shop force how to grind 9½-in. cylinders in one hour each, floor to floor. The possible uses of the internal grinding machine have since been developed to such an extent at the shop in question that another machine will be needed in the near future.

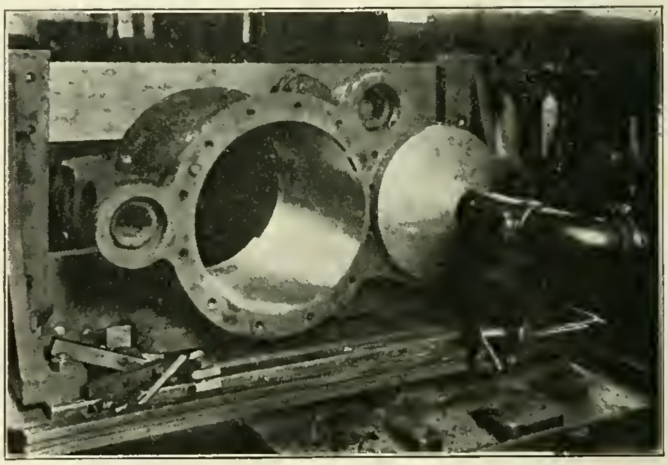


Fig. 3—The Arrangement for Exhausting Metal and Abrasive Dust While Grinding Is Important

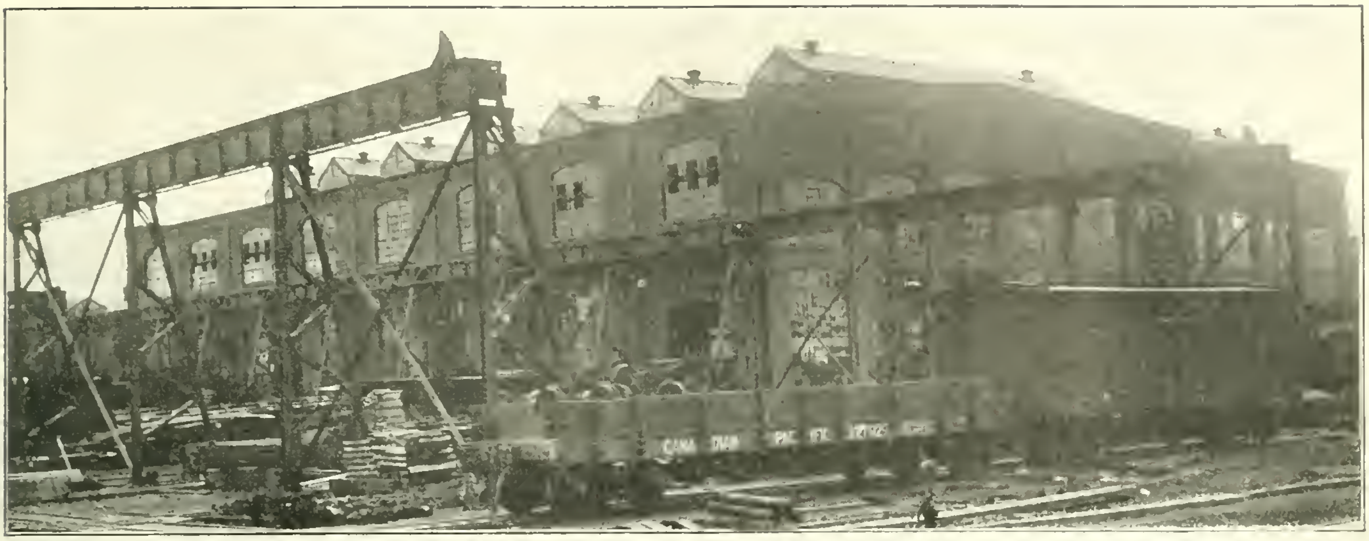


Fig. 1—Machine Section of Shop and Steel Storage Space

Steel Car Construction on the Canadian Pacific[*]

Special Machinery and Erecting Jigs at Angus Shops for Economical Manufacture of Freight Cars

By H. R. Naylor
Assistant Works Manager, Angus Shops

A COMPARISON of the modern 60-ton steel-frame box car with the 30-ton wood-frame box car commonly built fifteen years ago brings out two points: The complete change in design, and the effect this change in design must have had on the car shops. It is obvious that the facilities for building the wood-frame car would be quite inadequate for the steel car and must have created new problems with which the car builder had to contend; and it is the intention to deal with this phase of steel-car construction, especially as the Canadian Pacific was responsible for many of the important developments.

Development of the Steel-Frame Box Car

The gradual increase in locomotive capacity, making possible the hauling of longer and heavier trains, subjected the wooden cars to severe service conditions, which were in turn met by steel under-frames and other steel reinforcements; and at each stage of advancement wood framing was gradually replaced by steel, until in 1909 the Canadian Pacific originated a box car having the entire frame built of steel.

Within a period of six years (1909-1914) this road added 30,841 steel-frame box cars to its equipment and others soon adopted a similar design. After ten years of extensive service these cars had evidently proved their utility, for the United States Railroad Administration in one order alone included no less than 50,000 of this type.

The earlier steel-frame box car, was built with center sills of 15-in. channels, side sills of 8-in. channels, side and end posts of 4-in. Z-bars, and corner posts of 5-in. angles. The longitudinal sheathing was bolted to the inside of the framing, in which elongated holes were punched to allow the boards to be retightened without removing the bolts. This feature, however, has since been discontinued, as there is a possibility of the joints between the boards reopening if they are not effectively checked.

The New Steel-Car Shop

The Angus shops were already well equipped for building passenger and freight cars on an extensive scale, the large shops having supplementary planing mills, gray-iron and wheel foundries, and blacksmith, machine, and truck shops capable of supplying the greater proportion of all materials required. The output of wood-frame box cars at these shops had reached as high as 40 cars per day. This organization, however, was rendered obsolete to a large extent when the Canadian Pacific introduced the steel-frame box car necessitating the erection of an additional shop. This shop was designed for building the steelwork of both passenger and freight equipment, and embodied in its arrangement many novel features for the rapid handling of material. At the time of its erection it probably represented the best practice on this continent, being a combination of the good features observed in other shops with the original ideas developed at the time the layout was being planned.

The freight section of the shop was designed to construct steel-frame box cars in the most economical manner, and although some minor modifications have been made in the machinery layout and erecting equipment to meet subsequent developments, the shop has well served the purpose for which it was intended.

The new shop was located adjoining the wood-freight-car shop, facing a midway upon either side of which were also located the supplementary shops, the midway being served with overhead traveling cranes. It is a steel-frame structure, with steel columns carried on concrete piers, the lower foundation walls being of concrete, above which the walls are of red brick. The sash frames are of steel, the total sash area being approximately 40 per cent of the total wall space. The roof is carried on steel trusses with ample skylight area. The floors are of 4-in. concrete with a top surface of ⅝ in. mastic.

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[*] Abstract of a paper presented at the spring meeting of the American Society of Mechanical Engineers, Montreal, May 28, 1923.

There are three main divisions to the shop. The front one, facing the midway and occupying the entire front, is the machine section, consisting of two 100-ft. bays running parallel to the midway, the one adjoining the midway being 209½ ft. long, while the inner bay is 182 ft. long. Each bay is served by a 10-ton electrically operated crane having a span of 96¼ ft., and a height to base of rail of 28½ ft.

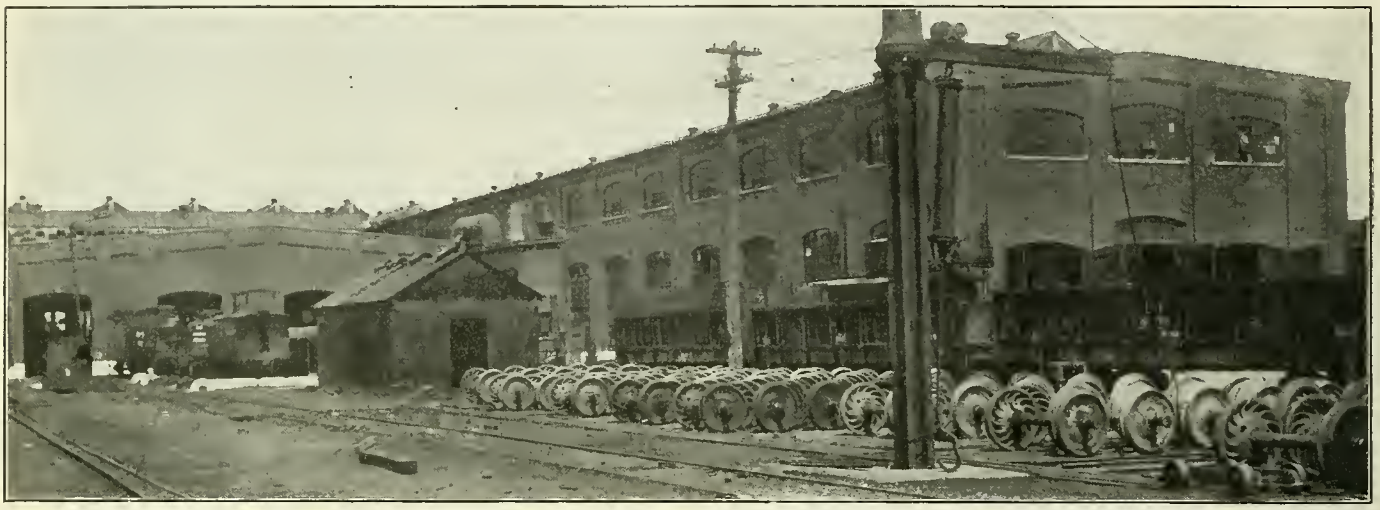


Fig. 2—Freight Car Erecting Section at Right, Passenger Car Erecting Section at Left

The freight-car erecting section is situated in the rear of the machine section, is 72 ft. wide and 405 ft. long, and was originally equipped with one 10-ton traveling crane, having a span of 67½ ft., and a height to base of rail of 27 ft. An additional crane of similar capacity has since been installed.

Situated also to the rear of the machine shop is the passenger-car erecting section, consisting of four bays having a total width of 110 ft. These four bays with the 72-ft. freight-car bay complete the full width of the back of the machine shop. Each bay of the passenger-car section is provided with a separate 2-ton traveling crane having a span of 24 ft. 10 in. and height to base of crane rail of 21 ft.

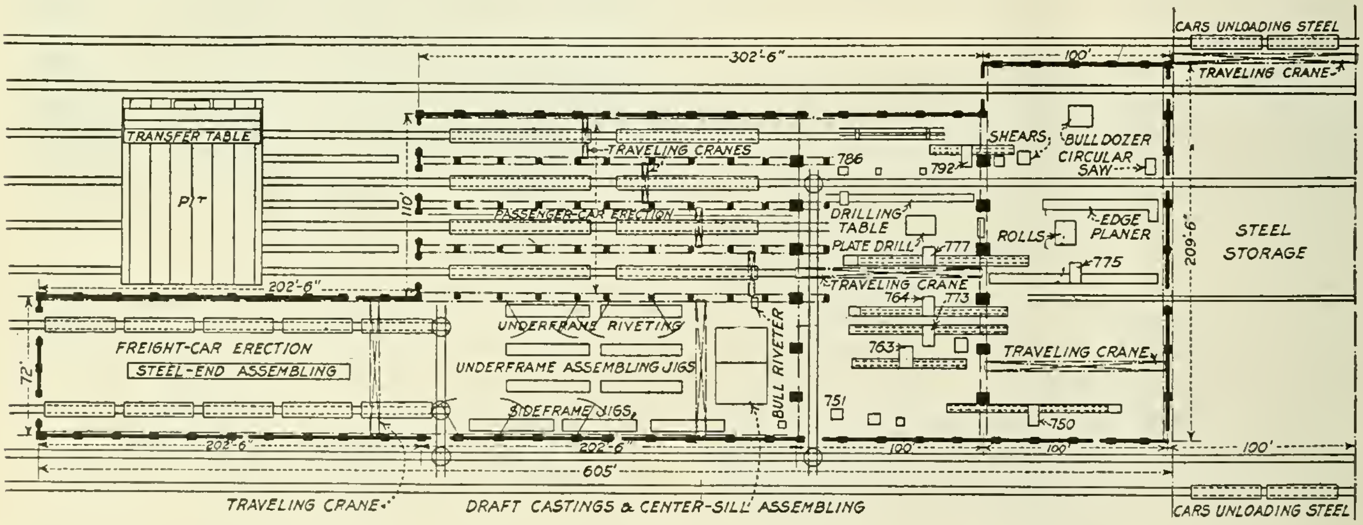


Fig. 3—Plan of Steel-Car Shop, Canadian Pacific Angus Shops, Montreal

Along the entire front of the shop, between it and the midway, there is ample provision for storing material. This storage yard is 100 ft. wide and is served by a 10-ton crane whose span and height are identical with those in the machine section in anticipation of future shop extension. This crane runway extends beyond the shop limits and spans several tracks where cars of material can be readily switched and unloaded.

Through the freight-car erecting shop, entering from the rear end, are two standard-gage tracks 48 ft. center to center which extend the full length but do not enter the machine shop. Outside the shop and parallel to the south wall a standard-gage track connects with a track on the midway through turntables. This track is used for delivering the car trucks from the truck shop to the assembly tracks.

Through each of the passenger-car erecting bays there is a standard-gage track leading in from the rear of the shop, also a transfer table for moving the cars during the various stages of completion. Through the center of the material storage yard, there is a standard-gage track connecting by turntables with three tracks running into the machine shop.

The Crane Facilities

The crane facilities are unique in that the whole area of the shop is traversed by electrically-operated traveling cranes so arranged that it is possible to install an unusual number, and yet maintain for each crane complete freedom of operation at all times. The crane arrangement was the deciding factor in the shop layout. It was decided that the machine section should be independent of the erecting sections insofar as crane service was concerned, and for this reason the crane runways in this section were installed in a direction transverse to those in the erecting shop. This made it possible to equip the two machine bays with separate cranes, each having a wide range of action with no interference.

The machine layout is arranged with the view of relieving the overhead cranes to the greatest possible extent. This applies particularly to the handling of the larger members, such as center and side sills which are required to pass over two punching machines situated in the different bays. As the first operation is completed the sills are transferred to the second machine by special devices independently of the cranes. On completion of the machining operations the sills are then skidded to the assembling tresdes in the erecting shop without assistance from the cranes.

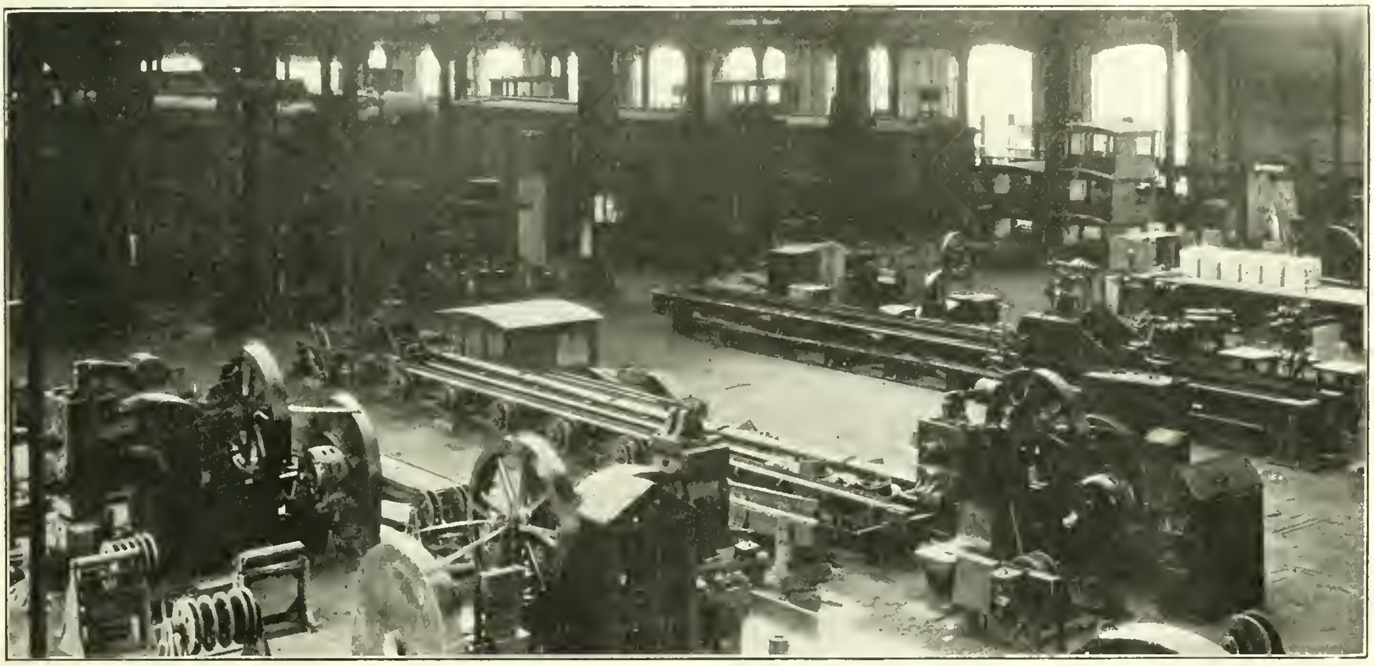


Fig. 4—Interior of Machine Section Looking Toward Erecting Section

The two cranes in the freight-car erecting shop, operating on the same runway, are entirely free from machine-shop handling, and as the first one is assigned to the preliminary assembly positions and the second to the final assembly positions, there is no overlapping or interference.

The Machine Equipment

The machine shop is equipped with the following machinery: Four automatic spacing punches, five coping punches, five high-speed punches, two horizontal punches, one 7-ft. 6-in. gate shear, one angle shear, one 36-ft. plate-edge planer, one 30-in. circular saw, one 30-in. metal band saw, one 7-ft. plate roll, one 10-ft. brake, one bulldozer, two special plate-drilling machines, and miscellaneous drill presses, all driven by independent motors.

The arrangement of the machines is such that the material after each operation moves forward in the direction of the erecting shops, backward movement being carefully avoided, thereby reducing material handling to a minimum.

The high-speed punches are belt-driven direct from motor to flywheel, gears being dispensed with. Clutches are of the 6-point type. The heads are equipped with two punches which are controlled by gag levers. These machines are well adapted for punching the smaller plates for which metal templets are made up and into which holes are drilled; by inserting a pin or gage in each successive hole and butting the plate against the pin, the desired spacing is obtained. In certain classes of work the operator can move the material fast enough to catch every hole with the punch running at the rate of 60 strokes per minute.

An unusual plan was followed as regards the installation of machines for heavy punching. The usual practice had been to install a small number of high-capacity machines for punching and slotting sills, side plates, and similar members, necessitating frequent changing of dies and templets, with further limitations in the event of breakdowns. It was therefore decided to overcome these handicaps by installing four automatic spacing punches of moderate capacity to obviate the expense and delay of die changing and double handling, and as the five additional coping punches are duplicates of those used in the automatic spacing tables, replacement can be made with but short delay should they become disabled.

The Machining Operations

The yard in front of the shop is used for storing the larger members such as sills, cover plates, side plates, etc.; the smaller parts such as the posts and braces, bolster and cross-bearer diaphragms, etc., are made by bulldozers and hydraulic presses in the blacksmith shop.

The machines are served by narrow-gage service tracks running from the material storage yard, special care being taken to unload the material close to the track by which it will enter the shop. The progress of material through the machine shop is as follows: Center sills and side-sill channels are loaded by overhead crane and brought into the shop on service lorries and deposited on trestles opposite the traveler at rear of center- and side-sill web spacing punch No. 775. Two air-operated traversing jacks lift the sills in pairs and place them on the traveler rollers ready to pass through the machine. On the far side of this punch, is an elevated runway carrying the traveler head which grips the sills with its projecting jaws and automatically spaces the punching. Along the traveler runway steel templets with projecting pins engage a trip lever suspended on the head of the traveler, close the electric circuit, arrest the travel of the head, and close the circuit of the punch control;

the punch then completes the operation. After passing through this machine the sills are released from the jaws of the traveler, lifted by jib cranes and deposited back to back on the rollers of sill-flange spacing punch No. 777, which are placed directly opposite the delivery end of the web punch. On completion of the first operation the sills are disengaged from the head clamp and pushed back over the rollers to the starting point, where they are again turned over by a special device attached to the jib cranes and passed through the machine for the second operation on the opposite flanges. The sills are then lifted by the traveling crane of the inner section of the machine shop and placed on the rollers of coping punch No. 763 directly opposite, where draft-key and lever slots are punched, completing the operations on the sills.

The center-sill and body-bolster cover plates and similar plates are punched on spacing punch No. 750. The side plates are punched on automatic spacing punch No. 764 in a similar manner to the sills, passing through for the first and second operations in pairs.

In all these operations the passage through the machines is rapid and the accuracy of the spacing mechanism is such that the punching error is slight and far less than it would be were each hole marked off and punched independently.

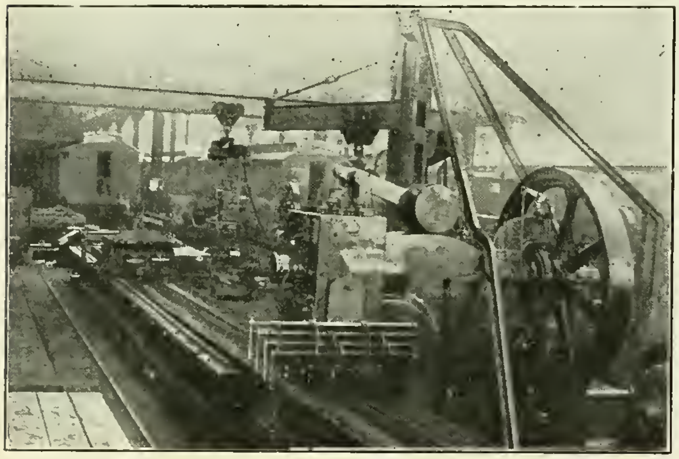


Fig. 5—Center and Side-Sill Web Spacing Punch

There are certain parts which cannot be handled satisfactorily on the spacing punches, yet the punching must be equally as accurate or otherwise much of the benefit obtained from the spacing punches is lost when the parts are assembled. The machining of the ends of the side posts and braces is an example of this kind. In this case special combination dies are used to shear the ends to shape and punch the group of holes in one operation.

The bolster cover plates and diaphragms are machined in a similar manner, the cover plates being passed over the spacing punch and the diaphragm flanges punched in one of the coping punches equipped with special dies for punching the flange holes in one operation. During these operations the machine is relieved of excessive load by varying the length of the punches, resulting in the holes being punched consecutively.

The usual practice for freight-car work is to punch rivet holes to a diameter not exceeding that of the rivet, and, when the parts are bolted together, to ream the holes to a size not exceeding that of the rivet by more than 1/16 in.

The Jig Method of Assembly

The erecting of steel frame box cars by the jig method was originated at the Angus shops. By this method the underframes, side frames, and end frames are assembled on jigs as complete units ready for the final assembly of the car. The jigs consist of stands or cradles by means of which the various members are accurately placed and held in proper relation to each other until they are riveted together. The advantages of this method are manifold. As each member lies flat in the jig the drawing together of the parts is reduced to a minimum, wedge bolts being used extensively for this purpose as they can be rapidly applied. A complete unit being assembled in one operation, the possibility of a cumulative error is avoided. The jigs dispense entirely with checking for squareness, alignment, and location of connection holes, thereby simplifying the final assembly to a considerable extent.

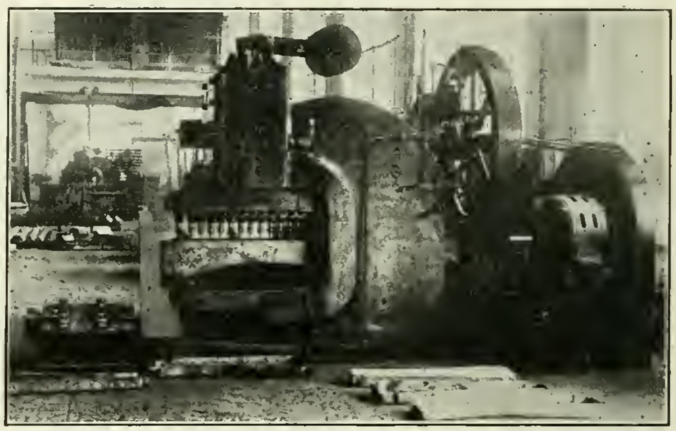


Fig. 6—Coping Punch for Punching Holes in Flanges of Bolster and Cross Bearer Diaphragms

Before any of the parts are assembled, all concealed surfaces are painted to prevent corrosion.

The center-sill channels after passing through slot-punching machine No. 763 are skidded from the idler rollers to trestles just inside the erecting shop, where the draft castings are temporarily bolted on and the holes reamed ready for riveting. An electric hoist operating on a runway below and clear of the overhead cranes, swings the sills into position and the draft castings are riveted on by a compression riveter. The individual sills are then moved across to a position on the left where the two center sills are assembled and riveted with bolster center castings and separators in position. The sills are placed on stands on which are four fixed pins corresponding to four rivet holes in the sills at the center line of the bolsters. By placing the sills flange down on these pins perfect alignment of the two sills in assured, which simplifies the application of cover plates later on. The draft gear is also applied in this position.

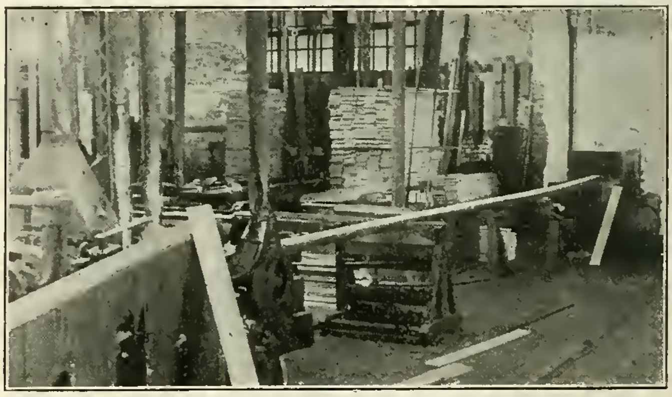


Fig. 7—Boards Leaving Matcher and Passing Automatically Through Painting Machine

The next step is the assembling of the underframes, and as this is a lengthy operation, four positions are assigned for the purpose. These jigs, consist of four steel cradles located at bolster and cross-bearer centers, and so arranged that each member of the underframe is held in proper alignment and at centers that will coincide exactly with connections on the side frames. The bottom cover plates of the bolster and cross-bearers are first placed on centering pins; the overhead crane then places the center sills in position, to which are attached the bolster and cross-bearer diaphragms with their cover plates and center-sill cover plate complete, after which the assembly is bolted together and the holes reamed ready for riveting.

The underframes are then swung over by the overhead crane to the riveting jigs on the right, which are constructed similar to those used for assembling, thereby maintaining the proper alignment. Each riveting position is equipped with two 50-ton compression riveters suspended from swinging jib cranes, the posts of which are in line with columns to the right. The crane jibs are 21 ft. in length with runways for air hoists, the suspension mechanism being so arranged that the riveters can be tilted to drive the rivets in the inclined bottom flanges of the bolster and cross-bearers which otherwise would have to be driven by an air hammer. The compression riveters were specially designed on the scissors principle, with a thin nose to permit of the top and bottom rows of rivets being driven without turning the underframe over in order to complete the operation.

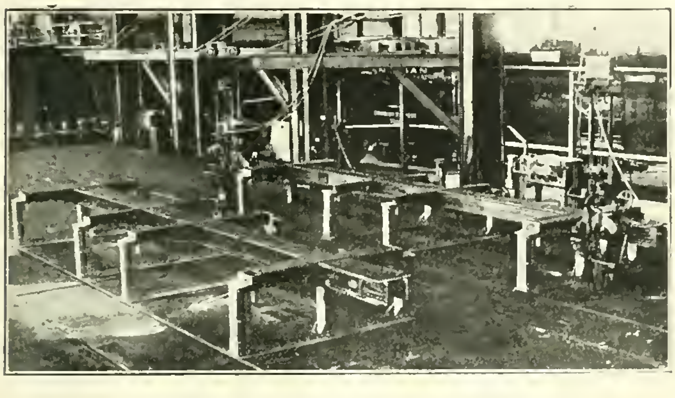


Fig. 8—Jig Used for Assembling Underframes

The side frames, consisting of the side sill, side-plate, post, braces, door posts, and track, are assembled as a unit on a jig frame situated abreast of the underframe jigs. This jig consists of channel-iron stands, the four corner ones of which are capped with short sections of channel iron in which are holes for locating exactly the side sills and plates. The stands on either side are tied together with angle bars which carry additional cross-bars upon which the various members of the side frames are placed in proper relation to each other. In this position the side frame is temporarily bolted, reamed, and riveted ready for the final assembly position.

Originally the end frames were assembled on jigs similar to those used for the side frames, but in recent years the end-post construction has been replaced by corrugated-steel ends. These steel ends and the end sills are assembled on trestles located between the final assembling tracks, and when temporarily bolted together are skidded to the second and third positions where they are reamed and riveted. In the fourth position the end ladders, roof-frame brackets, and other parts are applied, the ends as completed being then placed opposite the final assembling position.

The Final Erecting

As the trucks are assembled and painted, they are delivered from the truck shop and enter the erecting shop by the side door immediately ahead of the underframe and side-frame jigs, where they are turned on a turntable and placed in position on the assembling track. The underframe completed on the riveting jig is then lifted by the overhead crane and placed on the trucks, the slings are released, and a steel end is next placed in position and bolted on the end farthest away from the side-frame jigs; the side frames are then placed in position, and finally the second end, along with the center and side-sill cross-ties. The brake-cylinder, reservoir and piping are also applied at this time.

The car is then moved by car haul to the second position where the assembled members and the roof framing are riveted in place. In the third position safety appliances, brake rigging, couplers, uncoupling rods, etc., are applied, the remainder of the riveting completed. The entire frame is then sprayed with the priming coat of paint ready for finishing.

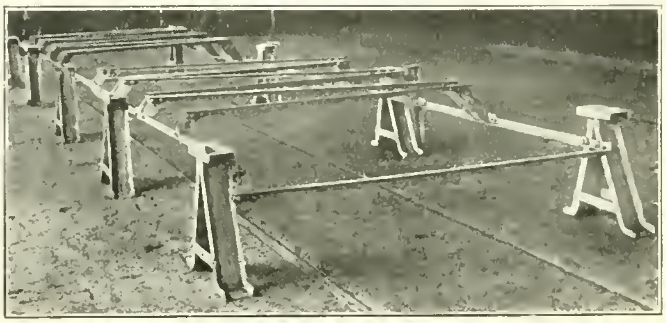


Fig. 9—Jig Used for Assembling Side Frames

Finishing the Car

The steel frames are switched each day to the wood freight-car shop where the decking, sheathing, roofing, and doors are applied and the painting operations are completed. The decking is of 1¾-in. red pine and the sheathing of 1½-in. Douglas fir, both having tongued-and-grooved joints. High-grade lumber free from knots, checks, or cracks is selected for this purpose and is then kiln dried, the moisture content being carefully limited in order to prevent the further shrinkage later on; the only objection of any importance raised against the steel-frame box car, as compared with other box cars, having been one arising from improper drying of the sheathing. After being machined the sheathing is again examined, and any boards checked or cracked are set aside and used for lining the ends of the car.

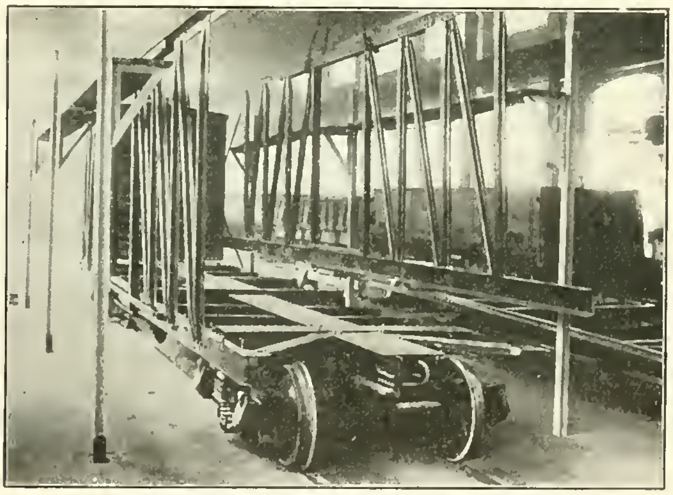


Fig. 10—Placing the Side Frames in Position

Before leaving the planing mill the sheathing, roofing, and running boards receive their priming coat of paint in a painting machine recently developed at the Angus shops and which differs from those in use elsewhere. The boards on leaving the matcher pass automatically through a painting machine where they are sprayed by a series of nozzles which can be set in any desired position according to the surfaces required to be painted. The paint is drawn up through suction pipes by means of air jets blowing across the nozzles, and as ejected is atomized by the air and blown on to the boards in a fine spray. The amount of paint applied is controlled by air valves or by regulating the speed at which the boards pass through the machine. No brushing or wiping is necessary. The boards on leaving the machine are piled on trailer trucks and distributed by tractors to the shops when dry. These machines will paint at the rate of 200 running feet per minute, which is about as fast as the boards can be conveniently piled for drying.

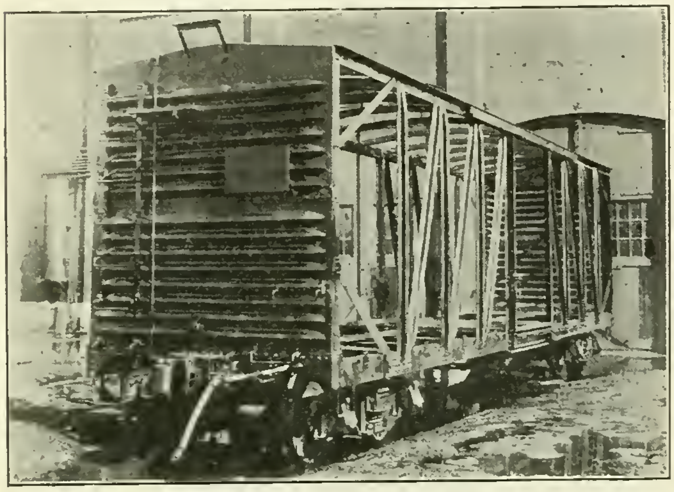


Fig. 11—Car with Steel Work Completed and Ready for Finishing

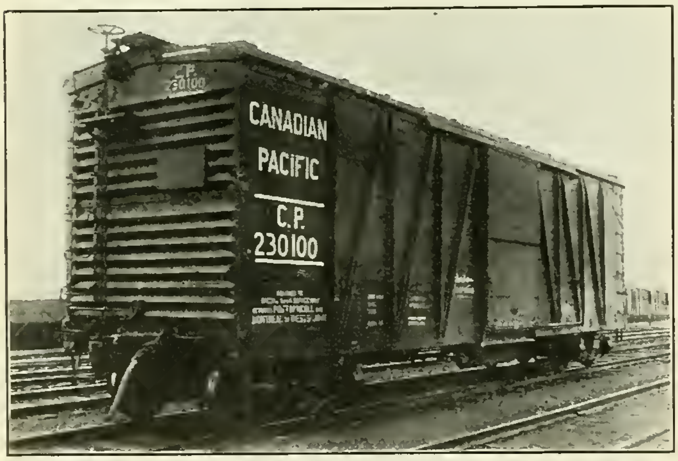


Fig. 12—Steel Frame Box Car Completed and Ready for Service

The first operation in the wood freight-car shop is to apply the decking, the joints of which are previously coated with a thick paint compound, as are also the ends of the side boards making contact with the bottom boards of the side sheathing previously applied.

The side sheathing which has already received the priming coat of paint is next applied, and to insure that the sides of the car will be watertight, the joints are coated with paint compound, after which they are wedged down into position and bolted to the framing. The end lining is then applied in a similar manner but vertically. In the succeeding operation the roof is applied, the boards and metal sheets of which have previously been primed.

After the doors are hung in place and the remainder of the safety appliances have been installed, the car is given two additional coats of paint and stenciled, when it is complete and ready for service.

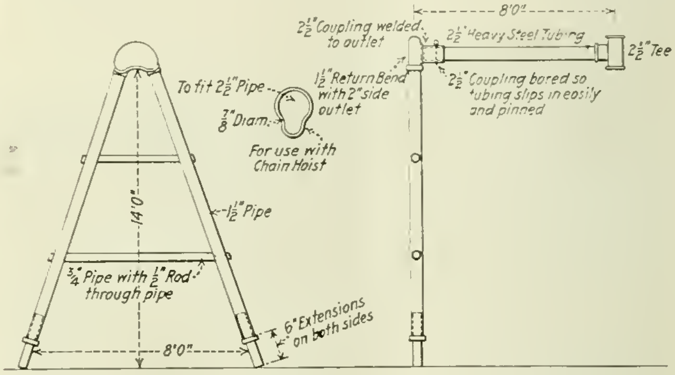
Removing Air Compressors

By W. F. Zwiehel,

Foreman, Air and Pipe Department, Central Railroad of New Jersey, Ashley, Pa.

For quickly and easily removing air compressors from locomotives while in a roundhouse or shop without crane facilities, the device illustrated will prove of value. It has already been used successfully in removing about 50 air compressors and will handle equally well the 9½ in. or the heavier cross compound type.

Briefly, the device consists of two triangular legs made of 1½-in. pipe joined at the top by a return bend to which is attached a horizontal piece of 2½ in. heavy steel tubing, the height being such as to allow for a slip ring and chain falls between the horizontal tubing and the top of the air compressor on the largest locomotive. The legs are 8 ft. apart at the bottom and of such a length that the return bend is 14 ft. above the ground, a slight variation in this distance being obtainable by means of the 6 in. extensions on the legs. The legs are tied together by two ½-in. rods, over which pieces of ¾-in. pipe have been applied to serve as spreaders.


8'0"
2½" Coupling welded to outlet
2½" Heavy Steel Tubing
2½" Tee
To fit 2½" Pipe
1½" Return Bend with 2" side outlet
2½" Coupling bored so tubing slips in easily and pinned
⅞" Diam.
For use with Chain Hoist
14'0"
1½" Pipe
¾" Pipe with ½" Rod through pipe
6" Extensions on both sides
8'0"

Device for Removing Air Compressors from Locomotives

The return bend has a side outlet in which a 2½-in. coupling is welded, the latter being bored out to fit over the horizontal tubing which is held by a pin. The slip ring is a sliding fit on the horizontal steel tubing, being applied before the latter is pinned to the coupling. A tee is provided to hook into the sand dome or be chained in such a way that the device will not move while an air compressor is being applied or taken down.

Non-observance of Rule 6 of the code of per diem rules, requiring subscribers to the car service and per diem agreement to make settlements for car hire with non-subscriber connections at the established per diem rate without any free time and without reclaim, has been complained of to the Board of Directors of the American Railway Association, and an appeal has been issued, calling upon the railroads to see that the provisions of Rule 6 are uniformly enforced. Non-observance results in discrimination as between non-subscriber railroads and in constant efforts of non-subscriber roads to obtain as favorable arrangements as may have been made with the few, all of which has a tendency to break down the entire per diem structure

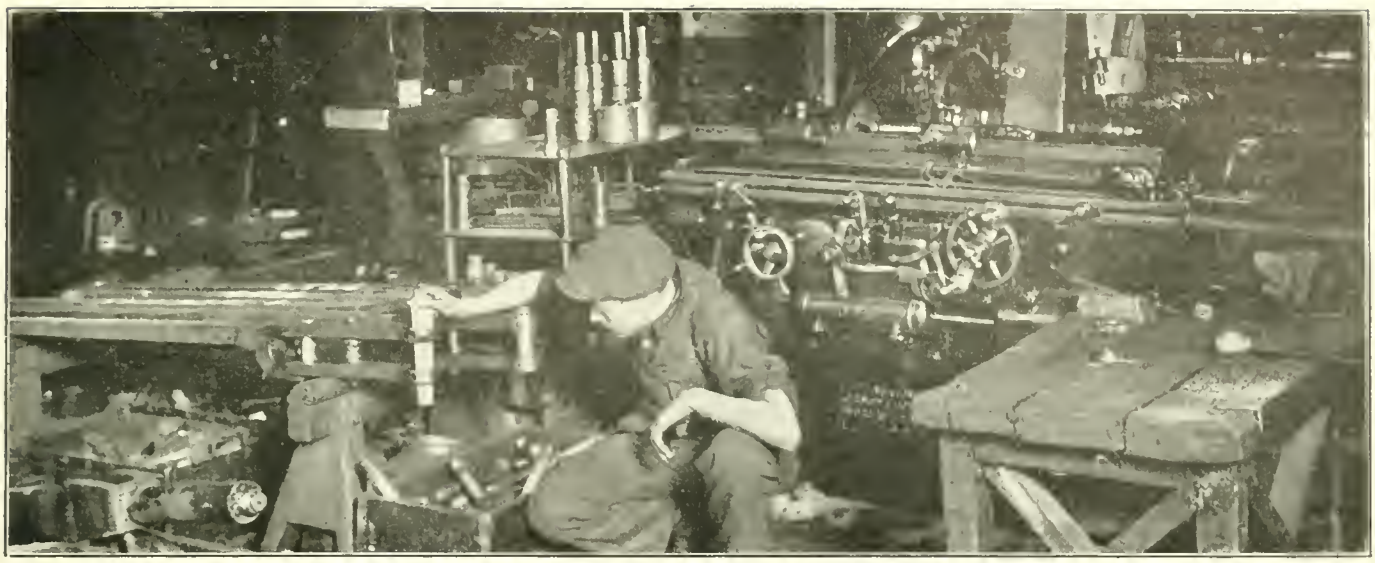


Fig. 1—Accurate Gaging and Grinding is Essential in Making Standard Pins and Bushings

Standardization of Locomotive Repair Parts

With Particular Emphasis on Methods of Standardizing and Machining Valve Motion Pins and Bushings

By M. H. Williams

LOCOMOTIVE repair shop work can be expedited and costs greatly reduced by standardizing new parts used in making repairs. Standardizing will enable certain surfaces, such as the body or bearing surfaces of valve motion pins and the bores of bushings, to be completely finished before it is known on what locomotive these parts will be used. Side rod knuckle pins and bushings, crosshead pins, crank pins, taper bolts and a large number of similar articles can also be standardized to a greater or less extent.

It is not contemplated that one standard can be set to cover all designs of locomotives, or that any radical change shall be made to existing standards. However, the possibility of reducing the number of designs of parts that must from necessity be frequently renewed should receive careful consideration. In many cases it will be found that slight modifications, not affecting the operation of locomotives, may be made to frequently renewed parts, enabling one design or size to be used on a greater number of classes of locomotives than is now the practice.

The principal requirement when standardizing is to make a careful study of present conditions and ascertain where designs of articles used for repairs can be modified, or several combined in one. In this way it is possible to manufacture each article in larger quantities, which in turn reduces costs. This is in line with the present demand that railroad shops turn out work as rapidly and economically as their size and equipment will permit.

Most railroad shops, when considered only as local units, are not large enough to warrant the installation of special production machines, such as automatic screw machines, automatic chucking machines, drop hammers for making drop forgings, forging machines, high-power milling machines, production grinding machines, etc. On railroads where standardization has been carefully studied and the number of designs reduced to a minimum, however, such machines can be economically employed in a single production shop, which supplies other system points with finished or semi-finished articles used in repair work.

The size of a railroad is the limiting factor. A railroad having only a comparatively small number of locomotives can not afford to install these special machines even when the work is concentrated in the largest shop of the system, and as a result, repair parts must be manufactured by relatively crude and expensive methods. Standardization on the smaller railroads with the object of reducing the cost of repair parts may at first glance seem impossible. As a matter of fact, if the parts are standardized, they may eventually be purchased in the open market.

Repair Parts Made by Outside Companies

There are in this country a number of locomotive builders, also manufacturing plants not necessarily engaged in locomotive work, which are well equipped for manufacturing locomotive repair parts. These companies would be glad to go into this business, providing the designs were standardized and orders from several roads could be combined, facilitating the manufacture of parts in large quantities. Repair parts could then be produced in a finished or semi-finished state, catalogued, and ordered readily by both large and small roads, much the same as repair parts for air brake equipment, injectors, lubricators, etc., are now ordered.

The standardization of certain parts used for the repair of locomotives is not as serious a problem as may at first appear. One method of standardizing valve motion pins and the machines shown by experience to be adapted for the purposes of making them, will be described. While this is not a new subject in the columns of the *Railway Mechanical Engineer*, it has been selected for treatment first owing to the large number of these pins required for repair work and the comparative ease of reducing them to a standard.

The valve motion pin, shown in Fig. 2, is representative of the great majority of these pins used on all classes of locomotives, from 10 to 16 pins being required for each of the 68,000 odd steam locomotives in the United States. A conservative estimate would place the total number required for renewals at 250,000 per year, or the production of 7 of the most modern six-spindle automatic screw machines; each working 8 hours a day, 300 days a year, not including time lost for breakdowns, repairs, or set-up.

The ideal pin of this nature should be supplied to repair shops having the body or bearing surface *A* ground to specified sizes within a limit of plus or minus 0.001 in., the lengths being as specified by each railroad. The taper ends *C* and *D* should be rough turned, the larger diameter of taper end *C* with certain exceptions being of the same size as body *A*, the larger diameter of taper end *D* being turned to the taper extended from the small end *C*. Holes *E* and *F* for spline and cotter pins respectively are drilled; the ends threaded; centers drilled at both ends, and the pin stamped with a catalogue number. The grooves or recesses *G* and *H* are necessary to prevent shouldering when grinding. Where motion pins are to be casehardened, this operation can also profitably be done at the time of manufacture.

The bushings, used in connection with these pins, to be described later, should be casehardened and internally ground about 0.008 in. larger than the pin body which will in turn admit of 0.004 to 0.006 in. for a running fit on the pin when the bushing is forced into the lever. (This is the allowance shown in Fig. 2.)

When making repairs, all the work required is to machine the two taper ends of the pin and the outside of the bushing. As the body *A* of the pin and the bore of bushing have both been ground to the correct size to fit each other, no work is necessary on these two surfaces which will reduce the time required to make pin and bushing renewals about 75 per cent.

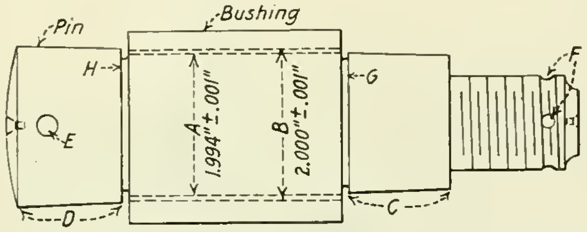


Fig. 2—Representative Type of Motion Pin and Bushing

Casehardened and semi-finished pins and bushings cannot be turned at the time of making repairs and, therefore, must be ground. Experience has shown that the plain cylindrical grinding machine is best adapted for this purpose, not only for the above mentioned pins and bushings, but in addition for kunckle pins and bushings, crank pins, crosshead pins and a large number of articles either casehardened or soft. In fact, one of the principal arguments in favor of grinding is the reduction in time required to finish an article to the required size.

Establishing Standards

Referring again to motion pins, the ideal condition for quantity production will be when all locomotive valve motion levers are reamed for the same taper per foot, and the lengths of pins as well as their diameters are reduced to the fewest number of sizes.

Certain railroads have adopted a taper of one in. per ft. for all taper holes in valve motion levers, which appears to be the most satisfactory from a shop repair, roundhouse and service standpoint. It would be a good thing if this taper could be made universal. With many existing standards, levers have been reamed at the large ends to some arbitrary sizes, such as 1¾ in., 2 in., etc., to the foot, without due regard to the body sizes. When considering repair conditions and the useful life of levers, it would be desirable to ream each new valve motion lever so that the pin body will just pass through the larger reamed side of the jaw, as shown at *A*, Fig. 3, the smaller reamed side of the jaw being reamed to a taper extended from the larger side. Both sides of the jaw are thus reamed at one time. This design will admit of a greater amount of enlargement of taper holes at the time of repairs, or in other words the lever may be reamed a greater number of times before the smaller reamed side is as large as the body of the pin. Obviously, when the latter condition exists, it is necessary to scrap the lever or resort to pins having larger bodies.

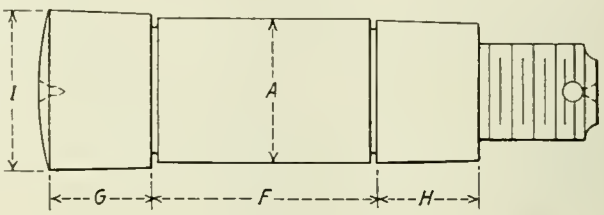


Table 1—Proposed Step Sizes for Valve Motion Pins

Step sizes	A	F	G	H	I
Standard ...	1.492 in.	2¼ in.	1⅛ in.	1⅛ in.	1 11/16 in.
A	1.492 in.	2¼ in.	1⅛ in.	1⅛ in.	1 23/32 in.
B	1,554 in.	2¼ in.	1⅛ in.	1⅛ in.	1 27/32 in.
C	1.617 in.	2¼ in.	1⅛ in.	1⅛ in.	1 29/32 in.

The possible exception to this design is in the case of extra long pins where the small ends become too small for a reasonable sized nut. While the adoption of pins of the design mentioned may cause a departure from existing standards, it will pay in the long run.

Step Sizes for Pins and Bushings

It would be difficult to set a hard and fast rule to govern step sizes most desirable for all designs of valve motion pins. Therefore the peculiar design for each class of locomotive must be a controlling factor. For relatively long pins having bodies 3 in. or greater in length and steep taper ends, it will in many cases be found that one diameter of body will answer for practically all repairs. In this event it is desirable to blank out the taper ends to step sizes, a system that has worked well being to make the steps 1/16 in., ⅛ in. and 3/16 in. larger than standard.

With shorter pins having a taper of 1 in. or less per foot, the taper holes in levers, owing to wear or re-reaming, are frequently enlarged so that the smaller of the two reamed holes of the lever jaw is equal to or larger than the body of standard pins as shown at *B*, Fig. 3. To meet this condition and obtain a full taper surface on the small end of the pin, the diameter of the body must be made larger than standard as shown at *C*.

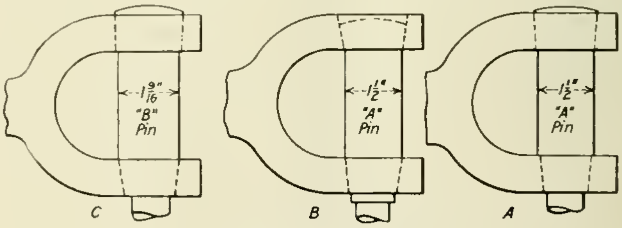


Fig. 3—Showing the Effect of Enlarged Taper Holes Due to Wear and Reaming

Satisfactory step sizes for the pin bodies are 1/16 and ⅛ in. larger than standard, as shown in Table I, the relative diameters of taper ends *C* and *D*, and body *A* remaining the same as shown in Fig. 2. Both the taper ends and body are thus enlarged 1/16 in. or 1/8 in.

Bushings should be standardized by making the bores a running fit on the pin bodies and the outsides sufficiently larger than standard to take care of enlarged lever holes. Table 2 shows the sizes for valve lever bushing suitable for use with the pins shown in Table 1.

The outside diameter of the first step size *A* is 1/16 in. larger than standard, the bore being of the standard diameter, suitable for use with pins *A*. In practice it has been found that the pins and bushings *A* are sufficiently larger than standard to take care of levers in which the taper holes in the jaws and the holes for bushings have been enlarged a moderate amount; i.e., approximately 1/16 in. as shown at *A*, Fig. 3. It is understood that either the pins or bushings may be ground down to a suitable size for holes in levers of any diameter between that required for new levers, or where enlarged to the amount mentioned.

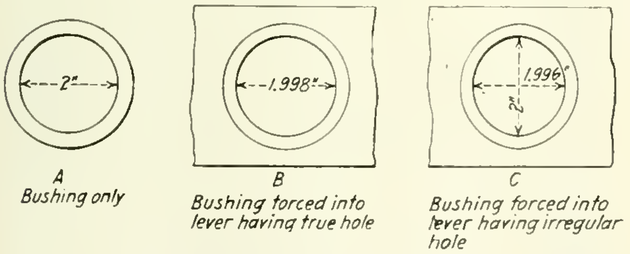
Where the pins and bushings *A* are found too small owing to additional wear of lever holes, the pins and bushings *B* are used, these being 1/16 in. larger than *A* in bore and outside diameter. Again referring to Fig. 3, this condition is shown at *C*. The pins and bushings *C* are 1/16 in. larger than *B* and are used in badly worn levers.

When manufacturing bushings they should be of correct length, oil holes drilled, oil grooves milled, stamped with catalogue numbers, casehardened, bores ground to limits of plus or minus 0.001 in. and placed in stock.

Running Fits Between Pins and Bushings

Experience has shown that for a good running fit the bores of bushings after being forced into valve motion levers should be from 0.004 to 0.006 in. larger than the pin bodies. When pressing a bushing into a lever, the bushing bore compresses a certain amount as shown graphically at *B*, Fig. 4; also at times the levers are slightly out of round as shown at *C*. Under the latter conditions, owing to the thin bushing walls, the bushing assumes approximately the same shape as the hole in the lever. In order to take care of compression and imperfect holes, good practice has shown that the bores of bushings at the time of manufacture should be 0.008 in. larger than the diameter of the bearing surface of the pin.

As a general rule, it is advisable to make bushings to normal sizes, such as 1½ in., 2 in., etc. By this practice standard plug gages easily obtainable from gage makers can be used. The body or bearing surface of pins are ground 0.008 in. smaller, or 1.492 in., 1.992 in., etc., the measurements being made with micrometer calipers to insure accuracy.



A
Bushing only

B
Bushing forced into lever having true hole

C
Bushing forced into lever having irregular hole

Fig. 4—Bushing Bore Reduced by Compression; Bushing Conforms to Hole in Lever

Manufacturing pins and bushings within the limits specified in Tables 1 and 2 does not call for more accurate workmanship than the everyday practice in manufacturing concerns, and this is a grade of workmanship which can readily be, and should be, the regular practice in railroad shops. However, proper facilities for measuring, such as micrometer calipers and plug gages must be provided, and the workmen should understand that the work must come up to the prescribed requirements.

Pins Made on Automatics

The pins are readily blanked out on automatic screw machines or turret lathes from bar stock. The taper ends, body and threaded end call for a grade of work easily obtainable when taking a single cut or pass with box tools, the principal requirement being to turn the body from 0.010 to 0.020 in. large to allow for final grinding. The spline, or hole for the key, and holes for cotter pins are readily drilled in a special jig which eliminates laying off, one adjustable drilling jig answering for all shapes and sizes. The holes for grinder centers in threaded ends are drilled when blanking out in the machines, the opposite or head ends being drilled in speed lathes.

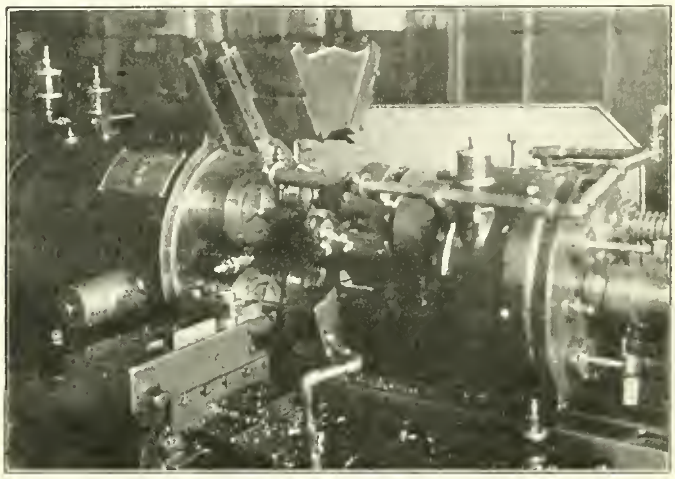


Fig. 5—Four-Spindle Automatic Adapted to Quantity Manufacture of Valve Motion Pins

With a modern six-spindle automatic screw machine these pins, 4¾ in. long, are blanked out, not including threading, at the rate of 14 an hour. This machine, however, can only be recommended for central shops or manufacturing concerns where the number of one design made at a time is in excess of 2,000 pins.

For the average shop, the four-spindle automatic screw machine (Fig. 5), or the single-spindle automatics appears to meet the requirements best when considering the time taken to set up tools and adjust the camming. With the latter machines pins 4¾ in. long are readily blanked out and threaded at the rate of 5 an hour, or with a battery of four machines, one man can turn out 20 an hour, not including machine delays. When made on turret lathes, the output for the above-mentioned motion work pins is about 6 an hour on an average.

Casehardening

Preparatory to casehardening, the threaded ends of the pins are covered with fire clay, and gas pipe caps placed over the clay to hold the latter in place, thus preventing the threads from hardening. The pins are placed in casehardening boxes along with a suitable compound; sealed; the boxes placed in a furnace and allowed to remain about 10 hours or the amount of time necessary for the hardening to penetrate at least 1/16 in. To caseharden properly, the furnace is kept at a temperature of about 1,650 deg. F., as shown by pyrometers, the pyrometer being a part of the regular casehardening furnace equipment.

On removal from the furnace, the box is opened and the pins quenched directly from the casehardening heat. While this does not refine the metal as well as when allowing the pins to cool off, be reheated and quenched, the results obtained by direct quenching meet all requirements.

Grinding Pin Bodies

The bodies of pins are now ground to sizes called for, keeping within the prescribed limits. Suitable machines for this purpose are the 10 in. by 24 in. or 10 in. by 36 in plain cylindrical grinding machine. The grinding wheels should preferably be about ¼ in. wider than the body of the pin, for by this means the wheel can be fed directly onto the work without lateral motion.

Some makes of grinding machines are equipped with automatic in-feed and throw-out attachments, by which the wheel is fed onto the work automatically a predetermined amount without lateral motion of work or wheel. This is a desirable feature for railroad production work as it permits the operator to remove and place driving dogs on the pins while other pins are being ground.

The operation of grinding is as follows: After first truing the wheel with a diamond, a pin is placed in the machine and ground to the required size, the diameter being measured with micrometer calipers. The automatic throw-out for in-feed of the wheel is then set for the desired diameter. After this, while grinding one pin, the operator removes the dog from the pin previously ground, places it on another pin, oils the center holes, etc. When the body of the pin in the machine is ground to the correct diameter, the throw-out automatically stops the in-feed of the wheel. The wheel is then backed off and the pin removed. The new pin is placed in the machine, the wheel fed in by hand until just touching the work, when the feed is engaged which automatically feeds the wheel the required amount. The same cycle is gone through for each pin. As a check, each pin is measured with micrometers when removed from the machine.

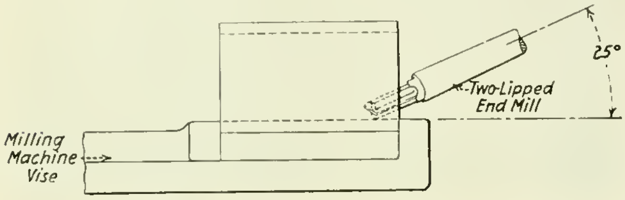


Fig. 6—Method of Milling Oil Grooves in Bushings

By this process, the grinding is almost continuous. With proper grinding wheels, the wheel wear is slight, but as each pin is measured, the throw-out for in-feed is reset to compensate for wear.

A good operator can grind from 20 to 30 pin bodies per hour, the ground surfaces being far superior to those obtained by filing.

Manufacturing Bushings

Bushings are preferably manufactured on single spindle automatic screw machines or turret lathes from bar stock or seamless steel tubing. When made from bar stock, the bar is drilled and rough turned at the same time; then finish turned and reamed; then cut off. The reaming is about 0.010 in. smaller than the size called for which allows for the final internal grinding. When made from seamless tubing having the correct external and inside diameters, the operations are reduced to that of cutting off. However, the internal diameter must be about 0.010 in. below standard to allow for final internal grinding, the same as with bushings made from bar stock. The question of using bar stock or tubing is determined by relative costs considering the price of material, labor and overhead.

After completing in the above machines, catalogue numbers are stamped on bushings; oil holes drilled using the drilling jig; and oil grooves milled as shown in Fig. 6. The milling cutter best adapted for the last operation is a two-lipped end mill about 5/16 in. in diameter. This cutter is used in a vertical milling attachment on a horizontal knee-type milling machine, the cutter being set to an angle about 30 deg. from the horizontal. When milling, the bushing is held on its two ends in a milling machine vise. The milling operation is as follows. The bushing is placed in the vise; the table raised until the mill sinks into the bushing the required depth at one end (the height of the table being governed by stops or a dial gage on the machine); the table is then fed the required amount to mill the oil groove; the table is lowered and the bushing removed. This results in a superior oil groove which only takes a fraction of the time required when forming with a hammer and chisel. The oil grooves are milled at the rate of 30 to 50 an hour.

The bushings are next casehardened and the bores quickly ground on internal grinding machines such as shown in Fig. 7. The principal requirements for this work are a rugged machine, quick means for holding bushings, and ability to caliper or gage the bore in the minimum amount of time. In other words, the speed of internal grinding is largely a question of the time consumed in chucking, stopping, starting and gaging.

With the chucking grinder (Fig. 7) the valve motion bushing is held in a 3-jaw universal chuck. The grinding wheel spindle is moved up to and away from the work by the large hand wheel. The operation of this hand wheel to the right also brings the universal chuck to rest, when, owing to the grinding wheel being so far removed, the work is readily gaged. By moving the handle wheel to the left, the chuck spindle is set in motion. The longitudinal feed for moving the grinding wheel back and forth in the bushing is thrown in. As a result of these little-time-savers, the grinding is almost continuous which increases the output to an extent where internal grinding is not an expensive operation.

In this work it is customary to make use of plug gages for sizing holes, the operation when grinding being to set the in-feed stop of the machine after grinding the first bushing to the correct size. After this the bushings are ground until the correct size is indicated by the feed stop. The hand wheel is then moved to the right and the bushing tested with a plug gage. If of the proper diameter, it is removed; if too small, the grinding is continued and the feed stop reset to compensate for grinding wheel wear.

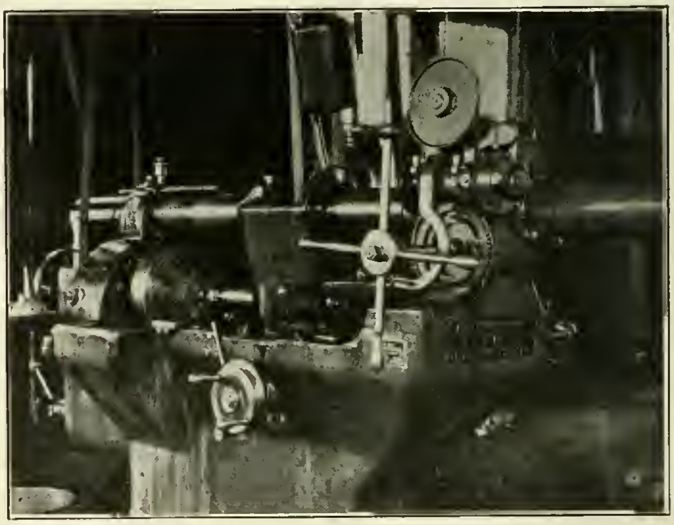


Fig. 7—Chucking Grinder for Finishing Bushing Interiors to Size

Fitting Pins to Valve Motion Levers

When levers are received in the repair shop, the taper holes are re-reamed either in a drill press or by hand just enough to remove rough spots and true the holes, care being taken not to enlarge the holes more than is absolutely necessary. When reamed in a drill press, floating holders or drive are employed to insure the most accurate reaming. The holes will of course vary in diameter and it is therefore necessary to fit each pin individually which is done quickly when the shop is properly equipped for this work.

After reaming and before fitting pins, it is necessary to measure the diameter of taper holes in clevises which is a slow operation without suitable gages. One of the most handy gages for this purpose is shown in Fig. 8 and its method of use in Fig. 1. This gage is about ¼ in. thick, made as follows: The two ends are centered; the edges rough ground to an approximate size and taper while revolving on the grinder centers. The gage is hardened; finish ground to standard taper; diameters stamped on the surface; and finally lines agreeing with the diameters are etched on one face so this side resembles a rule or scale. When etching, the gage is covered with wax, placed in a milling machine and graduated as follows: A point is carefully measured on the taper surface of the gage agreeing in diameter with a number or stamped size. A line is drawn at that point and the remaining lines are then drawn in the wax by a scratch point held in the machine spindle, the correct distances between graduations being indicated by a micrometer dial on the table lead screw. A line is generally placed on the gage to show the maximum size of re-reaming allowable which is a check against too great enlargement of holes. A convenient graduation for 1 in. taper per foot is to space the lines 0.120 in. apart, each line showing an increase in diameter of 0.010 in.

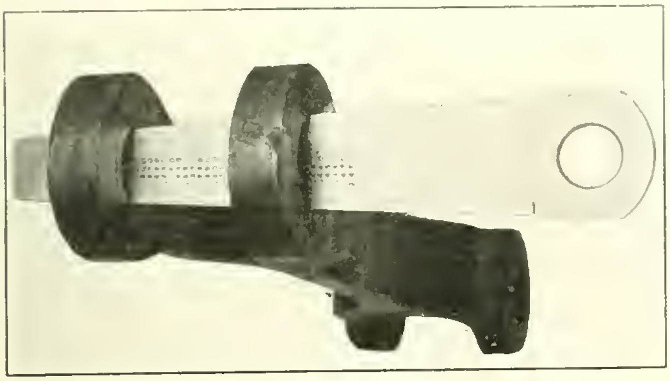


Fig. 8—Gage for Measuring Taper Holes and Checking Their Accuracy

Measuring Taper Holes in Levers

The flat gage is used both for checking the accuracy of reaming and sizing taper holes. For checking the accuracy of taper reaming, the gage is placed in a hole (Fig. 1), given about ⅛ in. turn which centers it in the hole, and tried for rocking or side motion at both ends. If there is an absence of side motion at both ends, the hole has been properly reamed. If there be side motion, it is an indication of improper reaming which at once calls attention to defective reamers or bad work when reaming.

Making use of gages of this kind in railway shops has a wonderful effect on the accuracy of reaming, which in turn tones up the general grade of work. Owing to the small amount of time taken to test the accuracy of a hole, practically all holes will be tested and should there be errors, the foreman will be in a position to fix the blame either on the reamer or workman who does the reaming. In other words, a check is available that can be made use of without elaborate preparations.

Grinding Taper Ends of Pins

Experience has shown conclusively that the taper ends of valve motion pins can be ground much quicker than by the past practice of turning and filing. Casehardened or soft pins are ground in practically the same time.

With hardened pins the grinding will at times cut below the hardened surfaces, but, as the two taper ends are a tight fit and not a running fit in levers, it is of but little moment if these surfaces are hard or soft. The principal requirement, as well understood, is to obtain a hard surface on the journal or body such as is insured with the processes of manufacture already explained.

The number of pins ground in a given time to fit rod jaws is in reality governed more by the appliances available and the way of going about the job than by the time the grinding wheel is actually cutting. In other words, it is the time between grindings that adds up and not so much the actual grinding. It therefore follows that any device which will reduce the time of handling should be utilized. Several devices for this purpose are explained below.

Driving dogs are used which screw on to the threaded ends of the pins as shown at *D*, Fig. 9. These dogs revolve free of the grinding centers, thus allowing the pins to turn on their own centers. The driving arm of the dogs is located at the side nearest the grinder headstock in order to prevent coming in contact with the wheel when grinding the smaller ends of pins. Driving dogs are applied or removed without the use of a wrench which is a small point but saves the operator picking up a wrench each time a pin is finished.

When preparing to grind taper ends, the grinding machine table (Fig. 9) is swivelled and set as near as possible to the required taper per foot from graduations marked on the end of the table. The grinding wheel is trued with a diamond and a pin placed in the machine. In order to prove the correctness of the angle to which the table is set, it is customary to grind the first pin a trifle larger than required and try it in the taper hole of the lever. The table is then given such final adjustments as may be necessary to insure a perfect fit of the pin. After properly setting the angle of the table, a large number of pins are ground without other adjustments.

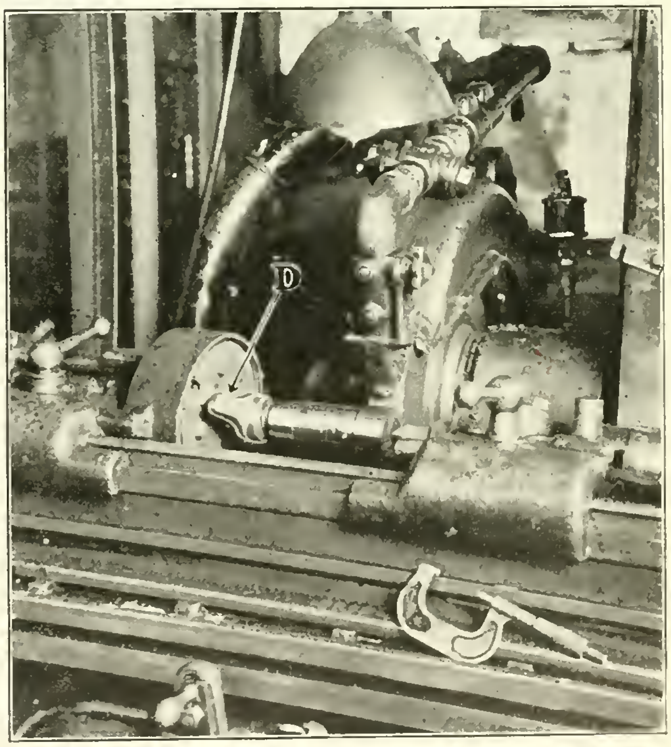


Fig. 9—Close-up View Showing How Taper End Bearings Are Ground

The taper ends are ground by feeding the grinding wheel directly on the work without lateral motion. The grinding and sizing operations are as follows: The smaller of the two ends is first ground, being measured with micrometer calipers, until the diameter nearest the body is the same as readings taken from the taper gage. When this end has been ground to the correct size, the throw-out stop for in-feed of the grinding machine is set to zero; the grinding wheel is backed off and transferred to the large end. The large end is then ground by feeding the wheel in to the same setting of the throw-out stop which results in finishing the large end to the same taper as the small end. The operator judges the the time when the grinding wheel should be stopped largely by the sparks thrown off.

Output of Fitted Pins per Hour

A skillful operator can grind the taper ends of practically all pins to fit the levers on the first trial. Assuming that the levers are located close to the machine, the output, including handling levers, measuring with a taper gage, grinding, and driving the pins into place, is from 6 to 10 pins an hour, or sufficient to meet the average requirements of a shop repairing 75 locomotives a month.

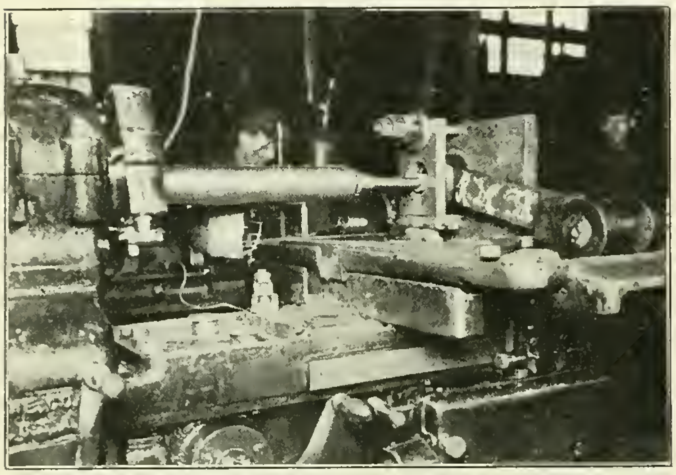


Fig. 10—Truing Worn Bushing Hole in Valve Motion Lever

Among the advantages gained by grinding may be mentioned the more accurate fitting owing to smooth surfaces; casehardened pins are finished as readily as soft; stock pins, economically manufactured by quantity production, can be used. From a repair shop operating standpoint, having these pins semi-finished and the bodies ground to sizes to fit the bushings is a decided advantage compared with older methods of making each piece individually, drilling cotter pin holes and where hardened pins are used, waiting for casehardening.

Fitting Bushings to Levers

In order to correct the defect, shown graphically at *C*, Fig. 4, it has been found good practice to true the holes in levers before applying bushings. In repair work practically every lever hole is of a different diameter and to attempt to ream the holes would require a large number of reamers. The time required for reboring is prohibitive. Either method results in an excessive enlargement of holes which shortens the useful life of levers. Practice has shown that the holes are trued quickly and accurately by grinding on planetary internal machines, such as shown in Fig. 10.

The operation of grinding a link foot hole, well shown by the illustration, is as follows: The link or lever is bolted to an angle plate, on the grinder table. (For long levers or rods, such as the radius and eccentric rod, the outer ends are supported by chains attached to a jib crane.) The table is adjusted vertically and horizontally so that the planetary movement of the spindle causes the wheel to grind an equal amount on all sides of the hole. The dogs controlling the longitudinal travel of the table are set and, if necessary, the wheel is trued with a diamond. During the grinding, the table and work automatically travel longitudinally, the wheel spindle eccentricity being gradually enlarged by hand as the hole is enlarged. This is continued until high spots or irregularities are removed, resulting in a true hole, enlarged only the minimum amount.

As a general rule, it is advisable to grind holes for bushings in valve motion levers when they differ more than 0.003 in. from a true cylinder. This must be understood to mean the amount the hole is out of round and not the actual diameter of the hole. Owing to the quick method of fitting bushings next explained, the diameter of holes in levers from a repair shop standpoint is not important.

Under conditions met with in repair work, practically no two holes in valve motion levers into which bushings are pressed are of the same diameter which makes it necessary to finish the outside of each bushing to a different diameter. In practice, either hard or soft bushings, such as shown in Table 2, are quickly ground on the outside to meet this condition of varying sized lever holes.

Calipering Hole Diameters

For calipering the diameters of holes in levers, a sliding triangular gage is used similar to the one described in detail on page 711 of the December, 1922, *Railway Mechanical Engineer*. In using this gage it is tried at several angles for the purpose of detecting errors in roundness, the latter being indicated to a person accustomed to its use by the rocking motion or "feel" in different positions. When there is a question as to the necessity of grinding a hole, the diameter is measured at the larger and smaller diameters and should this variation exceed 0.003 in., the lever is sent to a planetary grinder for truing defective holes. In the event of the hole being satisfactory, its diameter is ascertained by measuring over the projecting end of the gage with micrometer calipers, a person accustomed to this work measuring a hole in less than ½ min. This gage has the advantages of speed, accuracy and the use of one micrometer for measuring both the diameter of the hole and outside of the bushing.

Bushings, as shown in Table 2, are finished complete, including grinding the bores at the time of quantity manufacture. Therefore, all that remains to be done is to finish the outsides to a size suitable for a force fit in the levers. This is economically done on 10-in. by 36-in. plain cylindrical grinders.

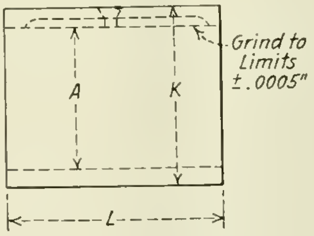


Table 2—Proposed Step Sizes for Valve Motion Bushings

Step sizes	A	K	L
Standard	1½ in.	1⅞ in.	2¼ in.
A	1½ in.	2 in.	2¼ in.
B	1 9/16 in.	2 1/16 in.	2¼ in.
C	1⅝ in.	2⅛ in.	2¼ in.

When fitting a bushing, the diameter of the hole in the lever is measured with the triangular gage and micrometer, a suitable bushing for the class being selected from stock and placed on an expanding arbor in the grinder. The diameter is then ground from 0.003 to 0.004 in. larger than the lever hole, the diameter of the bushing being measured with the same pair of micrometers used on the triangular gage. For short bushings it is the practice to feed the grinding wheel directly on to the work; for bushings where the length is greater than the wheel width, traversing motion is used.

Assuming that the levers are located close to the machine, thus avoiding the necessity of the operator traveling long distances when obtaining measurements, from 8 to 10 bushings are ground in an hour, including the measurement of lever holes.

As previously mentioned, the bores of *A* bushings (Table 2) and *A* pins (Table 1) for the same class of locomotive and part are ground to the proper diameter for a running fit on each other. When the lever holes have not been enlarged to any great extent, both *A* bushings and pins are used. As a result, the companion parts, such as lap and lead lever and lap and lead lever connector to crosshead, are bushed or pins applied without pairing these two levers. This makes it possible to repair the entire lot of each kind of levers that may be in the shop and then repair another lot of different levers. All lap and lead levers available are bushed or pins fitted at one time. The same operation is gone through with for the links, the radius rods, the eccentric rods, etc. After applying, bushings and pins, the levers are placed on racks and used as the erecting shop needs them.

Where lever holes are badly worn, *B* pins and bushings are used. These are similar to *A* pins and bushings and pair with each other, but cannot be used with the latter. In case of excessive wear, class *C* pins and bushings are used which will not pair with class *A*, or *B*. Where conditions require large pins or bushings, the companion levers must be kept in pairs. Experience indicates that 90 per cent of all repairs can be made with class *A* pins and bushings.

Summary of Advantages

The advantages gained by standardizing are: First, quantity production at reduced cost, eliminating the work of fitting each individual pin to each bushing at the time of making repairs. From a repair shop standpoint, another great advantage is owing to the fact that the levers can be used on any locomotive of the same class; they need not be put back on the same locomotive and any lever for the same class of locomotive will pair up with its companion lever. Finally, the quality of the fitting and bearing surfaces is greatly improved, tending to increase the time between repairs and the effective life of motion levers and parts.

Fuel Consumption of Oil Burning Locomotives*

Data Obtained on Southern Pacific Facilitate Comparison of Steam and Electric Motive Power

By A. H. Babcock
Electrical Engineer, Southern Pacific Railroad

PART II

It will be of interest to follow a train from Kern Junction to Summit. All freight trains stop at Kern Junction to check the register, and for orders. The grade from Kern Junction to Magunden being light, the acceleration is high, and the speed at Magunden averaged about 38 miles per hour. According to the curve the fuel consumption per 1,000 ton-miles on a 0.1 per cent grade at constant speed would be 10.25 gallons. The actual fuel consumption as shown by "A" is 16.29 gallons. The difference (16.29 — 10.25 = 6.04) represents the fuel cost of acceleration. The grade from Magunden to Edison is 0.83 per cent. The speed of the train was reduced from about 38 miles to 30 miles per hour. According to the curve the fuel consumption should be 20.75 gallons, but the actual fuel consumption is 16.43 gallons. The difference (20.75 — 16.43 = 4.32) represents the fuel saved by using a part of the kinetic energy in the train. From Edison to Flag No. 1 the grade is increased to 1.16 per cent, the speed of the train is reduced to about 26 miles per hour, and point "C" is at the left of the curve. From Flag No. 1 to Flag No. 2 the grade is—1.22 per cent, the speed of the train is increased to 38 miles per hour, the kinetic energy is increased, and point "D" is at the right of the curve. From Flag No. 2 to Flag No. 3 the grade is 0.89 per cent, the speed is reduced to 31 miles per hour, and point "E" is at the left of the curve. From Flag No. 3 to Flag No. 4 the grade is 2.21 per cent, the speed is reduced to 17 miles per hour, and point "F" is at the left of the curve. From Flag No. 4 to Flag No. 5 the grade is 1.14 per cent, the speed is increased to 20 miles per hour, and point "G" is at the right of the curve. From Flag No. 5 to Flag No. 6 the grade is 2.31 per cent, the distance is over 23 miles, the drop in speed from 20 to 12 miles per hour has very little effect on the total fuel burned, and point "H" is on the curve. From Flag No. 6 to Tehachapi, the grade is 1.24 per cent, and although the train accelerated after passing Flag No. 6, which would tend to increase the fuel consumption, the train was brought to rest at Tehachapi and the kinetic energy in the train offset a part of the fuel that would have been burned at constant speed, and point "I" falls to the left of the curve. From Tehachapi to Summit the grade is 0.62 per cent. The train started from rest, therefore due to acceleration point "J" falls to the right of the curve. It is of interest to note that the actual test data illustrate the well known fact that kinetic energy can be exchanged for fuel and fuel for kinetic energy.

It is not considered that the results of this test should be depended upon for slight grades either positive or negative, because there is no section of level track between Bakersfield and Mojave. For grades of less than 0.5 per cent, both positive and negative, the curve should not be depended upon for accurate results.

A locomotive of lower thermal efficiency than the No. 3614 would burn more fuel for any given grade than that shown on the curve. The result would be a flatter curve. On the other hand a locomotive of higher thermal efficiency would burn less fuel than shown and the curve would be steeper. It is, therefore, apparent that the slope of the curve is a function of the efficiency, and the steeper the curve the higher the efficiency.

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*A paper presented at the spring convention of the American Institute of Electrical Engineers at Pittsburgh, Pa., on April 25. This is the second part of an article in two parts. The first part described a method employed for securing an accurate measurement of the efficiency of an oil-burning steam locomotive in moving a 1,000-ton train over a given piece of track. The following describes the manner in which the method was applied and includes the results obtained.

Fuel Required

From the curve, the fuel required per 1,000 ton-miles on a 2 per cent grade equals 38.0 gallons, and for a 1 per cent grade equals 23.3 gallons. The difference (38.0 — 23.3 = 14.7) represents the fuel burned moving a 1,000 ton train one mile over a 1 per cent grade without friction; because both the 38.0 and the 23.3 gallons are for grade resistance plus train friction, the train friction being the same in each case, the difference is for a differential grade resistance of 1 per cent. A 1 per cent grade resistance is 20 pounds per ton. Then the work done in moving the given train one mile over a 1 per cent grade without friction equals 20 × 1,000 × 5,280 = 105,600,000 foot pounds. This required 14.7 gallons of fuel or 14.7 × 8 × 18,000 × 778.1 = 1,647,082,080 foot pounds. The thermal efficiency equals 105,600,000/1,647,082,080 = 0.0641, or 6.41 per cent. It will be seen at once that this method of determining engine thermal efficiency is independent of train resistance at driver tires which, at the best, is a difficult matter to determine with accuracy.

The method used above for determining efficiency is based on a known weight of train, a known grade resistance and test values for fuel consumption, and should be very nearly correct.

The fuel burned on a 1 per cent grade for grade and train resistance is 23.3 gallons. If the train resistance equals X then:

$$(20 + X)/X = 23.3/(23.3 - 14.7)$$

From which X equals 11.7 pounds per ton.

This does not check with the assumed 7 pounds per ton, shown in Table V, because the 7 pounds covers only rolling friction, and the 11.7 pounds is for rolling friction plus locomotive internal friction, such as pistons, valves, and other engine parts. If Schmidt's 7 pounds is correct for the rolling friction then the difference, (11.7 — 7), 4.7, is the locomotive internal friction; this friction for the given train of 1,000 tons is equal to a drawbar pull of 4.7 × 1,000 = 4,700 pounds, or about 9.0 per cent of the total drawbar pull on the maximum grade of 2.31 per cent from Flag No. 5 to Flag No. 6.

As the negative grade increases, the fuel consumption is reduced until the negative grade resistance is numerically equal to the total frictional resistance of train and engine. The minimum fuel consumption of 2.5 gallons per mile as shown on the curve represents standby losses and should be about equal to the fuel burned standing on a siding with the train, which is 42.8 gallons per hour. Then 42.8/2.5 = 17.1 is the drifting speed of the train in miles per hour, that corresponds to the minimum consumption of fuel. The down grade speed limit for freight trains by order is 18 miles per hour. Evidently, then, there is a good compliance with orders. For heavy negative grades the fuel consumption is again increased, for pumping air for braking purposes.

The over-all efficiency determined by this test was 5.57 per cent. It is the ratio of the integrated foot pounds of work done by the engine whenever the drawbar pull was positive, to the total energy in the fuel used over the same time. Apparently it is constant for all grades greater than 0.5 per cent.

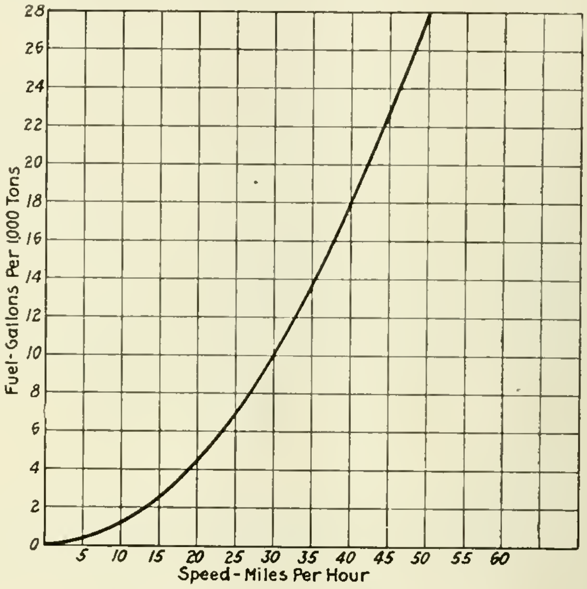

Fig. 6—Fuel Required to Accelerate 1000 Tons

Over-all thermal efficiency = 5.65 per cent

For a long time it has been known that drifting as much as possible saves fuel. Except on positive grades only, seldom is it possible to drift to rest. Fig. 6 gives a measure of the saving that may be made by taking advantage of favorable opportunities. The kinetic energy, in terms of fuel, in a 1,000 ton train moving at 50 miles per hour equals 27.74 gallons. If the engineer makes a sudden stop by heavy braking the greater part of this 27.74 gallons is lost in heat at the brake shoes. If his train schedule will permit him to drift down to 25 miles per hour before applying brakes the fuel equivalent for kinetic energy is 6.93 gallons, and 20.81 gallons of fuel will be saved. The curve shows that drifting to one-half of the normal running speed before applying brakes saves 75 per cent of the fuel equivalent for kinetic energy.

There has been much discussion of the question which train should take siding, when trains meet on a single-track line, that the maximum fuel economy should result. Many elements, other than fuel, enter into the total cost. The fuel burned chargeable to the meet is for two purposes: First for slowing down or stopping to throw switches, and second, for

TABLE III—GRADE AND CURVATURE—TEHACHAPI—EASTBOUND

Location		Distance miles	Rise feet	Total curvature degrees	Average grade per cent	Average curvature degrees	Per cent grade correction for curvature*	Equivalent grade per cent
From	To							
Kern Jct.	Magunden	3.4	17.8	.....	0.10	....	....	0.10
Magunden	Edison	3.1	135.7	.....	0.83	....	....	0.83
Edison	Flag 1	5.62	342.9	17.5	1.16	0.06	....	1.16
Flag 1	Flag 2	1.004	—68.9	99.3	—1.30	1.9	0.08	—1.22
Flag 2	Flag 3	6.225	268.9	589.5	0.82	1.8	0.07	0.89
Flag 3	Flag 4	0.892	89.0	376.3	1.89	8.0	0.32	2.21
Flag 4	Flag 5	2.179	115.0	417.5	1.00	3.6	0.14	1.14
Flag 5	Flag 6	23.355	2,575.0	6,751.0	2.09	5.48	0.22	2.31
Flag 6	Tehachapi	1.225	79.5	17.6	1.23	0.3	0.01	1.24
Tehachapi	Summit	1.8	58.5	.....	0.62	....	....	0.62
Summit	Flag 7	2.078	—46.0	.....	—0.42	....	....	—0.42
Flag 7	Flag 8	1.136	—65.0	13.6	—1.08	0.2	0.01	—1.07
Flag 8	Proctor	1.486	5.5	46.4	0.07	0.6	0.02	0.09
Proctor	Flag 9	1.488	—39.5	.....	—0.50	....	....	—0.50
Flag 9	Flag 10	0.852	—80.0	98.3	—1.78	2.2	0.09	—1.69
Flag 10	Flag 11	1.914	—50.0	27.9	—0.50	0.3	0.01	—0.49
Flag 11	Flag 12	8.637	—960.00	547.7	—2.10	1.2	0.05	—2.05

standby while waiting for the other train. The standby losses depend upon time rather than tonnage and have been discussed previously in the second group of factors.

As long as every movement of the train is in the normal direction that the train is traveling, only the extra fuel required for slow-downs or stops should be charged against the meet. Table V gives gallons of fuel burned running through sidings, distance in feet through sidings, weight of train, gallons of fuel that would have been burned moving the same distance on the main line, and the extra fuel burned.

TABLE IV—FUEL PER 1,000 TON-MILES—TEHACHAPI

Section		Gallons of fuel per 1,000 ton-miles	
		Eastbound	Westbound
Kern Jct.	Magunden	16.29	6.31
Magunden	Edison	16.43	2.93
Edison	Flag 1	20.86	3.13
Flag 1	Flag 2	6.11	21.03
Flag 2	Flag 3	16.31	3.50
Flag 3	Flag 4	30.71	2.24
Flag 4	Flag 5	26.39	3.35
Flag 5	Flag 6	42.43	2.77
Flag 6	Tehachapi	23.17	4.71
Tehachapi	Summit	20.59	4.24
Summit	Flag 7	5.62	15.19
Flag 7	Flag 8	1.62	15.33
Flag 8	Proctor	6.73	11.27
Proctor	Flag 9	4.35	22.14
Flag 9	Flag 10	2.70	27.17
Flag 10	Flag 11	4.30	19.82
Flag 11	Flag 12	3.06	46.56

An analysis of results indicates that taking siding on a heavy grade was quite different from taking siding on a medium grade. The first group in Table No. V is for grades over 2 per cent, and the second group for grades less than 2 per cent. The average fuel cost of taking siding on grades of over 2 per cent is 18.3 gallons. For grades materially less than 2 per cent no extra fuel was burned. The trains do not move at a speed of over 12 miles per hour up heavy grades, so that the fuel required for acceleration is less than 2 gallons per 1,000 ton train. Brakes are applied to hold the train rather than to stop the train. It is believed therefore that the extra fuel burned taking siding on heavy grades is due to the fact that the slow, heavy starting and pulling works the engine beyond its most efficient point, and in several cases the locomotive slipped its wheels. On light grades a freight train moves at a speed of 20 to 35 miles per hour. But trains take siding at low speed on all grades. The drawbar pull per ton is greater at high speed than at low speed, and the fuel saved by moving through sidings at a low and more efficient speed offsets the fuel loss due to braking. It is felt that these results should be applied in general with caution, because fuel used varied between wide limits.

TABLE V—FUEL COST OF MEET PER 1,000 TON TRAIN—TEHACHAPI

Trip	Fuel burned through siding gallons	Distance through siding feet	Weight of train tons	Fuel per 1,000 tons gallons	Fuel for equivalent distance main line gallons	Fuel cost of meet gallons	Station
			Grades Over 2 Per Cent				
2—E	44	4,374	1,030	42.7	34 0	8.7	Allard
4—E	70	4,544	1,018	68.8	35.2	33.6	Woodford
6—E	45	4,544	1,001	45.0	35.2	9.8	Woodford
7—E	45	4,544	1,021	44.0	35.2	8.8	Woodford
8—E	51	4,544	1,018	50.2	35.2	15.0	Woodford
9—E	89	5,468	1,020	87.2	42.4	44.8	Rowen
9—E	45	4,291	1,019	44.2	33.4	10.8	Cable
3—W	40	4,013	1,067	37.5	31.1	6.4	Warren
7—W	65	4,287	1,089	59.7	33.2	26.5	Fram
	Totals		9,283			164.4	
	Average		1,031			18.3	per 1,000 ton train.
			Light Grades				
1—E	25	4,411	1,021	24.5	20.0	4.5	Bena
1—E	18	4,305	1,016	17.7	26.1	6.4	Ilmon
4—E	21	4,411	1,020	20.6	20.0	0.6	Bena
8—W*	22	5,315	1,064	20.6	22.2	—1.6	Cameron
			Total			—2.9	
			Average			—0.7	

The engineer is held responsible for the fuel charged to road service. Part of this fuel is burned in the actual progression of the train; the remainder is burned in locomotive or train movements incident thereto. The fuel burned in actual train movements depends upon the efficiency of the locomotive and the skill of the engineer. The fuel burned for miscellaneous purposes depends upon traffic conditions and the general efficiency of the division organization in handling traffic. In this discussion the ratio between the fuel burned moving the train and the total fuel charged to road service is called "Operating Efficiency, Fuel." The operating efficiencies for each trip, averages eastbound and westbound, and for all test trips, are shown in Table VI.

TABLE VI—OPERATING EFFICIENCY—FUEL—TEHACHAPI

Ratio between fuel burned moving train and total fuel burned from 30 minutes before leaving initial terminal until 10 minutes after arrival at home terminal.

Trip	Operating efficiency per cent
1—E	92.6
2—E	96.1
3—E	96.5
4—E	93.9
6—E	89.5
7—E	95.1
8—E	95.7
9—E	95.2
Average eastbound	94.3
1—W	88.3
3—W	90.7
4—W	87.1
5—W	87.7
6—W	93.0
7—W	89.6
8—W	85.1
Average westbound	88.7
Weighted average eastbound and westbound	92.5

TABLE VII—LOCOMOTIVE THERMAL EFFICIENCY—TEHACHAPI

For a Train of 1,000 Tons—Eastbound

Location		Distance		Equivalent grade per cent	Grade resistance lb./ton	Total resistance lb./ton
From	To	Miles A	Feet B	C	D C × 20	E D + 7
Firing up 90 min.		.....	.....	.....	.....	.....
Standby 60 min.		.....	.....	.....	.....	.....
Testing air 30 min.		.....	.....	.....	.....	.....
Bakersfield	Kern Jct.	0.7	3,700	0.07	1.4	8.4
Kern Jct.	Magunden	3.4	17,950	0.1	2.0	9.0
Magunden	Edison	3.1	16,370	0.83	16.6	23.6
Edison	Flag 1	5.62	29,670	1.16	23.2	30.2
Flag 1	Flag 2	1.004	5,300	—1.22	—24.4	—17.4
Flag 2	Flag 3	6.225	32,860	0.89	17.8	24.8
Flag 3	Flag 4	0.892	4,710	2.21	44.2	51.2
Flag 4	Flag 5	2.179	11,500	1.14	22.8	29.8
Flag 5	Flag 6	23 355	123,300	2.31	46.2	53.2
Flag 6	Tehachapi	1.225	6,470	1.24	24.8	31.8
Tehachapi	Summit	1.8	9,500	0.62	12.4	19.4
Summit	Flag 7	2.078	10,970	—0.42	—8.4	—1.4
Flag 7	Flag 8	1.136	6,000	—1.07	—21.4	—14.4
Flag 8	Proctor	1.486	7,850	0.09	1.8	8.8
Proctor	Flag 9	1.488	7,860	—0.50	—10.0	—3.0
Flag 9	Flag 10	0.852	4,500	—1.69	—33.8	—26.8
Flag 10	Flag 11	1.914	10,100	—0.49	—9.8	—2.8
Flag 11	Flag 12	8.637	45,600	—2.05	—41.0	—34.0
Flag 12	Mojave	0.709	3,740	—1.15	—23.0	—16.0
Mojave to engine-house 60 min		.....	.....	.....	.....	.....
Standing at stations 80 min.		.....	.....	.....	.....	.....

Such a ratio is a measure of the operating efficiency of the division organization. The high value determined by this test, 92.5 per cent, indicates a co-operation between dispatchers and train crews not often realized. It indicates also a very small margin of possible gain between steam locomotives, well handled, and the theoretical limit of the electric locomotive, 100 per cent less engine auxiliaries. A second track would undoubtedly raise this ratio; but single-track operation does not excuse a low efficiency.

Many changes have been made in locomotive design during the past few years. Larger units, higher boiler pressure, superheaters, and, more recently, the addition of feed water heaters and boosters, have gone a long way toward increasing efficiency. Though the locomotive used for this test is one of the well-known types for heavy mountain service, and was tested under its most economical load, yet the average thermal efficiency is less than 6 per cent; hence a slight numerical increase in this efficiency would result in a tremendous saving in fuel. For example, the Super Power Survey showed an expected fuel saving of 67 per cent in freight service, which means a thermal efficiency of about 8.5 per cent. Whether in electric service such a point is within reach, others must determine. In making such comparisons it is necessary to take account of the ratio, revenue freight weight to total train weight. In this study it was 0.743. In electric service it may be very different. The mechanical engineers of this country will hardly admit that they are satisfied with even the best engine yet designed. The efficiency determined during this test is lower than many published values, but, as a rule, such tests are made with picked locomotives, especially adjusted for the test and operated by the best crews.

Table VII—Part 2

Eastbound

Distance miles A	Total weight of train tons F	Total tractive effort pounds G E × F	Million ft. lb. at drivers constant speed H $B \times G/10^6$	Hp. hr at drivers constant speed I H/1.98	Thermal hp. hr. for 5.57 per cent efficiency J + only I/0.0557	Computed fuel gallons K J/0.01765
....	.....	....	.....	.....	.....	90.0
....	.....	....	.....	.....	.....	20.0
....	.....	....	.....	.....	.....	21.0
0.7	1,000	8,400	31.1	15.7	281.8	4.9
3.4	1,000	9,000	161.6	81.6	1,464.0	25.5
3.1	1,000	23,600	386.3	195.1	3,502.0	60.9
5.62	1,000	30,200	896.0	452.6	8,121.0	141.4
1.004	1,000	—17,400	—92.2	—46.6	.....	6.0
6.225	1,000	24,800	815.0	411.7	7,390.0	128.6
0.892	1,000	51,200	281.2	121.8	2,186.0	38.1
2.179	1,000	29,800	342.7	173.1	3,106.5	54.1
23.355	1,000	53,200	6,559.0	3,312.0	59.455.0	1,034.7
1.225	1,000	31,800	205.3	103.9	1,865 0	32.5
1.8	1,000	19,400	184.3	93.1	1,671.0	29.1
2.078	1,000	—1,400	—15.4	—7.8	.....	11 0
1.136	1,000	—14,400	—86.4	—43 6	.....	2.5
1.486	1,000	8,800	69.1	34 9	626 3	10.9
1.488	1,000	—3,000	—23.6	—11.9	.....	7 0
0.852	1,000	—26,800	—120.6	—60.9	.....	2.5
1.914	1,000	—2,800	—28.3	—14.3	.....	8 5
8.637	1,000	—34,000	—1,551.0	—783.0	.....	29.7
0.709	1,000	—16,000	—59.8	—30.2	.....	4.7
....	.....	....	.....	.....	.....	20.0
....	.....	....	.....	.....	.....	57 0
						1,840.6

Table VII—Part 3—Locomotive Thermal Efficiency—Tehachapi

For a Train of 1,000 Tons—Westbound

Location From	 To	Distance Miles A	 Feet B	Equivalent grade per cent C	Grade resistance lb./ton D C × 20	Total resistance lb. ton E D + 7
Firing up 60 min		....	....	....	....	....
Standby 30 min.		....		....	....	....
Testing air 30 min		....	....	....	....	....
Mojave	Flag 12	0.709	3,740	1.15	23.0	30.0
Flag 12	Flag 11	8.637	45,600	2.15	43.0	50.0
Flag 11	Flag 10	1.914	10,100	0.51	10.2	17.2
Flag 10	Flag 9	0.852	4,500	1.87	37.4	44.4
Flag 9	Proctor	1.488	7,860	0.50	10.0	17.0
Proctor	Flag 8	1.486	7,850	—0.05	—1.0	6.0
Flag 8	Flag 7	1.136	6,000	1.09	21.8	28.8
Flag 7	Summit	2.078	10,970	0.42	8.4	15.4
Summit	Tehachapi	1.8	9,500	—0.62	—12.4	—5.4
Tehachapi	Flag 6	1.225	6,470	—1.22	—24.4	—17.4
Flag 6	Flag 5	23.355	123,300	—1.87	—37.4	—30.4
Flag 5	Flag 4	2.179	11,500	—0.86	—17.2	—10.2
Flag 4	Flag 3	0.892	4,710	—1.57	—31.4	—24.4
Flag 3	Flag 2	6.225	32,860	—0.75	—15.0	—8.0
Flag 2	Flag 1	1.004	5,300	1.38	27.6	34.6
Flag 1	Edison	5.62	29,670	—1.16	—23.2	—15.2
Edison	Magunden	3.1	16,370	—0.83	—16.6	—9.6
Magunden	Kern Jct	3.4	17,950	—0.10	—2.0	5.0
Kern Jct	Bakersfield	0.7	3,700	—0.07	—1.4	5.6
Bakersfield to Enginehouse 60 min				....	....	....
Standing at station 106 min				....	....	....

It is not desired to give the impression that the values of factors given as the result of this investigation are absolute and applicable to all conditions. It is believed that this method of testing attacks the problem from an entirely different angle, from which it is possible to make, of certain factors, analysis in detail not otherwise possible.

Undiscriminating application of the results of this study easily may produce extremely inaccurate results; for example, where the conditions surrounding the particular problem bear only a remote resemblance to those of the line over which the tests were made. Weather, grade, service and many other conditions have their effect upon train operation. Similar tests should be made in passenger and freight, mountain and valley service, also with other types of power.

Table VII—Part 4

Westbound

Distance miles A	Total weight of train tons F	Total tractive effort pounds G E × F	Million ft. lb. at drivers constant speed H $B \times G/10^6$	Hp. hrs. at drivers constant speed I H/1.98	Thermal hp. hr. for 5.57 per cent efficiency J + only I/0.0557	Computed fuel gallons K J/0.01765
....	.....	.....	.....	.....	.....	90.0
....	.....	.....	.....	.....	.....	10.0
....	.....	.....	.....	.....	.....	21.0
0.709	1,000	30,000	112.2	56.7	1,017.5	17.7
8 637	1,000	50,000	2,281.0	1,151.5	20,670.0	259.7
1.914	1,000	17,200	173.8	87.7	1,574.7	27.4
0.852	1,000	44,400	199.3	101.0	1,811.3	31.6
1.488	1,000	17.000	133.6	67.5	1,211.2	21.1
1.486	1,000	6,000	47.1	23.8	427.1	7.4
1.136	1,000	28,800	172.8	87.3	1,566.7	27.3
2 078	1,000	15,400	169.0	85.3	1,531.7	26.6
1.8	1,000	—5,400	—51.3	—25.9	.....	9.9
1.225	1,000	—17,400	—112.6	—56.9	.....	6.8
23.355	1,000	—30,400	—3,748.0	—1,892.5	.....	86.2
2.179	1,000	—10,200	—117.3	—59.2	.....	9.1
0.892	1,000	—24,400	—115.0	—58.0	.....	2.1
6.225	1,000	—8,000	—262.9	—132.8	.....	26.0
1.004	1,000	34,600	183.4	92.6	166.7	28.9
5.62	1,000	—16,200	—480 7	—242.7	.....	24.2
3.1	1,000	—9,600	—157.2	—79.3	.....	10.5
3.4	1,000	5,000	89.8	45.3	813.7	14.1
0.7	1,000	5,600	20 7	10.5	187.8	3.3
....	.....	.....	.....	.....	.....	20.0
....	.....	.....	.....	.....	.....	75.5
						956.4

List of Factors
Table VIII

	Unit	Value
First Group		
Fuel to fire up with water at 60 deg. fahr.	Galions	167
Fuel to fire up with water at 120 deg. fahr.	Gallons	131
Fuel to fire up with water at 180 deg. fahr.	Gallons	96
Second Group		
Fuel to hold under steam, in enginehouse, without auxiliaries—per hour	Gallons	17.4
Fuel to hold under steam, out-of-doors, with auxiliaries—per hour	Gallons	36.6
Fuel to hold train on siding—per hour	Gallons	42.8
Third Group		
Train resistance—Hood & Schmidt	Pounds	7
Total train and locomotive resistance—level track	Pounds	11.7
Average overall thermal efficiency	Per cent	5.57
Maximum overall thermal efficiency	Per cent	6.41
Fuel per 1,000 ton miles per per-cent grade without friction	Gallons	14.7
Locomotive internal friction in terms of maximum drawbar pull	Per cent	9
Fuel cost of meet per 1,000 ton train on grades of 2 per cent or over	Gallons	18.3
Fuel cost of meet per 1,000 ton train on light grades	Gallons	0.0
Average operating efficiency—fuel	Per cent	92.5

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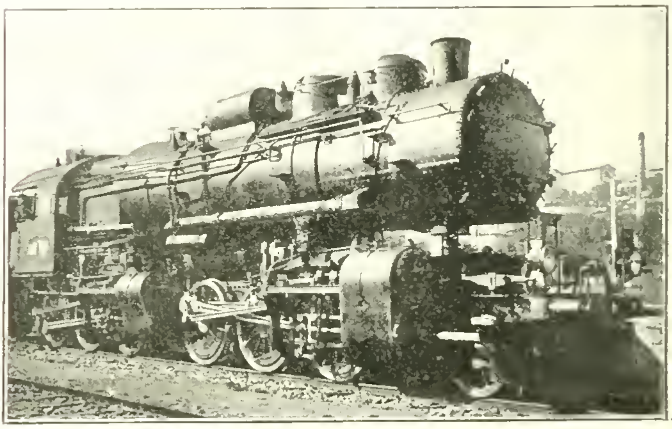
Mallet Locomotive With Brotan Boiler for the Hungarian State Railways

Tests on a Refrigerator Car Model

Experiments Indicate That the Side-Draft Bunker System is Superior to the Present Arrangement of End Bunkers

By P. X. Rice

THE tests on a model of a side-bunker refrigerator car described in this paper bring out marked advantages of this arrangement as compared with the present designs of end-bunker cars. These advantages are: (1) Quicker cooling of the load; (2) colder temperatures, especially in the upper layers of the load; (3) more uniform distribution of temperature through the load; (4) saving of ice by reduction of transmission through the floor; (5) entire length of car floor made available for loading; (6) length of cars not limited.

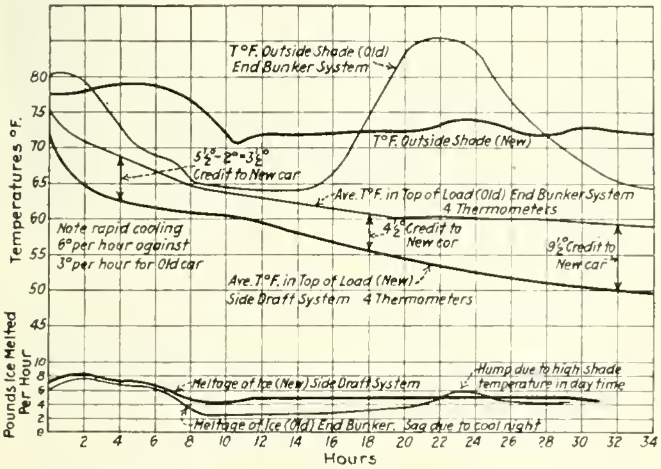

Fig. 1—Comparison of End-Bunker System with Side-Draft System on October 10, 1922

So far as the tests on this car indicate a conclusion, the side-draft system has all the above advantages over the ordinary end bunker arrangement, as shown graphically in Figs. 1, 2 and 3 which show the principal results instead of the large number of more or less unimportant thermometer readings taken during the test.

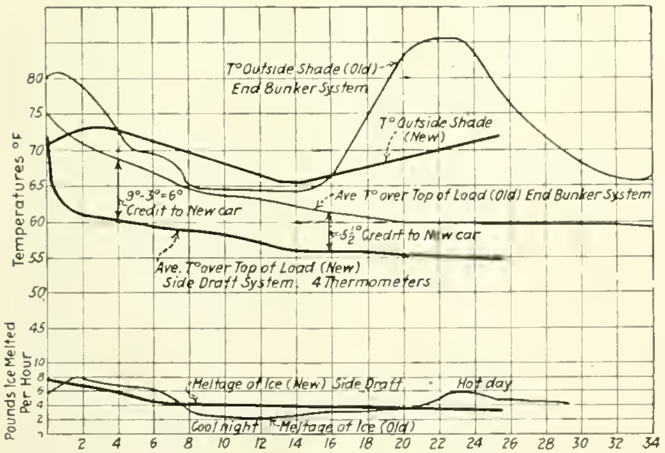

Fig. 2—Comparison of End-Bunker System with Side-Draft System on October 17, 1922

Test Car Arranged for End Bunker System

The model car was built to a scale of one-fourth the linear dimensions of the average of a large number of railroad cars of the end-bunker type. Inasmuch as this was designed to be a comparative test of a model, with different bunker arrangements, no attempt was made to duplicate the insulation commonly used on actual cars. Inside dimensions were as follows:

Total length inside, 10 ft. 0 in.
Length between bulkheads, 8 ft. 6 in.
Height, inside to ceiling, 21 in.
Width, inside, 24 in.
Clearance of floor rack above floor, 1¼ in.
Opening under bulkhead, 3 in.
Opening above bulkhead, 3 in.
Insulation of floor, sides and ends
  1 in. pine car wall and 1 in. air space formed by two thicknesses of building paper.
Insulation fo roof, 1 in. pine ceiling, one 1 in. air space and one ¼ in. air space, using one thickness of building paper per air space.
Insulation of bulkhead, 1 in. pine.
  Doors, none. Access to inside by removing roof which was fitted to car with sealing strips to prevent influx of atmosphere.
Bunker, wire basket type, depth, 15 in.
Bunker, wire basket type, length, 20 in.
Bunker, wire basket type, width, 7 in.
Cargo: 10 bushels of potatoes spread loosely over the floor rack to a height of approximately 14 in., except at center of car where an open space was left for circulation of air as usual.

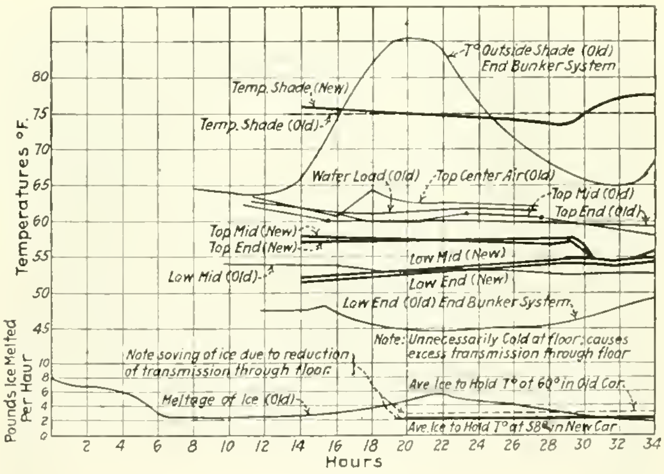

Fig. 3—Transmission Through Floor

Test Car Arranged for Side Draft System

After being tested with the end-bunker system, the bunkers and floor rack were taken out of the model car. Then the new type of side-draft and overhead-bunker system was built into one side and top of the car. Fig. 4 shows a general view of the inside of the car with load. Fig. 5 brings out the details of one of the new bunkers without the clearance screen, or grate, used to prevent ice from clogging the duct.[†] The best type of bunker tried is shown in Fig. 6. Fig. 7 shows the location of the bunkers with this arrangement and

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[*] This is part of a bulletin "The Economics of Refrigerator Car Installation" being prepared by the Pennsylvania State College Engineering Experiment Station under the direction of Prof. A. J. Wood, head of the Mechanical Engineering Department, who has for many years carried out investigations covering the design of refrigerator cars.

[†] The screen bag shown in the duct opening is not recommended, because with ice in the duct opening the air-flow down the duct is restricted so much that, although the air is found to be much colder, refrigeration of the load is not as rapid as with the grate type of bunker shown in Fig. 6.

indicates the position of the thermometers on the front and back sides and the two ends.

Location of Thermometers

Fig. 7 locates the thermometers named on the data sheets and curves, but an explanation is also necessary. "Outside shade temperature" was simply the temperature of the roof. Sunshine was kept off the car in order to simplify conditions. The "top end" and "top mid-temperatures" represent the temperatures of the top layer of potatoes near the front side of the car adjacent to the end of the load and of the upper layer of potatoes near the doorway, respectively. "Back top" corresponds in position to the "top end" except it is read from the back side of the car near the ends. "Top center" is the temperature of the usual warm air space between the doors, near the ceiling as shown. "Low end" and "low mid" temperatures were taken in the lower layer of potatoes. Under "Exploration" the observations named "Back side mid" and "end mid" are load temperatures about half way between the top layer and the lower layer of potatoes.

A large number of extra temperature explorations were made in all parts of the car, principally to insure that no unexpected temperatures existed. These investigations helped to improve the design of bunkers and space for circulating air, but would not interest the average reader and are not shown on the curves.

Procedure in Testing

Ten bushels of potatoes were dumped into the car, filling all the floor rack area, except at the doorways, to a height of approximately 14 in. Thermometers were placed in the holes marked "top end," "top mid," "low end," "low mid," "top center air," and "shade," temperatures of those portions recorded. Ice was broken into pieces of approximately 3 in. and 40 lb. was placed in each of the two bunkers. During the early periods of the tests, the above cycle of observations was repeated as rapidly as possible, but as soon as the temperatures of the load began to reach stable temperatures, the time interval between cycles of readings was increased to several hours. Some of the tests were continued with stable load temperatures as a measure of heat transmission through the car walls. Shade temperature on the later tests was regulated to maintain a temperature comparable to the earlier tests; for this purpose the steam heating system of the building was controlled.

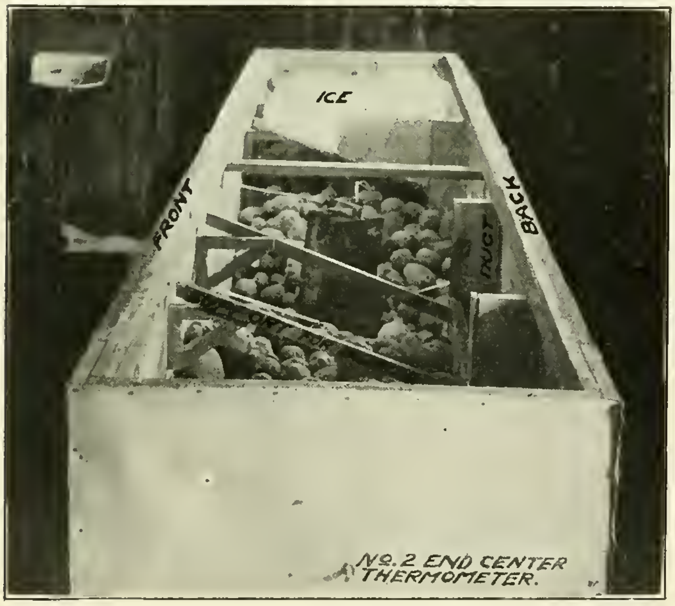

Fig. 4—General View of Side-Draft Car Model

Meltage of ice was recorded by catching and weighing the water dripping from the pans under the bunkers. Sometimes the small drip pipes became clogged and caused irregular meltage rate graphs, but this occasional error was not sufficient to interfere with the work, as the accumulated water in the drip pan was weighed as soon as the drip pipe could be cleared. The ice was allowed to melt down considerably nearer exhaustion than occurs in railroad service so that the effect of low ice could be observed, but the original charge of ice was sufficient to permit a test of the rapidity of cooling of the load. To test the transmission of heat through the walls of the car equipped with the side-draft system of bunkers, it was necessary to let the ice become exhausted until the top of the load warmed up to the temperature carried by the less effective end-bunker system, then the down-draft ducts were closed with boards to stop duct circulation, and a single 20 lb. cake of solid ice was placed in each bunker to maintain the temperature.

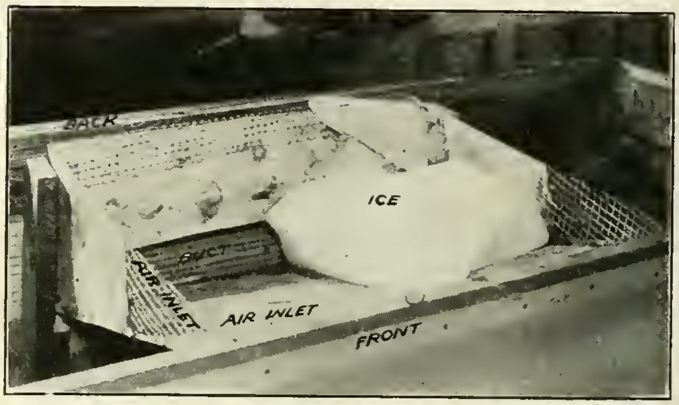

Fig. 5—Side-Draft Bunker Without Grates

Test Results

1. *Rapid Cooling.* In the comparative tests of the model car, it was found that the side-draft system cooled the load at the rate of 6 deg. F. to 10 deg. F. the first hour, as compared with 3 deg. F. per hour for the end-bunker system. (See Figs. 1 and 2.) Proper allowance was made for the fact that in the new car the temperature at the beginning of the test was 2 deg. F. to 3 deg. F. cooler than the load in the end-bunker system. During this period the consumption of ice per hour was substantially the same in the two systems, although the new car was doing more work of refrigeration. This is probably due to the excessively cold floor in the old car (see Fig. 3), which caused excess transmission through the floor and melted some of the ice not used for refrigeration.

In devising the side draft system with the bunkers near the top of the car, several arguments which predicted rapid cooling and cold carrying temperatures presented themselves as follows:

(a) The distance traversed by the air circulating from the bunker down through the draft-duct at the side of the car, along the floor to the opposite side or to the end or to the middle of the car, is much shorter than in the end-bunker system. The distance traveled in a complete circuit of the new model car is only approximately 8 ft. instead of 14 ft. as in the end-bunker system. For long express cars the advantage would be even greater. Thus, the frictional resistance to circulation is reduced. Furthermore, each pound of cold air has to absorb less heat and therefore is more effective for refrigeration.

(b) The cross sectional area of the above mentioned air circuit may be made quite large simply by extending the bunker and draft ducts along the length of the car as far as desired; even then, there is more floor space available for load than is possible in the end-bunker car. In practice the proportions of dimensions shown in Fig. 7 are expected to satisfy the temperature requirements of all perishable products.

(c) Circulation depends also on the driving pressure, in this case the difference in the weights of cold and warm columns of air. In the end-bunker system when the ice is half exhausted, only the lower half of the column of air in the bunker space is cold and the effective driving force is considerably reduced. This results in considerably slower refrigeration (see Fig. 8, which compares the temperatures of two similar cars in a transcontinental test trip). Car No. 8505 was not re-iced at one of the regular stations where car No. 7757 was re-iced. It will be seen that the partial exhaustion of ice in the bunkers of car No. 8505 did not interfere with chilling of the air while passing through the bunkers; in fact, the record shows that the air emerging from the bunkers with low ice was slightly colder than in the bunkers full of ice. But circulation was affected unfavorably, as shown by the warmer load temperatures of car No. 8505. If the bunkers of car No. 7757 had been kept even fuller and the bunkers of car No. 8505 had been more nearly exhausted, say one-eighth full, the advantage of having ice placed at the top of the draft duct would have been even more pronounced. In the proposed side-draft system the ice is near the ceiling and the natural convection is not appreciably lessened when the ice in the ceiling bunkers is almost exhausted.

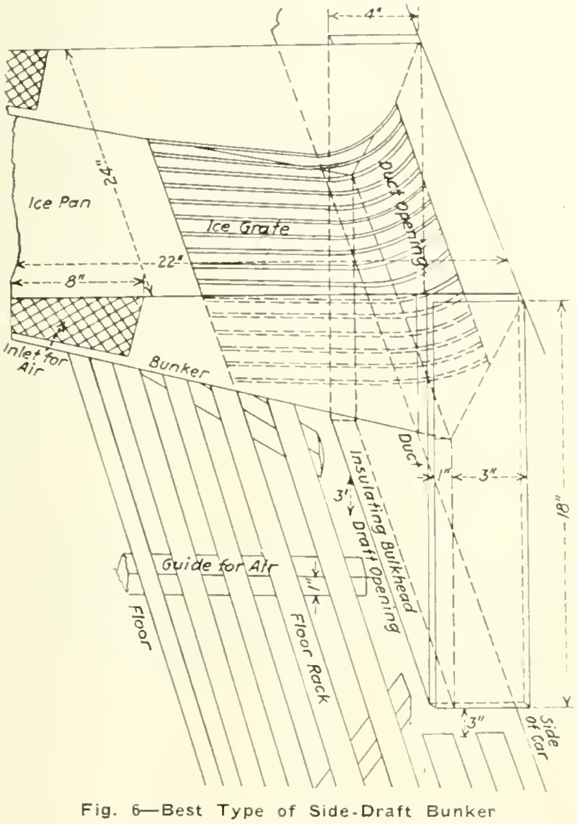

Fig. 6—Best Type of Side-Draft Bunker

(d) The sheet metal bottom of the bunker has considerable heat absorbing surface. Referring to Fig. 3, it will be seen that even with the draft duct closed in the new car the temperatures in the top layer of load was lower than in the end-bunker car. For certain kinds of perishable commodities it would be desirable to close a damper in the side-draft duct, after sufficient heat had been extracted by the draft system, so that excessively cold temperatures would not be attained.

(e) Uniform distribution of temperatures throughout the load was predicted by tests on the well known type of cars having the refrigerating surfaces near the ceiling.

(f) Floor temperature will not be as low in the side-draft car and if other conditions were the same as in the end-bunker car, the transmission of heat through the floor would not be so great.

(g) On account of the very rapid cooling of the load possible in the side-draft car, it may not be necessary to precool for the shipment of certain perishable commodities if the time between icing stations is not unusually long.

2. *Colder Temperatures.* Figs. 1 and 2 show that the top layer of potatoes were maintained at a temperature from 5½ deg. F. to 9½ deg. F. colder in the new car than in the end-bunker system. Particular attention is directed to the top of the load because it is there that spoilage of cargo usually occurs. It is believed that further refinements of the side-bunker system would give it as much advantage in this respect as could be desired. Furthermore, it would be possible to provide more than double the area of heat absorbing surface on the steel bottom of the bunkers and double or treble the cross sectional area of the ducts, so that nearly freezing temperatures could probably be carried in all parts of the car if desired, or the use of salt or brine tanks would probably freeze meat cargoes more securely than ductless systems can, and in a shorter time.

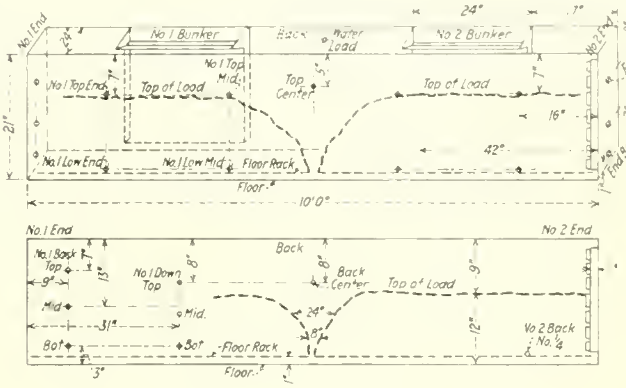

Fig. 7—Location of Thermometers in Model Car

The reason for the colder carrying temperature observed in the new car is the same as that described in connection with the rapid cooling.

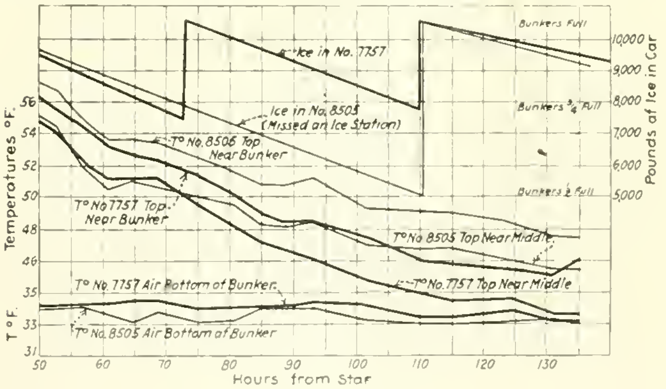

Fig. 8—Advantage of Ice Near Ceiling of Car

3. *Uniform Distribution of Temperatures.* Fig. 9 shows how evenly the temperatures are distributed in the various parts of the load. For comparison the temperatures in the old end-bunker type of car are shown in Fig. 10. In the side-draft system the load temperatures did not at any time differ more than 5 deg. F. from the top of the load to bottom of the load, whereas the end-bunker car permitted almost 20 deg. F. temperature difference. In actual refrigerator cars of the end-bunker type, it is common to find a difference of 35 deg. F. between the top and bottom of the load

at the beginning of a trip and 20 deg. F. at the end of 48 hours.

4. *Saving of Ice.* The primary purpose of the side-draft system is to give superior refrigeration rather than to save ice. If the new cars are built and operated so as to produce considerably greater refrigeration than is supplied by the old end-bunker cars, with no increase in insulation, the consumption of ice will be as great or greater (see Figs. 1 and 2). Each unit of work of refrigeration requires a definite amount of ice meltage. But a large part of the ice is also consumed on account of transmission of heat through the floor, sides, and roof of the car, and any economy of ice must be obtained by reducing this loss to a minimum. In the new side-draft system the loss of ice due to transmission, for a given load temperature, is reduced by having the ice near the load where useful heat abstraction takes place and not by cooling the floor excessively as is done in the end-bunker system. For equal temperatures in the top, or critical portion of the load, the side-draft system saves ice (see Fig. 3). With the side-draft system it may be necessary to use dampers in the draft ducts to reduce the rate of refrigeration to equal the refrigeration of the end-bunker cars, especially when the desired carrying temperatures have been attained.

5. *Length of Car Available for Load.* Calculations show that 95 per cent of the entire floor space is available for load as compared with 80 per cent in end-bunker cars. This represents an important economic gain, if the space occupied by the draft ducts at the side of the car does not disturb the present standard loading customs of shippers who might dislike to re-arrange their fruit boxes on a longer and somewhat narrower floor. It is possible to dispose of the ducts in the walls of the car if they be made thin, but if this is done the air circulation might not be much better than in the present end-bunker cars.

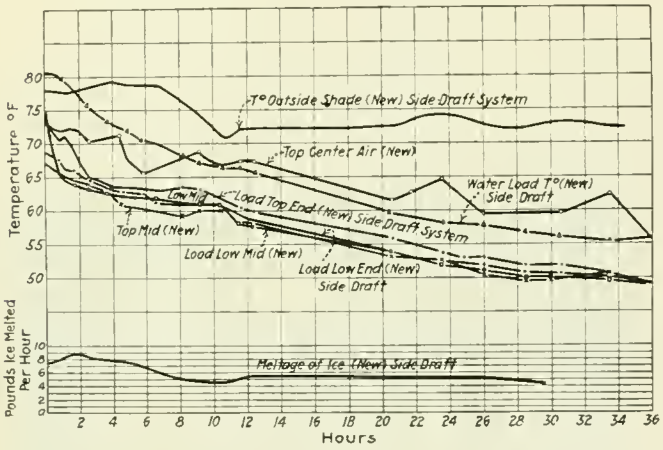

Fig. 9—Temperatures with Side-Draft System Were Comparatively Uniform

6. *Length of Cars not Limited.* It is conceivable that 60 ft. cars can have bunkers of the side-draft system placed much nearer to the center of each half of the load and that the length of draft ducts may, for especially difficult service, be placed along the entire length of the car on one side except at doors. The ice hatches in the roof need not be very numerous because the bunkers do not have to be as long as the ducts.

Recommendations

It is recommended that railway car owners and car builders test the side-draft system in an actual railway car with the same dimensions and insulation as one of their standard end-bunker cars, comparing the two types of cars during an actual trip with some especially perishable load, observations being made to check the first four claims previously made. Experience may suggest additional improvements. It is suggested that further study be made of various types of bunkers such as shown in Figs. 5, 6 and 11. The problem may be to arrange for the air passing through the bunker to be cooled almost to the temperature of the ice or ice and salt but without impeding the circulation of the air. However in the tests it was found that low resistance paths through the bunker provide quicker refrigeration than is possible with the air forced into more intimate contact with the ice at the expense of air friction. Perhaps the scheme in Fig. 11 which causes the air to flow up through the ice and then down through the ice again before entering the draft duct would be superior to the bunker used in the tests, but the increased air friction would probably reduce the rapidity of refrigeration.

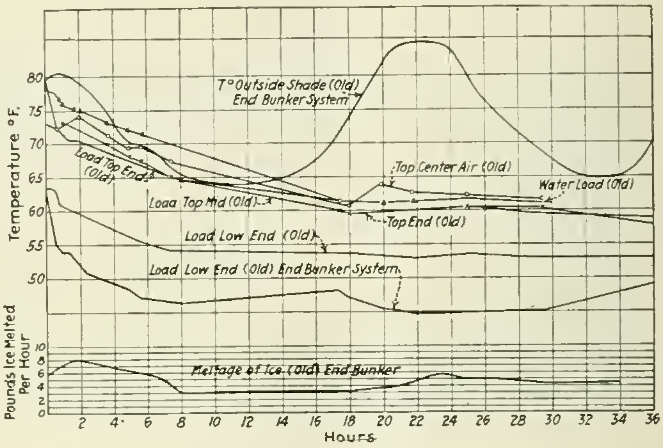

Fig. 10—Temperatures with End-Bunker System Showed Considerable Variation

So far as can be predicted no further development is required to make the side-draft system superior in all respects to the end-bunker type, but the prospective owners of such cars will profit by developing the car to its utmost before building them in large numbers. Changes may be required to conform to structural requirements. The ice must be supported in the top of the car and hatches arranged so that the ice crews can work effectively. It may be necessary to

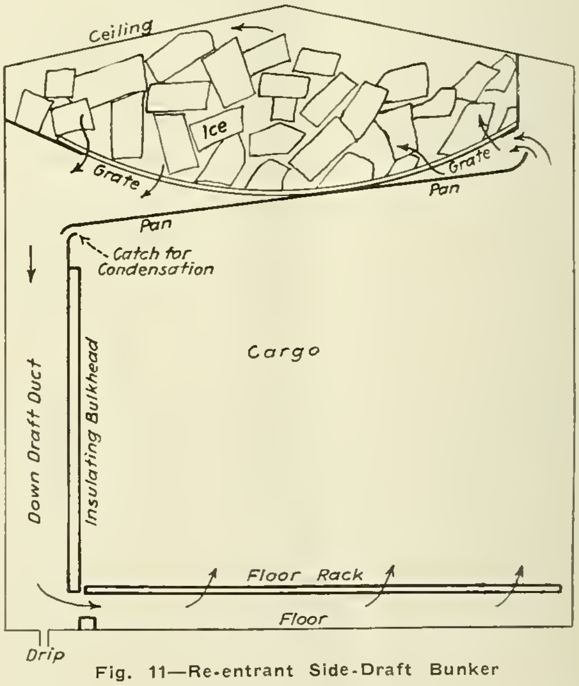

Fig. 11—Re-entrant Side-Draft Bunker

provide dampers in the draft ducts to prevent excessively low temperatures, or the size of draft ducts and bunkers may need to be reduced.

After the best possible bunker and draft system has been tested to satisfaction the system can then be tried in cars of 50 ft. or 60 ft. lengths. It is believed that the side-draft system will be especially advantageous for long cars. Three lengths of cars and locations of bunkers are shown in Figs. 12, 13 and 14. It was found by test that a considerable improvement was made by providing an "up duct" (see Fig. 14) to aid circulation at the ends of the car. It is also essential to have guides or vanes under the floor rack to cause a proportionate share of cold air to flow toward the ends of the car (see Fig. 6).

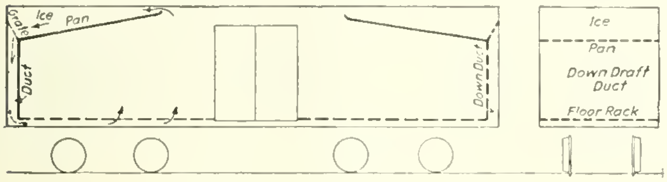

Fig. 12—End-Draft Bunkers for Short Cars

As yet it is not known what provisions must be made to care for the inevitable condensation on the under surface of the bunker. During tests on the model car no water dripped onto the potatoes though there was a slight deposit of dew on the bottom of the bunker. If the condensation had increased considerably, as it might with a load of moist vegetables, the moisture on the bunker bottom would have run down to the duct where it would drip down between the insulated bulkhead and the metal chute or "down duct" into the drip pan at the bottom of the duct where all the ice water was caught for drainage. Whether dew would be shaken off the inclined bunker bottom by the motion of the train before gliding to the duct is not known. Possibly a pan would be required under the bunker with a few inches of space to allow air to circulate.

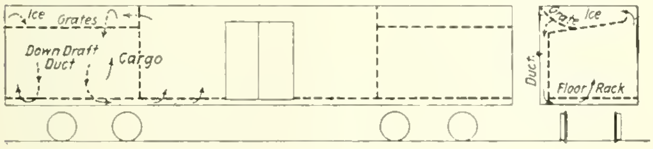

Fig. 13—Side-Draft Bunkers for 50-ft. Cars

The bunker iron must be thick enough to be water tight despite abuse. In designing the ice grates in the bunker they should be made inclined so that the ice will always keep sliding down toward the draft duct and keep that opening fairly well covered with ice as long as any ice remains in the car. Bars of iron are better than wire netting which would cause the ice to lodge some distance from the center of the draft duct.

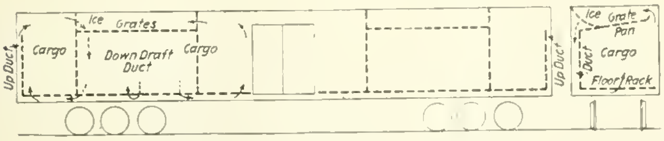

Fig. 14—Side-Draft Bunkers for 60-ft. Cars

No experiments were made on the ventilation performance of the new car. Probably the best and simplest way to accomplish ventilation is to use the ice hatches, the forward hatches discharging air to the bottom of the forward half of the car while the rear hatches exhaust air from the bottom of the rear half of the car.

There remains the problem of heating the car to protect its cargo in cold season. No attempts have been made to improve on the effectiveness of the heating systems used in existing types of cars. If charcoal heaters are to be used in the ends of the new cars as is done in the end-bunker cars, it will be necessary to insert bars across the car to prevent shifting cargo from demolishing the heaters.

The Inspection of Freight Cars*

By Emil Erickson

Foreman Car Department, New York Central, Chicago, Ill.

There is so much that can be said about freight car inspection that I am not going to try to cover everything, but will confine myself to the principal subjects.

First—Inspection of cars on arrival in receiving yard.

Second—Inspection of cars in classification yard.

Third—Inspection of cars at miscellaneous loading points.

Fourth—Inspection of cars on repair or shop tracks.

My thought in setting out the plan outlined below is that it is desired to get the best possible inspection and get cars in such condition so as to enable the transportation department to make the highest possible speed with trains over the road and also to prevent the loading of bad order cars.

In order to secure the best results in this respect it must be always borne in mind that there should always be sufficient time allowed on trains and sufficient help to do the necessary work in the proper manner.

Inspection in Receiving Yard

On arrival of cars in receiving yard, the track must be properly protected by flag or light and where work is done that requires men going underneath cars, the track should be locked for the protection of the men doing this work. It is well to give the inbound trains an air test in order to locate any defective air brakes. Where conditions permit, these defective brakes can be taken care of out in the train yard, otherwise they must be sent to the repair track. Giving the inbound train this air brake test on arrival, prevents getting any of these defective cars made up into a train and later on making it necessary to switch them out.

The train should be carefully inspected for any other defective cars that have to go to the repair track for repairs. All defects that can be repaired in the train should be marked "repair in train." Any loaded cars having defects such as should be repaired before reloading, should be carded to the repair track or shop when empty in order to avoid reloading of this car before repairs are made. Empty cars should be carefully inspected and carded for the class of commodity they are fit to carry. Bad order cars should be carded to repair tracks or shops for repairs.

It is the intent of the above outline to get all cars properly inspected and carded on arrival in the receiving yard so as to prevent any unnecessary switching and handling of cars. No loaded car should be cut out and sent to the repair track that can be repaired in the train, as this means delay as well as extra expense of handling. Cars inspected for the loading of powder and other explosives should never be inspected except in daylight, as it is almost impossible to make proper inspection by lamplight, and the man making this inspection should be familiar with all instructions governing this class of lading. This should also refer to cars for the loading of flour, grain, merchandise and other classes of lading that require a car with a watertight roof, sides and ends. In making inspection of cars for this class of lading, inspectors should always be instructed to keep the proper records and follow out instruction issued by the railroads they are working for.

Inspectors should be instructed to give careful attention to the inspection of running gears, draft gears and safety appliances; particular attention should be given to the brake connection pins and cotters, brake beams and hangers, brake hanger bolts and cotters, box bolt and column bolt nuts, arch bars, truck sides and wheels, knuckle pins, etc.

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*Paper submitted in Prize Contest on Car Inspection.

Loose and worn box bolts and missing oil box covers generally indicate flat or shelled out wheels. Close inspection should be made for wheel defects such as worn or broken flange, seamy and hollow treads, broken brackets and plates. Defective draft rigging can generally be noticed by broken striking plates, coupler pulled out too far or coupler horn back solid against the striking plate.

Inspecting Cars in Interchange

Cars coming from connections should be carefully inspected for delivering line defects to protect the receiving line against such defects that are chargeable to the delivering line. However, in this connection it might be stated that inspectors at interchange points should be taught not to be too technical in receiving cars from connections as there is no need under the present A. R. A. rules for any inspector to hold up cars in interchange unnecessarily. This refers particularly to loaded cars as it is more important to get the load to destination than to hold the car up for some minor defect.

Empty cars offered in interchange on orders for certain classes of lading should be carefully inspected to see that they are fit for such lading to prevent them from being moved from the point of interchange to the loading point and afterwards rejected at the loading point.

Inspectors should be carefully instructed in keeping proper records as to cars carded bad order, defect and cause, cars carded for lading, etc. Reports should be made out for all cars damaged in yard or train service, giving full information as to how the damage occurred. All necessary information should always be shown on bad order cards as well as damage reports as to how damage was caused and all records should be carefully checked to see that they conform to the A. R. A. rules.

Car inspectors should never be expected to keep records of seals, records of contents, destination or other transportation records, as the inspector has enough to keep his mind on if he takes care of his own work properly. This, of course, does not refer to small unimportant points where the work is limited.

Inspection in Classification Yard

After the work has been properly completed in the receiving yard and trains are made up in classification yard, the air brake men should give the train the standard A. R. A. air brake test and in addition to this make an inspection of the train for any defects that may have developed in yard switching, in order to prevent any cars that may have been damaged from leaving the terminal yards for road movement in a defective condition.

In some yards local conditions may not permit making repairs in the receiving yard on account of limited room and other operating conditions. In these cases the defects can be taken care of in the classification yard after the train is made up and turned over to the inspectors by the transportation department but in either case there should be sufficient time allowed to do the work properly. It is a great deal better to get the train in A-1 condition before allowing it to leave the terminal than it is to have delays on the division, oftentimes making it necessary to set out cars on the road which in most cases causes delay to the shipment and resultant damage claims.

Inspection on Industry Tracks

If all cars are inspected and handled as outlined above there should be no need of reinspecting empty cars set at freight houses, industries and other points for loading. The only inspection needed at these points should be the inspection of cars unloaded and reloaded to see that they are fit to carry the load that the shipper intends to put into the unloaded car and for such defects as may develop in switching. Inspectors inspecting at industries, freight houses and other points should be thoroughly familiar with loading rules to see that they are lived up to in all cases, and also see to it that cars that are set for loading are the proper kind of cars for the class of lading that is to be loaded.

Inspection on Repair Tracks

Loaded cars on repair tracks or shop tracks should be inspected by a competent inspector before repairs are started and all work that is to be repaired should be written up on the original record repair card. The defects and cause of defects in all cases should be plainly stated; for example: The words broken, missing or bent should not be used alone but the condition under which they are broken, missing or bent must be plainly stated.

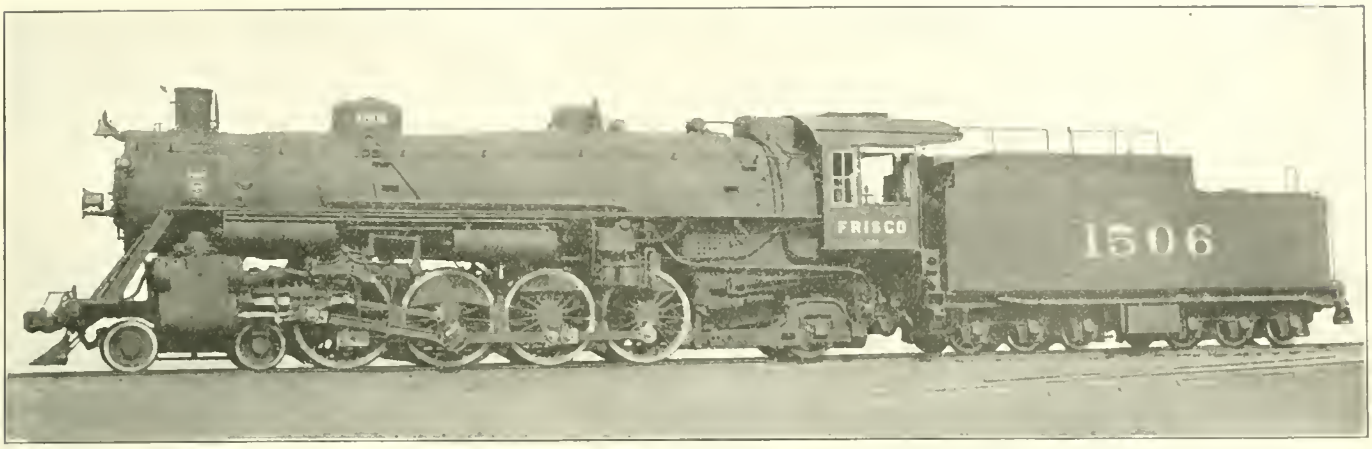
All cars on repair tracks should have couplers gaged as to height and also have knuckles gaged to determine any worn parts. A very satisfactory way of doing this so as not to have half of them overlooked is to assign a man to go over all cars on the repair track each morning to gage coupler height and knuckles and mark on the end of the car, the coupler height as well as the condition of the knuckle. In this way the inspector in writing up the other work can enter this information on his record repair card.

Trucks should be carefully examined as to brake hangers and pins, cotters, and other defects; all journal boxes should be carefully inspected as to condition of packing, journal bearings and other parts. On heavy loaded cars particular attention should be paid to side bearing clearance. In fact no car should be permitted to leave the repair track without having all necessary repairs given attention, in order to keep the car from being set out or placed on the next repair track. Of course in case of loaded cars, judgment should be used so as not to cause delay unnecessarily for defects that will not prevent the car carrying its load to destination or cause damage to its lading.

Empty cars set for light repairs should be thoroughly inspected and repair work to be done should be written up as stated above on the original record repair card. Empty cars undergoing light repairs should always be put in shape for the best class of service possible with light repairs. At most places and at most times the repair track foreman and the inspectors have to govern their work according to the demand for the cars. If there is a heavy demand for cars for a certain class of lading he has to see to it that he gets his cars fixed up for this lading in the least possible time in order to take care of this demand. But he should at all times bear in mind that the nearer he gets his car in 100 per cent condition before releasing it from the repair track the longer it will stay off the repair track.

Empty cars placed for heavy repairs should be properly spotted with sufficient room for doing the necessary work. A first inspection should be made which should consist of writing up the work on the original record repair card and marking out repairs that are visible on the first inspection. After the repairmen have dismantled the car as far as repairs marked up on the first inspection are concerned, a second inspection should be made to mark out defects that are concealed when making the first inspection and are later on uncovered.

When cars are on repair tracks for any kind of repairs, light, heavy or medium, the material checker should always be in close touch with the work in order to get a correct check of material removed and applied for the information of the bill clerk. In order to assure proper work being done at all times, a competent inspector should check the work as to workmanship before cars are released from repair tracks or shops.



Mountain Type Locomotive of 54,100 lb. Rated Tractive Force

Mountain and Mikado Types for the Frisco

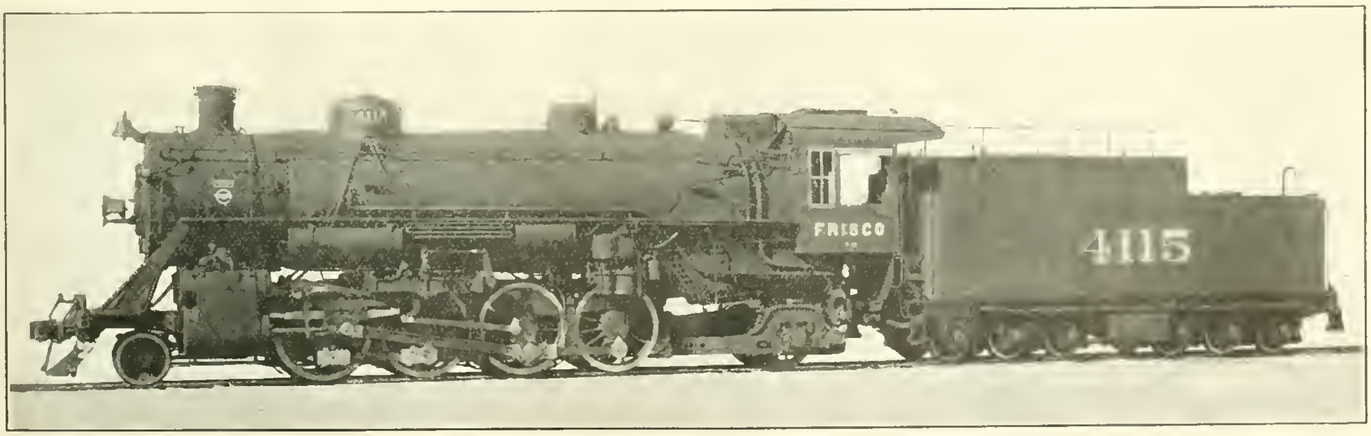
New Oil-Burning Locomotives Based on U. S. R. A. Designs Modified to Suit Railroads' Standards

An important addition to the motive power equipment of the St. Louis-San Francisco has recently been received from The Baldwin Locomotive Works, which has built 50 heavy locomotives for this road—15 of the Mountain or 4-8-2 type for passenger service, and 35 of the Mikado or 2-8-2 type for freight. In general design, these locomotives are based on the heavy Mountain and Mikado types built for the United States Railroad Administration with details revised throughout to suit the standards of the Frisco Lines.

Both types of locomotives burn oil for fuel, and are built to specifications which, apart from the necessary changes in dimensions, are closely similar. The locomotives are designed for operation on curves of 20 deg. and grades of 2 per cent, and are built with height and width limits of 16 ft.-2 in. and 11 ft.-0 in. respectively. The following are the principal details that are interchangeable in the two types: Throttle, dry-pipe and accompanying fittings; all smokebox details, smokestacks, and boiler fittings, such as plugs, etc.; cab-fittings, cabs (except front sheets), front bumpers and pilots, drawbars and connecting devices between engine and tender, and principal frame cross-ties and frame fillings; cylinder and steam-chest packings, steam-chest heads and bushings, piston valves and power reverse gear; front and back main rod brasses, and front, intermediate and back side rod brasses and crank pins; main driving boxes, brasses and axles, and front and back engine truck boxes, axles and wheels; electric headlight equipment, and such furniture as sandboxes, steps, etc. The tenders are duplicates throughout.

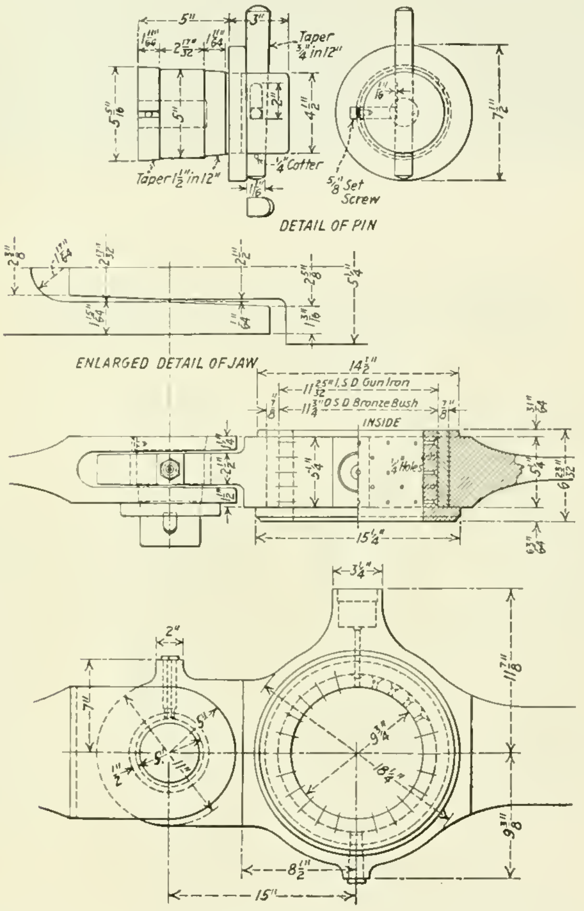
The boilers of both classes are of the conical wagon-top type, with combustion chambers. The firebox sides, crown and combustion chamber are in one piece, and the combustion chamber seam is welded on the bottom center line. The inside throat-sheet is welded to the firebox and combustion chamber, and the tubes are welded at the firebox end. The seam in the fire-door opening, which measures 16 in. by 20 in., is also welded. Provision is made so that arch-tubes and stokers can be subsequently applied, should it be necessary to change the locomotives to coal burners.

These locomotives are equipped with Baker valve motion, controlled by the Ragonnet power reverse mechanism. The piston valves used on both types have a steam lap of 1¼ in. and are set with a travel of 8¾ in., and with a lead on the passenger locomotives of ¼ in., and on the freight locomotives of 3/16 in. In the former case the exhaust clearance is ⅛ in., while in the latter the valves are line and line on their exhaust edges. The front stubs on the main rods are

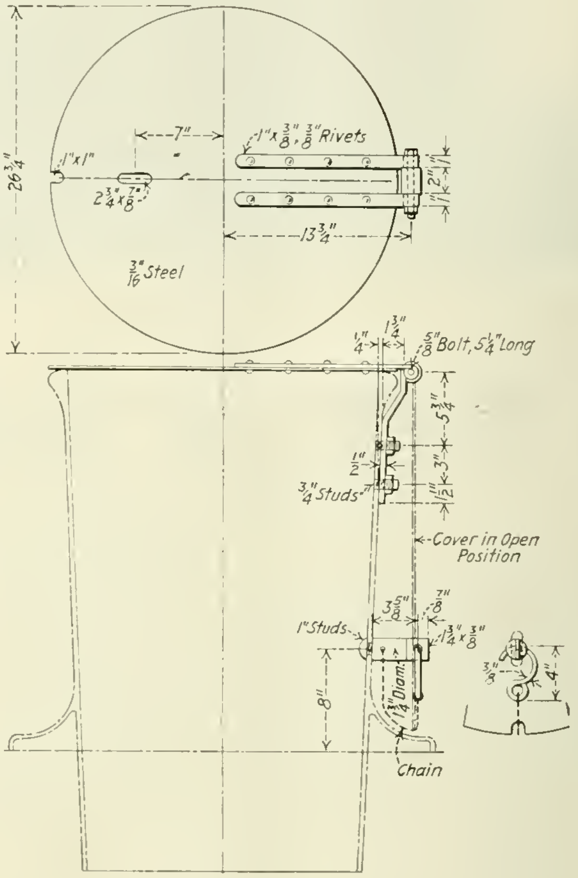


Mikado Type Locomotive of 60,000 lb. Rated Tractive Force fitted with adjusting wedges, while the back stubs are of the solid end type with hard bronze bushings which float in gun iron bushings pressed into the rods. Similar bushings are used in the main connecting stubs of the side rods. The pistons are of rolled steel with gun iron bull-rings, and the guides and crossheads are of the Laird type.

The main frames of both types are 6 in. wide, spaced 41 in. between centers, and have exceptionally strong transverse bracing. Between the cylinders and the firebox there are three intermediate boiler supports on the Mikado type, and four on the Mountain type. The front and rear supports, which are each 9 in. wide, and have a length equivalent to about one-third of the boiler circumference, are steel castings, radially planed to give a smooth sliding surface. The front support is bolted to the guide bearer, and the rear support to a frame crosstie. The intermediate supports each consist of two 6-in. by 6-in. angles, which are bolted to vertical expansion plates. One of these supports on the Mountain type (and the only intermediate support on the Mikado type) is placed under the gusset course of the boiler. The angle irons are riveted to a liner by rivets having countersunk heads on top and the liner is then secured to the shell by rivets placed outside of the angle irons. The vertical expansion plate is then inserted between the angles and bolted into place. Liners are also riveted to the outside of the boiler shell above the sliding supports.

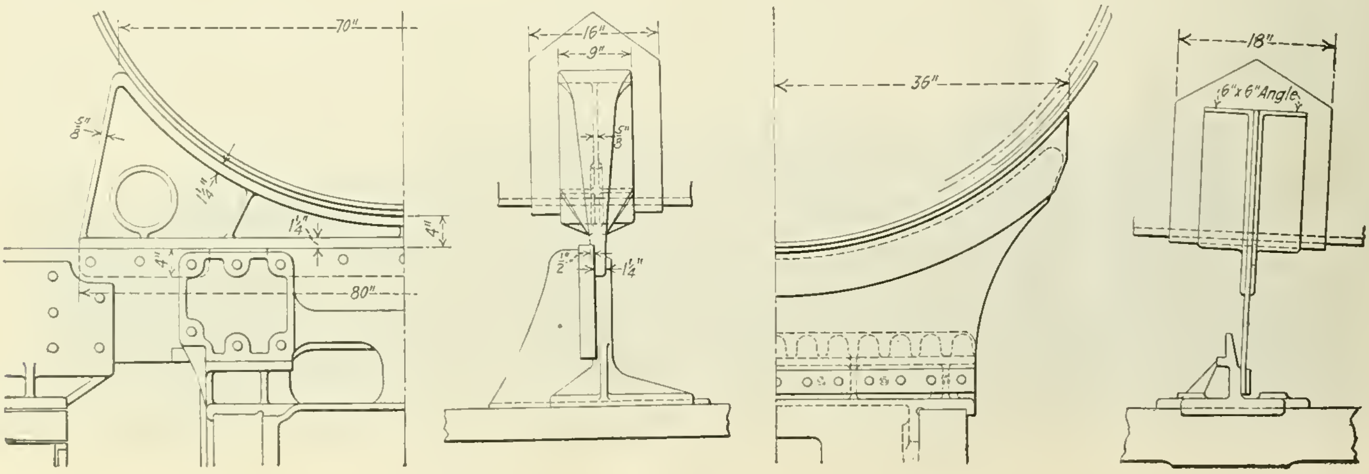


Details of Rod Bearings and Knuckle Pin (Dimensions Shown Are for Mountain Type)



Stack Cover and Fastenings

The rear frames are of the Commonwealth cradle type,



Boiler Braces at Guide Yoke and Under Gusset Course

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	St. Louis-San Francisco	
Type of locomotive	4-8-2	2-8-2
Service	Passenger	Freight
Cylinders, diameter and stroke	28 in. by 28 in.	27 in. by 32 in.
Valve gear, type	Baker	Baker
Valves, piston type, size	14 in.	14 in.
Maximum travel	8¾ in.	8¾ in.
Outside lap	1¼ in.	1¼ in.
Exhaust clearance	⅛ in.	0 in.
Lead in full gear	¼ in.	3/16 in.
Cut-off in full gear, per cent		
Weights in working order:		
On drivers	232,100 lb.	244,690 lb.
On front truck	56,700 lb.	25,870 lb.
On trailing truck	51,000 lb.	49,820 lb.
Total engine	339,800 lb.	320,380 lb.
Tender	244,700 lb.	244,120 lb.
Wheel bases:		
Driving	18 ft. 0 in.	16 ft. 9 in.
Total engine	39 ft. 6 in.	36 ft. 1 in.
Total engine and tender	76 ft. 9⅝ in.	72 ft. 3½ in.
Wheels, diameter outside tires:		
Driving	69 in.	63 in.
Front truck	33 in.	33 in.
Trailing truck	43 in.	43 in.
Boiler:		
Type	Con. wagon top	Con. wagon top
Steam pressure	200 lb.	190 lb.
Fuel	Oil	Oil
Diameter, first ring, inside	82 in.	86 in.
Firebox, length and width	120⅛ by 84¼ in.	120⅛ by 84¼ in.
Height mud ring to crown sheet, back	68 in.	68 in.
Height mud ring to crown sheet, front	91½ in.	91½ in.
Tubes, number and diameter	219—2¼ in.	219—2¼ in.
Flues, number and diameter	45—5½ in.	45—5½ in.
Length over tube sheets	21 ft.	19 ft.
Grate area	70.3 sq. ft.	70.3 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	329 sq. ft.	286 sq. ft.
Tubes and flues	4,053 sq. ft.	3,666 sq. ft.
Total evaporative	4,382 sq. ft.	3,952 sq. ft.
Superheating	1,107 sq. ft.	1,048 sq. ft.
Comb. evaporative and superheating	5,489 sq. ft.	5,000
Tender:		
Style	12 wheel	12 wheel
Water capacity	12,000 gal.	12,000 gal.
Oil capacity	4,500 gal.	4,500 gal.
General data estimated:		
Rated tractive force, 85 per cent	54,100 lb.	60,000 lb.
Cylinder horsepower (Cole)	2,824	2,493
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	68.3	76.4
Weight on drivers ÷ tractive force	4.29	4.08
Total weight engine ÷ cylinder hp.	120.0 lb.	128.5 lb.
Boiler proportions:		
Comb. heat surface ÷ cylinder hp.	1.94	2.00
Tractive force ÷ comb. heat. surface	9.86	12.00
Tractive force × dia. drivers ÷ comb. heat. surface	680	756
Cylinder hp. ÷ grate area	40.3	35.5
Firebox heat. surface ÷ grate area	4.7	4.1
Firebox heat. surface, per cent of evap. heat. surface	7.5	7.2
Superheat. surface, per cent of evap. heat. surface	25.8	26.5

arranged for the Delta type B trailer truck with booster application. Boosters have been fitted on three locomotives of each type, and the other engines can subsequently be equipped should this appear desirable. These boosters are supplied with super-heated steam.

The equipment of all these locomotives includes automatic drifting valves on the cylinders, and flange lubricators on the leading drivers. Another interesting detail is an incandescent lamp mounted on the top of the stack in position to throw its light in an upward and rearward direction, so that the fireman can tell at night whether the locomotive is throwing smoke. Careful attention has been given all details with a view to providing comfort and convenience for the crew.

The tenders have one-piece, cast steel frames, and the trucks are of the six-wheel equalized pedestal type with frames of the same material. The oil and water capacities are 4,500 and 12,000 gal. respectively.

Further particulars of both types are given in the table of dimensions.

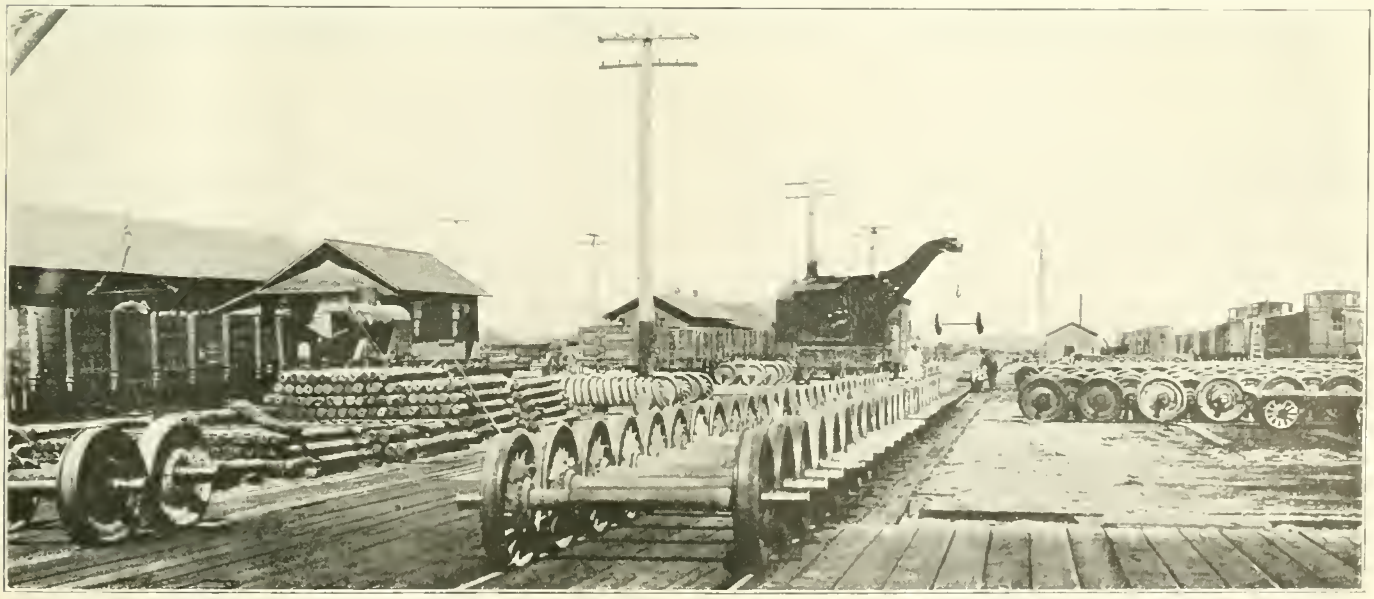
Device for Testing Superheater Units and Air Reservoirs

ONE of the most simple and efficient devices yet developed for testing superheater units and air reservoirs is shown on the following page. It was designed and constructed for use in the Readville shops of the New York, New Haven & Hartford.

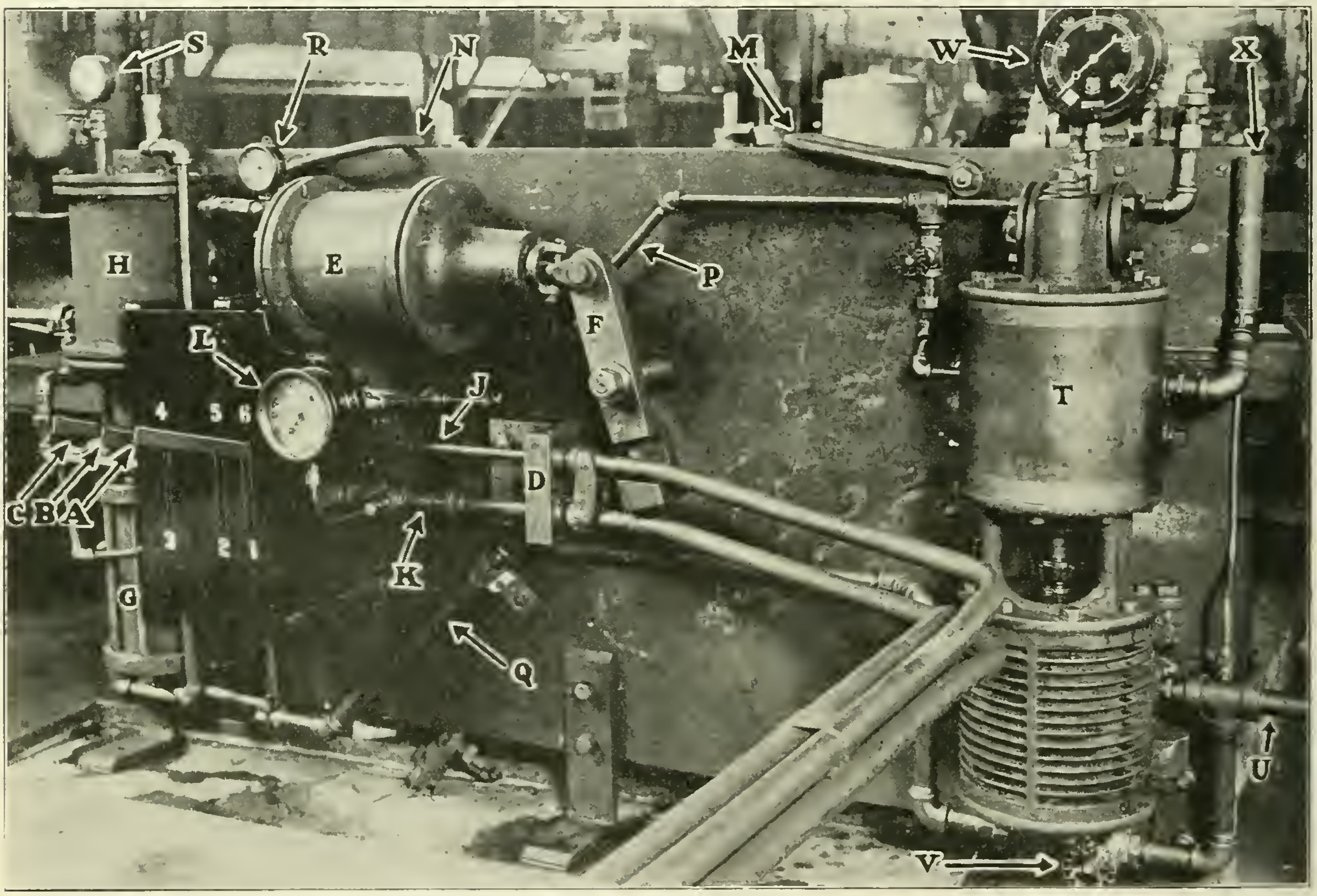
As shown, the operating mechanism is mounted on a large steel back-plate 1 in. thick, supported on the bottom by three right-angle legs with holes drilled to provide for bolting to the floor. The rugged design of the testing device throughout is evident from the illustration. Moreover it is a compact unit which can be readily moved to the most convenient place in the shop by means of a crane and chain hooks attached to the hangers *M* and *N*. At the time of taking the photograph the tester was not in its final location and it has since been moved to the erecting shop where superheater units can be handled to and from the device with the minimum effort.

Referring to the illustration (p. 360), a superheater unit is

* * * *



A Systematic Method of Handling Wheels and Axles Is Essential to Efficient Car Shop Operation shown applied to two false seats in the substantial angle block *D* rigidly bolted to the back-plate. In testing, the unit is held with a heavy pressure against block *D* by means of lever *F*, pivoted as shown and operated from brake cylinder *E*. The final test pressure on the unit is obtained by hydraulic pressure from cylinder *G* direct-connected to brake cylinder *H* by means of a piston rod. The piston in *H* is operated by shop air pressure at 80 lb. from a one-half inch pipe, the pressure being shown by gage *S*. The unit is filled and tested through pipe *J*, being blown out through pipe *K* which is connected through a suitable valve to the exhaust, not shown. The test pressure on the unit is indicated by gage *L*, being between 400 and 500 lb. Shop air pressure at 80 lb. is provided in pipe *P*, the connections being such that this pressure is shown by gage *R*. City water at a pressure of 40 to 50 lb. is provided to pipe *Q* and used for filling the units and hydraulic cylinder *G*.



A Compact and Efficient Device for Testing Superheater Units at the Readville Shops of the New York, New Haven & Hartford

This tester is operated by means of three levers *A*, *B* and *C*, each of which has two positions and is interlocked with two three-way valves. Three levers are required, for the reason that there are three main pipe connections, namely city water, high pressure water and air required in blowing out units. The arrangement of the interlocking levers to the six valves is extremely ingenious and foolproof, making it impossible to perform the various operations out of their proper order. Moving handle *A* to position *1* supplies air to brake cylinder *E*, clamping the unit quickly and with a heavy pressure which practically eliminates all chance of leakage at the two joints. Handle *B* is moved to position *2* allowing water at street pressure to fill the unit and cylinder *G*. Moving handle *C* to position *3* shuts off the water supply and admits air on top of the piston in cylinder *H* applying hydraulic pressure to the unit. Moving handle *C* back to position *4* exhausts the air in cylinder *H* and closes the connection from cylinder *G* to the unit. The unit is opened to the atmosphere and water and scale blown out by shop air pressure when handle *B* is moved to position *5*. Moving handle *A* to position *6* shuts off air pressure to the unit and releases the air in cylinder *E*, also releasing the unit.

All of the above operations take far longer to describe than to perform. In fact, a unit can be applied on this device, tested and released in a fraction of a minute. Not only is the operation speeded up but the test is much more thorough and severe than that ordinarily accorded superheater units. Cylinder *G* is bushed so that a pressure of 400 to 500 lb. is obtained quickly showing up any defects which exist. This allows defects to be corrected before the units are reapplied and perhaps cause service failures.

Testing Reservoirs

Air reservoirs are tested by means of the Westinghouse 9½ in. air compressor *T* which is bushed on the air end to boost the shop pressure to at least 225 lb., at which the reservoirs are tested. Pipe *U* is connected to the reservoir (not shown in the illustration), and in operation valve *V* is opened allowing water to practically fill the tank. Valve *V* is then closed and the air compressor started increasing the pressure on the reservoir to 225 lb. when the standard hammer test is given. The test pressure is indicated by gage *W*, connected by a copper pipe to the tee at the air discharge as shown. Pipe *X* is the exhaust from the air compressor.

Fuel Association Meets in Cleveland

A Large Attendance and Heavy Program; New Field for Conservation at Power Plants Taken Up

About 400 members of the International Railway Fuel Association were in attendance at the fifteenth annual convention which was held at the Hotel Winton, Cleveland, Ohio, May 21 to 24, inclusive.

Julius Kruttschnitt, chairman, executive committee, Southern Pacific, delivered the opening address, in which he presented a comprehensive survey of the possibilities for economy in the use of railway fuel and outlined quantitatively the direction in which the future developments looking toward reductions in fuel consumption are most likely to meet with success. He also showed that the officers and men who have to do directly with the consumption of fuel are not alone responsible for the reductions in the amount used, but that this responsibility must be shared by every department, including the executive. An abstract of Mr. Kruttschnitt's address will appear in a later issue.

President Clark's Address

In his address, J. N. Clark (Southern Pacific), president of the association, said in part as follows:

Never before has the transportation industry been called upon to carry the load which is now offered and that the industry expects us to do our share is proved by the generous and encouraging response received from practically every railroad president asked to send officers and men to this convention. Let us show our appreciation of this confidence by sending each man back home broadened in his vision, more thoroughly alive to his own individual responsibility and more enthusiastic to tackle the job than when he left it. This can best be done by each one feeling that this is his convention and that he must faithfully attend all the sessions, absorb the best ideas advanced by others, contribute freely from his own experience, and carefully study the exhibits.

During the last nine months the railroads have handled the largest volume of business ever before offered during a similar period, and it is certain the peak will not be reached before October. Our work is already mapped out for us and it is none other than to see that this volume of business is handled with the minimum consumption of fuel.

The report of the secretary-treasurer, J. G. Crawford, gave the membership at the end of 1922 as 976 and showed a balance on hand of $500, with all bills paid.

The association was also addressed by T. K. Maher, president, The Maher Collieries Company, Cleveland, Ohio, and H. M. Griggs, manager, Ore and Coal Exchange, Cleveland, Ohio. Mr. Griggs outlined the work of the exchange, which serves as a clearing house of advance information relative to the exchange of lake and rail traffic in coal and ore, and presented data showing a volume of lake and rail movements through Lake Erie ports during the seven months' navigation season, that requires the dumping of an average of 3,000 cars of coal daily and 5,000 empty cars a day for ore loading.

In two papers, one presented by R. S. Twogood (Southern Pacific) and the other by Professor R. W. Noland (Purdue University), a new field for the development of fuel economy was opened up. The first dealt with the handling of small power plants and the second with economy in the heating of stations and buildings. The association authorized the appointment of a committee to take up the study of this phase of railway fuel consumption, co-operating with the American Society of Mechanical Engineers in the development of a practicable test code for use at small power plants.

The following officers were elected for the next year: President, M. A. Daly (Northern Pacific); vice-presidents, J. W. Dodge (Illinois Central), P. E. Bast (Delaware & Hudson) and J. R. Evans (Chesapeake & Ohio). The new members of the executive committee are: J. E. Davenport (New York Central), H. T. Bentley (Chicago & North Western), E. E. Chapman (Atchison, Topeka & Santa Fe), C. H. Dyson (Baltimore & Ohio) and W. J. Tapp (Denver & Rio Grande Western). J. B. Hutchinson (Pennsylvania) is secretary-treasurer.

An abstract of the report on feedwater heaters is given below. Other papers and reports will be abstracted in later issues.

J. N. Clark (Southern Pacific), President

M. A. Daly (Northern Pacific), Vice-President

J. W. Dodge (Illinois Central), Vice-President

P. E. Bast (Delaware & Hudson), Vice-President

Report on Boiler Feedwater Heaters

The first part of the report outlined the development and history of feedwater heaters and summarized the various reports on the subject that have been presented to the association since the initial report in 1914.

A very complete questionnaire was sent out by this year's committee and the results of the answers from 18 roads were embodied in tabulated form.

Present Equipment—America

The replies to the questionnaire show the popularity of the feedwater heater to be increasing steadily, and some roads state that all new power will be equipped with the device. One road says that it eventually expects to have every locomotive having cylinders 20 in. in diameter or over equipped with feedwater heaters.

Some state that they see little increase in capacity of heater-equipped power, but the majority point out that the increased capacity is dissipated in increased speed. It has been found that engineers who are accustomed to working their locomotives by sound run with a longer cut-off due to some of the exhaust being taken by the heater, thus reducing the sound and causing the engineer to think he was not getting the same amount of work out of the locomotive. This, of course, counteracts some of the saving effected by the heater, but longer experience and greater familiarity will naturally overcome such conditions.

It has been found in some cases, either due to working the locomotive harder or the presence of oil in the water, that on long runs the locomotive equipped with the feedwater heater has a tendency to foam badly toward the end of the run. It was naturally expected that with less water being drawn from outside sources the reverse would be true.

One road has eliminated the oil separator and has made a feedwater heater of 5,400 gallons capacity the standard, with the view that the maximum capacity of the locomotive is required so seldom that the injector should take care of the short periods which the larger locomotives are worked beyond the capacity of their heater.

A check of locomotives built since March 1, 1922, and now on order, brings out the interesting fact that practically one-third of the whole number are equipped with feedwater heaters. Of the 1,724 heaters ordered since 1920, 1,429 were ordered during the year ending May 1, 1923.

Two roads are reported to have been trying heaters not so widely known, one, a waste gas type, known as the Foster-Thompson heater, and the other a locally designed waste steam type known as the Skinner feedwater heater. Both roads report that they have no test data or performance that can be published at this time.

Present Equipment—Foreign

The past year has brought to light several interesting developments in locomotive feedwater heating abroad. What is probably the most practical form of gas type heater so far constructed, was recently applied to a locomotive of the Austrian Federal Railways. This is the invention of J. Rihosek, mechanical engineer, Vienna, and is designed so that it may be removed from the smoke box and replaced as a unit and thus conveniently cleaned inside and outside.

In an article recently contributed to a foreign publication, the author states that tests of this heater have supplied valuable data regarding the amount of heat that can thus be reclaimed from the waste gases.

Rihosek, however, calls attention to the fact that heaters of the exhaust steam and waste gas type may be combined in series whenever the weight of the locomotive permits such an arrangement. In this case, it is stated that cold water from the tender would first be heated by exhaust steam to a temperature of about 190 deg. F. and subsequently, in a waste gas heater to temperatures ranging from 265 to 300 deg. F. It is pointed out, moreover, that the added economy resulting from elevating the feedwater to temperatures considerably above that of exhaust steam is not the only advantage of this arrangement since the boiler scale forming impurities will be partly deposited in the heater, owing to the higher temperatures in the second stage of the apparatus.

Another significant development is the introduction of the open type of heater abroad. In place of the Knorr apparatus which has been exclusively used in Germany, Austria and Hungary, a pump of the Worthington type has recently been adopted for new motive power on the Hungarian State Railways. It would appear from the illustrations of this equipment, however, that after being discharged from the open type heater, the feedwater is passed through a closed type heater before entering the boiler. The open type apparatus used on these locomotives is manufactured in Budapest. This is positioned on the left side of the locomotive and the closed type heater which is used in series, comprises a drum located underneath the smoke box. The locomotives to which this equipment is applied are also provided with feedwater purifiers of the Pecz-Rejto type mounted on top of the boiler barrel.

Since the effect of feedwater heating is to increase the rate of evaporation in the boiler, it follows that any tendency toward foaming occasioned by chemical impurities in the water will be enhanced by feedwater heating. Water purifiers are already being tried in some foreign countries and it is believed that their possibilities are such that investigation should be made and reported to the association. It is suggested, therefore, that the subject of water purification by means of apparatus supplementary to the feedwater heater might properly be studied by your committee during the coming year, since it appears that the possibilities of this means of water purification have never been fully investigated.

The Exhaust Steam Injector

The exhaust steam injector, which the committee has been requested to investigate, is yet in its development stage in this country. From the information available, it seems that there is not quite as great a range with the exhaust steam injector as with the live steam injector. The range is, however, sufficiently great to meet the requirements of the average service of American locomotives. This device is extensively used in Europe, there being at this time in the neighborhood of 6,000 exhaust steam injectors actually in service.

A report from an English road states that they have 515 exhaust injectors of the Davies and Metcalfe type, operating in both passenger and freight service. The locomotives and trains are not as heavy, however, as the general average in this country, but since the performance of the device is considered quite satisfactory it seems reasonable to expect that improvements will shortly be made which will render it adaptable to heavier service. The particular road mentioned states that all new power purchased is being equipped with exhaust steam injectors.

The type of oil separator used with the Davies and Metcalfe exhaust steam injector is the same as that used on the Elesco in this country.

It is difficult to calculate accurately the coal and water saving of the exhaust steam injector, because these vary largely with the amount of water delivered. Under conditions of high back pressure, such as are met with when the engine is working at maximum capacity, the exhaust injector will feed the boiler without the use of any live steam whatever. When the engine is working at low rating, the live steam used runs up as high as 2½ per cent of the weight of water delivered to the boiler.

The temperature of the water delivered to the boiler is highest when the injector is working at its minimum rating, but the heat recovery is greatest when the injector is working at maximum capacity.

Tests made in this country have shown coal savings around 10 per cent to 15 per cent. The best results, of course, are obtained when the exhaust injector is kept continually at work from one end of the line to the other. Starting and stopping the injector not only results in the loss of some water in priming, but no exhaust steam is saved when the injector is not working.

Summary

A summary of trials and experiments of various roads with various kinds of feedwater heaters brings out the following basic principles which should govern heaters as applied to locomotives in order to realize their full benefit:

1. The boiler feedwater shall be heated from a source of heat that would otherwise have been wasted.

2. The apparatus shall present the greatest possible simplicity of construction with the smallest possible number of wearing parts. It shall occupy as little space as possible and be of the minimum weight.

3. The feedwater heaters should give a continuous and certain supply of hot water, the temperature of which will increase with an increase of the pressure of the exhaust steam or the temperature of the front end gases.

4. Arrangements shall be provided for separating any lubricating oil from either the steam or the water of condensation and the lubricating oil allowed to enter the boiler shall be reduced to a minimum.

5. Hot gas heaters or economizers should be arranged to present the minimum interference with the passage of the gases from the boiler flues to the stack, and should also be so constructed as to be quickly and easily removed and replaced. They should have the minimum of separable joints within the front end.

The members of the committee were E. E. Chapman (A. T. & S. F.), chairman; E. A. Averill (Superheater Company); H. A. Macbeth (N. Y. C. & St. L.); J. A. Carney (C. B. & Q.); Geo. S. Mikles (N. Y. O. & W.); G. N. Gresley (London & North Eastern); Geo. E. Murray (G. T.); J. M. Lammedee (Worthington Pump & Machinery Corp.); L. G. Plant (Railway Review); W. A. Larick (N. Y. C.); Prof. J. M. Snodgrass (University of Illinois); L. P. Michael (C. & N. W.), and G. Von Boden (S. P.).

Discussion

H. B. Oatley (Superheater Company) presented a written discussion in which he estimated a fuel saving of $1,000 a year for the feedwater heater on the basis of a locomotive burning $10,000 worth of coal a year. From this should be deducted $150 for investment charges. The only debatable question, he stated, is how much of the remaining $850 will be required for additional maintenance. The only solution of this question is experience based on a large enough number of heaters in service at one place to permit this work to be regularly organized. He stated that variations in local conditions were such that the experience of one road would not answer the question for another.

The only case cited in which maintenance has been excessive was on the Central Vermont, where, in spite of the fuel saving effected, the heaters have been removed because of excessive terminal attention. E. A. Averill (Superheater Company) gave the results of a study of work reports on 334 arrivals of feedwater heater locomotives over a period of one month at one terminal, after the heaters had been in use from five to six months. Eighty per cent of the work reports contained no reference to the heaters, 95 per cent showed no work that would require over 15 min., and the remaining five per cent called for inspection or work of indeterminate amount. The record was perfect as to failures chargeable to the feedwater heaters.

On the Southern Pacific some trouble has been experienced from hot water leaking into the low pressure pump cylinder when the heater is not working, thus causing the suction to break when the heater is started. To avoid this trouble it has been found best to start the heater pump at the same time as, or a little before the locomotive, and to work it continuously while the locomotive is working. Engines with feedwater heaters on the Southern Pacific have been found to steam so freely that the exhaust nozzles have been increased in size.

Air Brake Association Meets in Denver

To Develop Tolerances for Triple Repairs; Discuss System of Central Repair of Engine Brakes

A REPRESENTATIVE gathering of air brake supervisors and foremen from all sections of the United States and Canada were in attendance at the thirtieth annual convention of the Air Brake Association. The meeting was held at the Albany Hotel, Denver, Col., on May 1, 2 and 3 and was exceptionally well attended by representatives of the western roads.

The opening session called to order by the president, Mark Purcell, Northern Pacific, was given over to a number of addresses and business reports. W. R. Scott, president of the Southern Pacific, Texas and Louisiana Lines, gave some of the early history of the air brake and told how when he was a member of the Traveling Engineers' Association the air brake discussions early demonstrated the need for a separate organization to devote its entire time to air brake subjects. He paid a tribute to the fertility of invention and the energy of the men who have been instrumental in the development of the air brake, citing a case in which the Westinghouse Air Brake Company had furnished enough empty and load brakes to equip several trains in six weeks after the need for such a brake had been suggested to the officers of the company as a means of facilitating operation

Mark Purcell (Northern Pacific)
President

George H. Wood (A. T. & S. F.)
1st Vice-President

C. M. Kidd (N. & W.)
2nd Vice-President

F. M. Nellis (Westinghouse Air Brake Co.) Secretary

of trains on the mountain grades of the Southern Pacific.

In speaking of the future of the association, Mr. Scott said that its opportunities for useful service were as great as they have been in the past. One of the things demanding its attention in the future, he said, was the relation of automatic train control to brake operation. The co-ordination of the operation of the train control system with that of the brake system and signal system under the wide variety of conditions encountered on American railroads, he said, presented a phase of the subject not covered by the limited installations so far made and introduced air brake men to a new phase of railway operation. He also expressed the belief that the further development of the light and load brake should be taken up.

Mr. Scott said that he had learned that many of the members in attendance had come on their own time and at their own expense. This he said should not be. The cost to the roads of sending men to the convention he considered infinitely small compared with the value of the work of the association, and he suggested that if the association approached the individual executives, they could be made to see that it would pay them to send their men.

Mr. Scott referred briefly to the program of the executives to provide adequate service to the American people during the current year and said that it had been suggested that he tell the association what it could do to help in carrying out this program. This he said was attacking the problem from the wrong end; the air brake men should tell the executives what measures should be adopted in their field and should formulate their own part in the program.

President Purcell's Address

President Purcell in his address said: "To a large extent the state of economy and efficiency reached in railway transportation in its present stage is due to brake control. Without such control, the number of trains that could be handled over a district in a given time would be very much less because the trains would have to be spaced farther apart and the speed restricted to prevent accidents.

The maintenance and operation of brakes is one of the most important departments of railway operation. The best methods of organized inspection and repairs are time-savers in getting trains over the road and through terminals. Air brake men are best qualified to recommend what practices should be followed and now that a greater shortage of equipment is threatened than was ever experienced before in the history of the railroads, there is an opportunity for the air brake men of the country to be of great assistance to the roads in getting the most service out of the equipment available by facilitating more rapid movement of cars and increased mileage with less time on the repair tracks.

"The Air Brake Association has acquired a degree of authority such that it is being consulted with respect to brake matters and train operation more than in the past. This points to the need of exercising the greatest care when recommending or endorsing measures that action be not too hasty, but that they be carefully investigated and fully discussed in all their bearings before action is taken."

S. G. Down Compares American Railways and Those in Foreign Countries

S. G. Down, vice-president of the Westinghouse Air Brake Company, who has during the past few years observed railroad performance in most civilized countries, said that none of the government controlled roads with which he has come in contact can compare in efficiency with American railroads. Those who are so ready to attack railway management in this country, he said, ought to have to get along with the transportation conditions prevailing where the roads are operated by the governments.

One of the great advantages of the railroads in North America as compared with continental Europe is the universal interchange of equipment. In Europe, he said, one of the greatest difficulties in the way of interchange is the number of types of brake equipment employed in the different countries which will not operate synchronously with each other. He stated that in North America there is an investment of five hundred million dollars in brake equipment, all of which operates interchangeably. The magnitude of this investment he cited to show the importance of keeping on firm ground as to fundamentals and not introducing any changes that will interfere with the universal interchange of cars.

The following papers were read and discussed:

Expediting Train Movement, by the North-West Air Brake Club; Charging Freight Trains and the Use of Release Position, by W. F. Peck (Baltimore & Ohio); Causes for Slow Operation of Locomotive Air Compressors, by the Pittsburgh Air Brake Club; Feed Valve Tests, by the Manhattan Air Brake Club, and two papers on the 8½-in. cross compound compressor, one by the Central Air Brake Club and one by the Dixie Air Brake Club. George H. Wood (Atchison, Topeka & Santa Fe), in a brief talk also discussed the relation of train control to the air brake.

Expediting Train Movement

By The North-West Air Brake Club

The following is an abstract of a paper presented for the North-West Air Brake Club, by H. G. Clark (M., St. Paul & S. S. M.):

In his address before this convention W. R. Scott, president of the Southern Pacific Lines, called attention to the impending transportation crisis and stated that among other measures to meet the situation, it is proposed to reduce the bad order cars from the present 9 per cent to 5 per cent, the freight locomotives awaiting heavy repairs from about 21 per cent to 15 per cent, and to increase the car mileage to 30 per day. That strenuous efforts in 1920 were able to raise the car mileage to only about 25 per day, and that the car loading is expected to exceed by from 7 to 15 per cent the peak of 1920, will indicate the task before us.

In his efforts toward maintenance, the air brake man must not lose sight of the fact that the air brakes are merely one important means toward the end of moving traffic. A train or even a car held for brake testing or repairing only, where such work could in part or in whole have been done during a necessary delay for some other work is an inexcusable interference with traffic movement. To the extent that the air brake man keeps this in mind, informs himself of the operating department's plans for expeditious freight train movement and submits plans for testing and repairing that will utilize dead time to the best advantage and cut necessary delays for such work to the minimum, will he realize his opportunities.

But the inauguration of good plans will accomplish little. They must be followed up patiently and persistently. There must also be a general co-operation by all railways, not leaving the burden largely to those with steep grades, as has been done too generally. A chain is no stronger than its weakest link; if mountain roads must make the heaviest repairs the traffic of the entire country will be materially slowed and endangered.

The thing to strive for is to have the air brakes in such condition when the outgoing engine is coupled to the train that all that will be required is a formal test to insure that the brake condition is as intended, followed by an immediate release.

As no one can argue against the desirability of this and as it cannot be even remotely approached if the outgoing test is awaited to disclose any defective brakes, it is plain that without the incoming brake test no worth-while effort has been made to meet the great needs of the times.

It is not enough merely to get an order issued that the incoming test shall be made. Some of the first difficulties such an order runs into are:

(a) A delay because the engineman felt it necessary to recharge before applying for the test. This tends toward an incomplete recharge and a poor test.

(b) The brakeman closes the angle cock on the tender before the test application is completed, thus destroying the test except by a delay to thoroughly recharge and then apply.

(c) If the train is to be put on two tracks, it is felt that the test application cannot be made. This is not so.

(d) A switchman opens an angle cock soon after the test application is made, thus increasing the rate of brake cylinder leakage and spoiling the test.

(e) If the incoming crew see no car men present they decide that no test application is necessary. The test application should be made invariably.

(f) Uninstructed switchmen bleed off good brakes before they are inspected, thus causing such brakes to be bad ordered.

(g) The air brake inspection is combined with the general inspection, thus taking so much time to complete that effective brakes are condemned for leaking off. The air brake inspection should be completed within 20 minutes after the test application is made.

(h) The engineman fails to insure a full 20-lb. service reduction for the test, often making no more than was required for the stop, instead of adding to this enough to make the total reduction a full 20 lbs.

If full advantage of necessary delays is to be taken to do air brake work, then all cars on repair tracks must have their brakes so tested as to disclose their actual condition, all must be repaired that are not efficient, irrespective of stencil dates, and all must be cleaned where the stencil date is nine months old or more. Full advantage also must be taken to inspect the repair brakes, as well as other practicable parts, on cars "parked" at transfer and freight sheds, and team tracks where the number per day will justify. Motor driven compressors requiring no care other than occasional inspection and oiling, and pipes laid on the ground will often permit of quickly preparing to do such work. At what time is it more important to have a freight car ready to proceed than right after it is loaded? And when is there a better time to prepare a car for being loaded than when it is being emptied?

Monthly brake cleaning reports, identifying the cars and the previous cleaning stencils, with all cases where the brakes were found ineffective within four months after cleaning tabulated by home road cleaning points, will make it possible to stop inefficient cleaning.

To have high ideals to strive for is well worth while, but to insist that ideals be attained when existing conditions are far from ideal will obtain far less results than to stipulate merely a moderate improvement. In fact, emergencies occasionally justify practices deviating from the standard. More brakes can be cared for if the brake cylinder pistons are cleaned under the car and replaced than if taken to a room. To say that the work cannot be done efficiently under the car is to ignore that many roads with the best average brake maintenance do this.

Referring to such an emergency as evidently impends, and with the distinct understanding that this suggestion does not apply otherwise, if at some transfer or freight sheds where many cars are available per day it is impossible to get an air supply, at least for some time, why not locate and indicate the ineffective brakes by an incoming test just before the cars go to such points, and then clean the brake cylinders and replace the triple valves with others that have been cleaned and passed over the test rack? This will not only effect a big improvement with no car delay. But if well instructed and reliable men are assigned to the work it is confidently believed that the results will well justify the temporary deviation from correct practice until compressed air can be supplied.

Even if you have a train yard test plant why not have the test application made on the incoming trains by the enginemen and save time for the train and the car men instead of coupling to the yard plant, charging and applying the brakes? The need for having the inspectors present when the trains stop will reduce the dead time for trains.

Furthermore, it is easily possible by casual and quick inspection, a twist on each angle cock and retaining valve pipe (the latter while changing the triple valve or by vibrating it when no change is necessary) and by a pull with a wrench on any unions, to very materially reduce pipe leakage without any air pressure for testing. On one mountain grade subject to interchange traffic, unsatisfactory retaining valve efficiency was very materially improved by having the train inspectors at the previous terminal shake each retaining valve pipe and tighten joints that this disclosed to be loose.

Other possible and valuable improvements with no air for testing are turning angle cocks and hose to proper position, tightening loose brake cylinders, auxiliary reservoirs and pipes, locating and replacing missing cotters, replacing worn-out brake shoes, etc., as well as repairing defects of other than the brake parts.

The will to do all that we can and earnestly looking for them will disclose remarkable opportunities for improvement without car or train delays, often with no more men, and, in many particulars, even without air for testing.

Discussion

The discussion of this paper dealt very largely with the advantages of the incoming brake test and the difficulties generally encountered in making it effective. Some of the members advocated the release of the brakes after the train had been brought to a full stop in the yard in order that the slack might be stretched before making the 20-lb. test reduction. This, however, was not generally favored by the members who took part in the discussion because of the additional time required and, therefore, the greater difficulty of getting the co-operation of the incoming crews and the yardmaster to make the test effective. It was suggested by several of the members that yardmasters are responsible for the greatest opposition to the effective performance of the incoming test because of their hurry to break up the train. Some of this objection can be overcome by permitting them to close the angle cock between cuts of five to ten cars behind the inspector, so that the brakes on the cars already inspected can be bled off.

There was no dissent in the discussion to the opinion that the incoming brake test is a most effective means of reducing terminal delays and effecting promptness in the dispatching of trains through the utilization of terminal time for the making of air brake repairs rather than trying to do the work after the train is made up and ready to depart from the yard. The extent to which the test is effective depends on the determination of the responsible officers to make it effective, and not on any inherent conditions that may be imposed by the test itself.

Closing Business

The following officers were elected for the next year: President, George H. Wood, A. T. & S. F.; first vice-president, C. M. Kidd, N. & W.; second vice-president, R. D. Burns, Penna.; third vice-president, M. S. Belk, Sou. The following are the members of the Executive Committee: H. L. Sandhas, C. R. R. of N. J.; H. A. Clark, M. St. P. & S. S. M.; W. W. White, M. C.; J. J. Flynn, D. & H., and William H. Clegg, C. N.

Annual Convention of the Master Boiler Makers

Preliminary registration of the fourteenth annual convention of the Master Boiler Makers' Association, held at the Hotel Tuller, Detroit, Mich., on May 22 to 25 incl., indicated a record attendance. About 300 members of the association, 125 representatives of the Boiler Makers' Supply Men's Association and many guests were present.

The meeting was called to order at 10.15 a. m. by Thomas Lewis, general boiler inspector of the Lehigh Valley at Sayre, Pa., and president of the association. After the invocation, J. C. McCabe, general boiler inspector of the State of Michigan, acting for the mayor of Detroit, was introduced. He reviewed briefly the promotion of safety in boiler requirements in the State of Michigan, giving credit to the builders of locomotive boilers for the part their methods have played in building better boilers and to the members of the association in properly maintaining them. The standards of construction and material used in locomotive work have aided the American Society of Mechanical Engineers materially in developing the standards of sections of the Boiler Code. The great value of the work of the association is shown in the comparatively few accidents that occur.

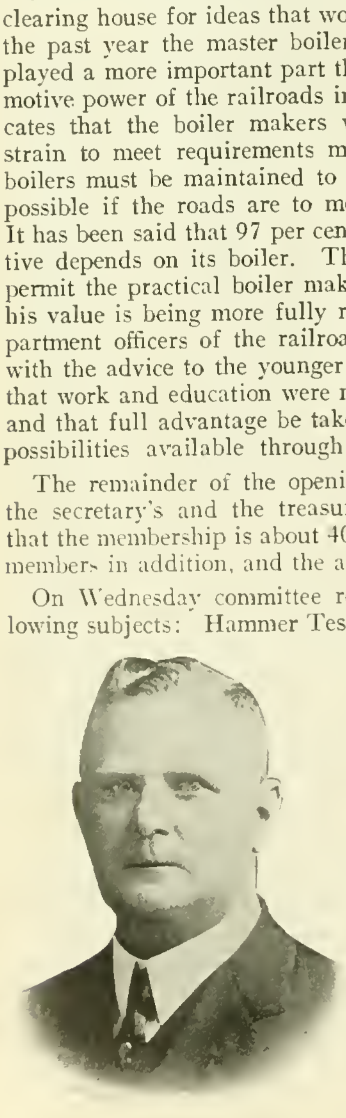
President Lewis, in his annual address, pointed out the annual meeting fulfilled two functions—that of giving men interested in boiler work the opportunity to meet others whose life work was the maintenance of boilers and of providing a clearing house for ideas that would be helpful to all. During the past year the master boiler makers of the country have played a more important part than ever before in keeping the motive power of the railroads in condition. The future indicates that the boiler makers will be under even a greater strain to meet requirements made upon them. Locomotive boilers must be maintained to as nearly perfect efficiency as possible if the roads are to meet increased traffic demands. It has been said that 97 per cent of the efficiency of a locomotive depends on its boiler. The present emergency will not permit the practical boiler maker foreman to be ignored and his value is being more fully realized by the mechanical department officers of the railroads every day. He concluded with the advice to the younger members of the trade present that work and education were necessary to their advancement and that full advantage be taken by them of the educational possibilities available through the papers and discussions.

The remainder of the opening session was occupied with the secretary's and the treasurer's reports, which indicated that the membership is about 400, with almost 200 delinquent members in addition, and the association is financially sound.

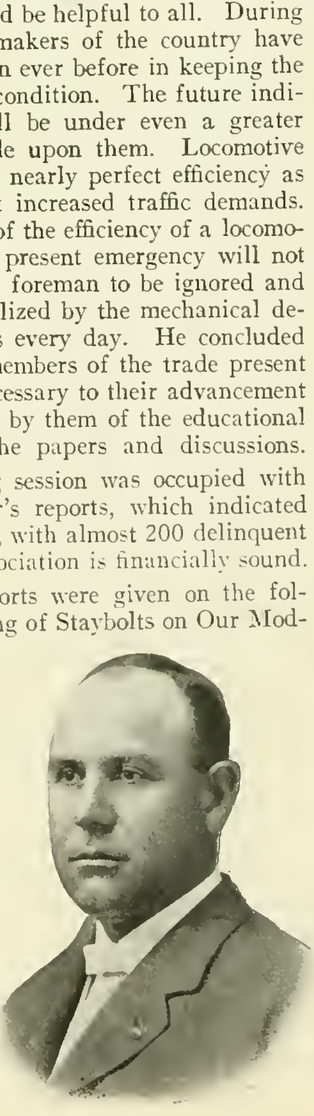
On Wednesday committee reports were given on the following subjects: Hammer Testing of Staybolts on Our Modern Locomotive Boilers Is Now One of the Most Important Duties of Local Boiler Inspectors, J. A. Holder, chairman; Are the New Combustion Chamber Boilers as Easy to Maintain as the Straight Standard Firebox? Henry J. Raps, chairman; The Finished Material (Boiler Plates) Should Be Sound and Free from Cracks, Surface Flaws and Laminations, and No Hammer Dressing, Patching, Burning or Electric Welding Is Allowed, Charles P. Patrick, chairman; Is the Use of Automatic Stokers on Locomotive Engines Injurious to the Firebox Sheets? Do the Firebox Sheets Crack More Readily in a Stoker-fired Engine than in a Hand-fired Locomotive? H. A. Bell, chairman; What Are the Best Methods of Detecting Defective Boiler Sheets in the Shop Before going to the Laying Out Bench and Put into Service? John J. Keogh, chairman.

The remaining sessions were devoted to committee reports, discussions, and the election of officers, as indicated in the following: What Is the Standard Method of Applying Flues in Locomotive Boilers, Also in Stationary Boilers? Albert F. Stiglmeier, chairman; The Life of the Superheater Tube and the Number of Safe-ends That Should Be Applied Before They Are Cut Down for a Smaller Boiler, J. P. Malley, chairman; To Report Topics for 1924 Convention, John F. Raps, chairman; Care of Water Tube Stationary Boilers, J. J. Davey, chairman. Addresses: Steam Leaks and the Bad Effects on the Boiler Plate, D. A. Lucas, chairman; What Experience Has Been Had in Connection with the Electric Weld Heater, John W. Hoyt, chairman; Report of Committee on Rules for Recommended Practice and Standards, Leonard C. Ruber, chairman; Reports of Committees; Election.

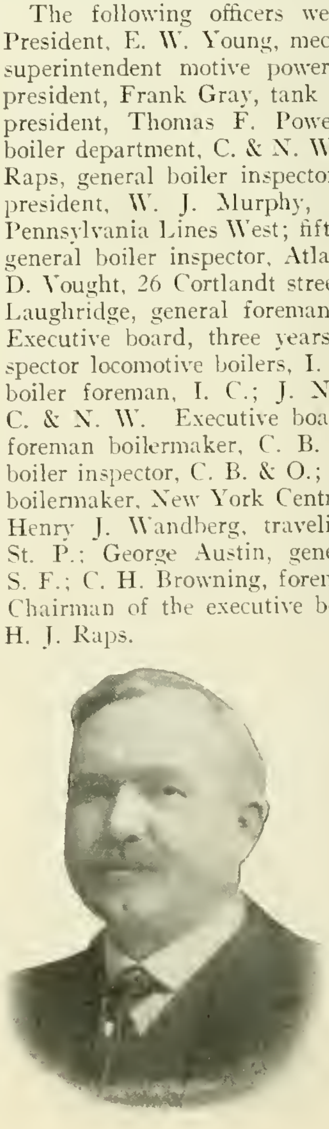
The following officers were elected for the next year: President, E. W. Young, mechanical assistant to the general superintendent motive power, C. M. & St. P., first vice-president, Frank Gray, tank foreman, C. & A.; second vice-president, Thomas F. Powers, assistant general foreman, boiler department, C. & N. W.; third vice-president, John F. Raps, general boiler inspector, Illinois Central; fourth vice-president, W. J. Murphy, general foreman boilermakers, Pennsylvania Lines West; fifth vice-president, L. M. Stewart, general boiler inspector, Atlantic Coast Lines; secretary, H. D. Vought, 26 Cortlandt street, New York; treasurer, W. H. Laughridge, general foreman boilermaker, Hocking Valley. Executive board, three years: E. J. Reardon, district inspector locomotive boilers, I. C. C.; Henry J. Raps, general boiler foreman, I. C.; J. Nicholson, foreman boilermaker, C. & N. W. Executive board, two years: Jeromia Hart, foreman boilermaker, C. B. & Q.; K. E. Fogarty, general boiler inspector, C. B. & Q.; John Harthill, general foreman boilermaker, New York Central. Executive board, one year: Henry J. Wandberg, traveling boiler inspector, C. M. & St. P.; George Austin, general boiler inspector, A. T. & S. F.; C. H. Browning, foreman boilermaker, Grand Trunk. Chairman of the executive board, E. J. Reardon; secretary, H. J. Raps.



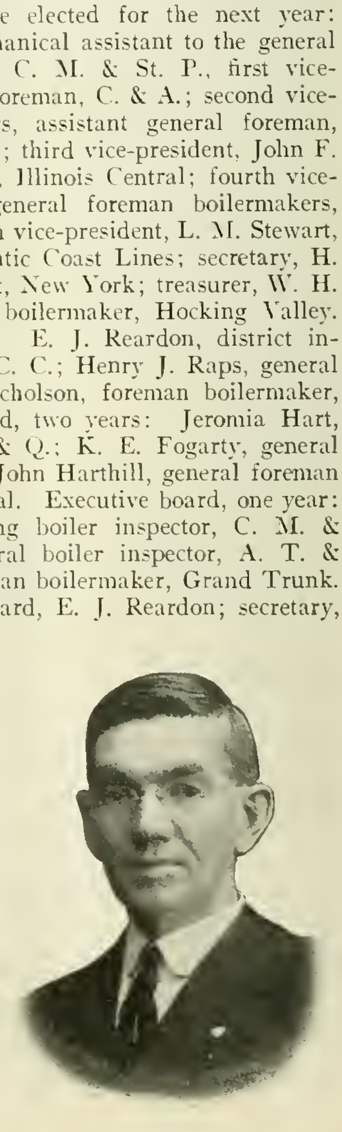
Thomas Lewis, Retiring President



E. W. Young, President



Frank Gray, 1st Vice-President



W. H. Laughridge, Treasurer

New

And Improved

Machine Tools

And

Shop Equipment

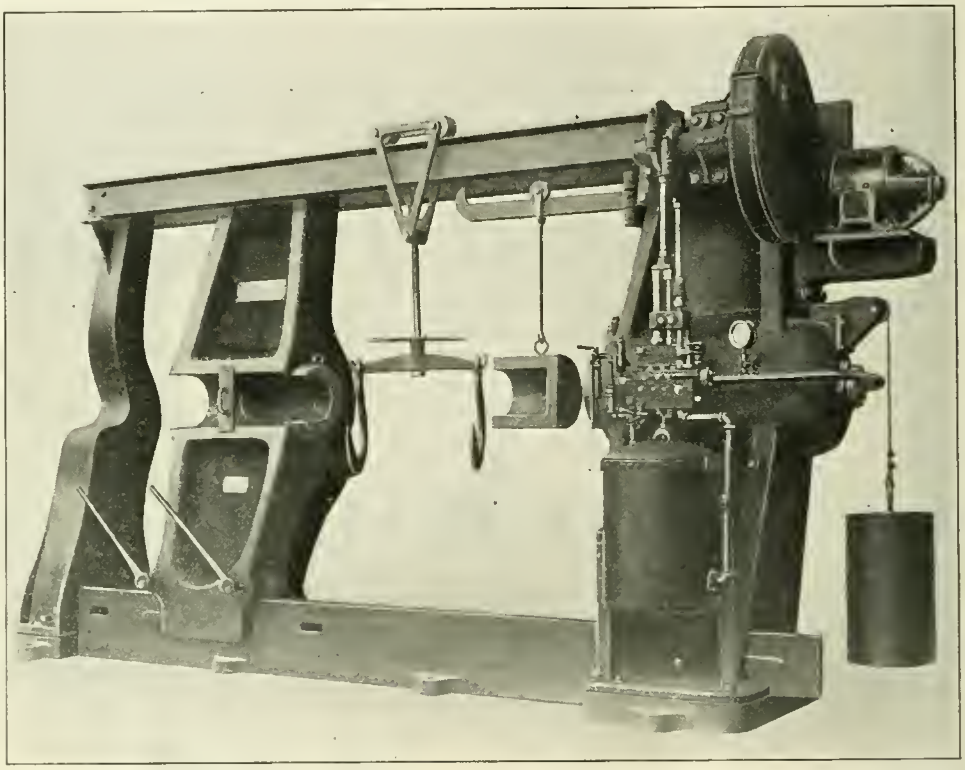
Hydro-Pneumatic Convertible Wheel Press

THE hydro-pneumatic wheel press illustrated has been designed by the Chambersburg Engineering Company, Chambersburg, Pa., so that it can be easily converted from a vertical to an inclined type press or vice versa. It is therefore, adapted for use in connection with either an overhead traveling crane, or lifting hooks carried by a trolley running on a removable I-beam supported on the press. In the illustration the machine is arranged as a vertical press with the lifting hooks in position. When the I-beam which carries the trolley for the lifting hooks is removed, the machine is transformed into an inclined type press, allowing chains or cables of an overhead crane to clear the upper tie bar when handling wheels and axles in and out of the machine.

Provision is made in this design for an extra rapid movement of the press ram out against the work by means of compressed air. A heavy counterweight is used for the pullback, being connected to the ram with a wire rope running over a turned sheave, thus assuring rapid return of the ram.

The pump is made from a solid steel forging, and is of the triplex, single-acting type, driven by a shaft well supported in double bearings. All valves in the pump are made of monel metal. Trip levers control the movement and speed of the press ram without stopping the pump or motor. If desired, the ram can be held against the work under full tonnage indefinitely. The levers for operating the press are conveniently located and are easily and quickly operated in a natural rotation.

The machine is practically of all steel construction, the main castings being made of carefully annealed open hearth steel of a special analysis. The cylinder is copper lined, truly bored and burnished. The ram is made of close grained charcoal iron and is turned and finished with a rolling process, thereby giving it a surface which resists the corroding action of water and keeps it in a smooth and polished condition. The inside end of the ram is provided with a cup leather of improved design, arranged with a spring ring to prevent the collapse of the leather and loss of water when the ram is returning. The resistance beam is carried by turned rollers on planed ways. It is provided with a removable top and a removable yoke. The opening in the resistance beam is sufficiently large to admit the largest diameter axles easily. A jib crane is attached to the cylinder beam, to carry the ram distance piece, which permits it to be swung out of the way when not in use. The tie bars are steel forgings, arranged with machined stops at suitable distances apart to accommodate standard M. C. B. axles. There is provided on the press a large pressure gage, graduated to show tons pressure on the ram and also pounds pressure per sq. in. Also a safety valve is provided on the pump to prevent overloading the press. A rear guard completely covers the gearing. This machine has a massive plate and it can be bolted directly to the concrete foundation.



Chambersburg Hydraulic Wheel Press Arranged to be Used as Vertical Type

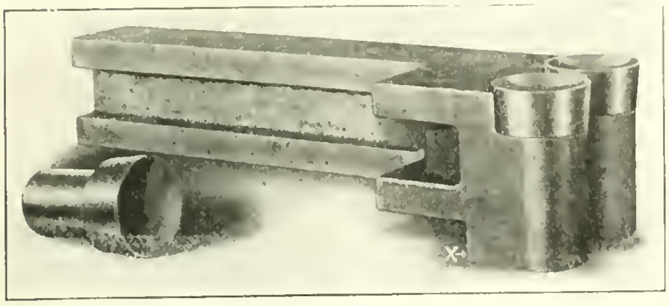
Simple design, durable construction and ease of operation are features of the wheel press illustrated. It can be used for mounting one or both wheels simultaneously, and demounting one wheel at one pressing. It is made in sizes ranging from 34 in. to 120 in. between the tie bars, and from 100 to 1,000-ton capacity.

Special Toolholder for Turning Tires

FOR turning locomotive and car wheel tires, Sir W. G. Armstrong, Whitworth & Company, Ltd., London, S. W. 1, England, has developed the interesting special toolholder with circular cutters illustrated. This toolholder was developed in an effort to eliminate the necessity of chipping and grinding the hard places in tires. It was also desired to turn the hardest tire without removing more metal than necessary to bring the tire back to its true form.

Normally, two cutters are inserted in one holder, and when turning, one cutter is presented to the work at the edge of the tread, the other cutter being presented in the center of the tread; thus each tool has to traverse only one-half of the width of the tire. The last named cutter being presented to the middle of the tread, where the tire is usually hardest, has a better chance of standing up to the work by virtue of the fact that it is cool and the edge has not been dulled by traversing the first portion of the tread before reaching the hard place.

The radius of the cutters is equal to the radius of the tire at the point where the tread joins the flange. Thus, by the use of a simple gage, the radius can be formed by the roughing tool. The cutters are made of Super Tyr steel which is hardened in water and has the necessary qualities to turn the hard places in tires.



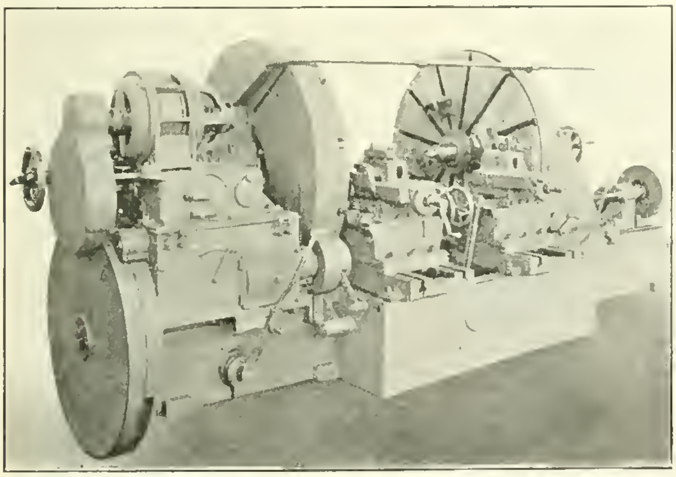
Armstrong-Whitworth Toolholder With Circular Cutters

The cutters themselves are inserted in the holder without keys or screws and therefore when turning exceptionally hard places, it is a simple matter to withdraw the rest and turn the cutter slightly bringing a new cutting edge up to the work. The top of the cutter is ground slightly concave to give the necessary top rake, this rake varying according to the hardness of the tires. By means of a simple fixture on an ordinary surface grinding machine, these cutters can be reground in a few minutes. All the grinding takes place from the top, and as the cutter is ground down, thickness rings are inserted beneath the shoulder in order to maintain the correct height on the cutting edge. By this means the cutter is ensured a long life. In fact two of these cutters have double the life of an ordinary round nose roughing tool. At the same time the holder is a permanent item of equipment. The abutment *X*, in conjunction with a mark on the rest, will assist in resetting tools in the same position.

This arrangement is said to have been thoroughly tested with the hardest tires with complete success.

Eighty-Inch Standard Driving Wheel Lathe

THE wheel lathe illustrated has been placed on the market by the Putnam Machine Works of Manning, Maxwell & Moore, New York, to handle driving wheels with 28 in. to 75 in. diameter treads, as a considerable number of railroad shops are never called upon to turn wheels above this diameter. Convenience of operation is a special feature, and by a unique arrangement in which a clutch is used to drive the faceplate through the feed pinion, six additional faceplate speeds are obtained for journal turning.



Putnam 80-in. Wheel Lathe Driven by A. C. Constant Speed Motor

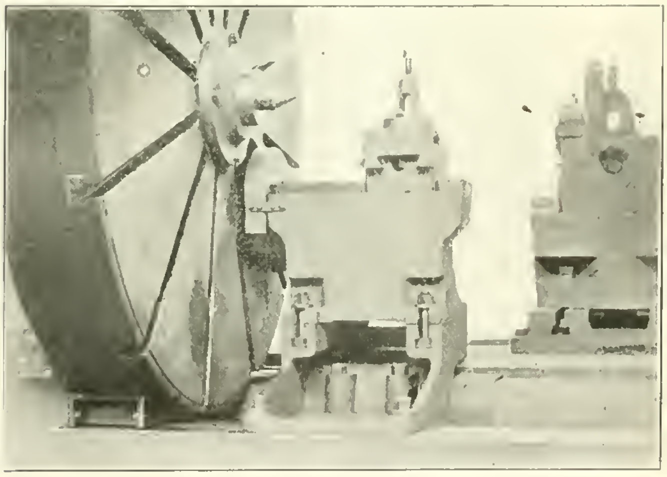
Each faceplate is equipped with four improved Putnam adjustable equalizing driving dogs. The tailstock has power traverse by an individual motor; a friction clutch allows the motor to be started under no load, and an automatic trip throws the clutch out when the tailstock has run back far enough to take the wheels out of the machine. This trip is adjustable for different lengths of axles.

The tailstock is clamped by two large bolts on front and two on the rear which engage T-slots in the bed. These bolts are set up by two wedges actuated by a right and left-hand screw, equalizing the strain on each bolt and quickly and firmly clamping the tailstock to the bed. This device is operated from either the front or the rear of the machine with a ratchet wrench.

The tool rests have in and out adjustment on the bed sufficient to turn wheels from 28 in. to 75 in. tread diameter. The tool slides have in and out adjustment and longitudinal power feed. The slide bases have hardened and ground steel plates on the surfaces where longitudinal tool slides bear. Combination tool blocks reduce the number of operations to a minimum. Each tool slide has one roughing tool and forming blades mounted side by side, each independently detachable for regrinding. A set of forming blades is furnished with each machine.

The feeding mechanism gives several impulses per revolution and is practically continuous. The feed ratchets operate in either direction and are of the enclosed type. A calipering attachment is furnished as regular equipment. Suitable telescoping sheet iron guards extend between the faceplates entirely covering and protecting the working parts from chips and scale.

When so desired the machine is equipped with single or double quartering attachments with capacity for quartering wheels of locomotives with 24 in. to 36 in. stroke.



Outside Journal Turning Attachment

Either inside or outside journal-turning attachments or both can be supplied when wanted; there is power feed to both these attachments. With the inside attachment both journals can be turned simultaneously and finished from hub to hub if necessary. There is a power cross feed for facing hub liners.

The lathe can be furnished with power cross feed for facing the sides of tires and can also be arranged for boring tires. It is so designed that it may be readily arranged to handle narrow or broad gage wheels.

The drive can be either by single pulley belt, 30 hp. constant speed motor, or 30 hp. adjustable speed direct current motor. Faceplate speeds of .5-.7-.9-1.1-1.5 and 1.9 r.p.m. for tire turning and 4.4-6-7.6-9-12.6 and 16 r.p.m. for journal turning are obtained while 1/8-1/4-3/8 and 1/2-in. feed per revolution are provided.

Locomotive Frame Slotting Machine

An innovation in the design of locomotive frame slotting machines has recently been produced by the Niles-Bement-Pond Company, New York. The principal departure from conventional practice lies in the method used for the main drive of each unit. The former method of securing the reversing motion was by means of the familiar crank and connecting rod or through the use of reversing pulleys and belts for transmitting power to a rack on cutter bar. The new design utilizes a reversing motor mounted on each head which, driving through one pair of gears only, rotates a vertical screw that directly engages the cutter bar.

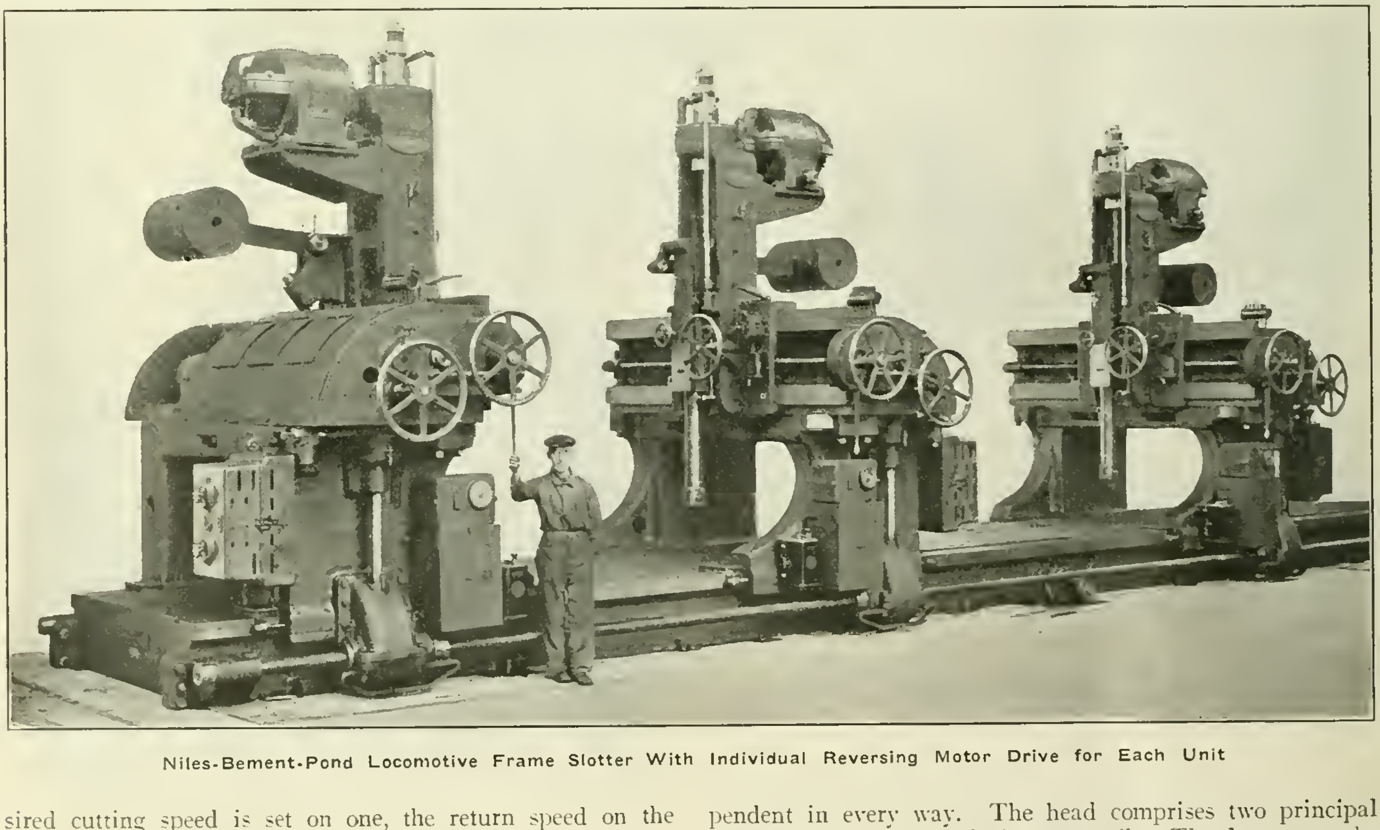
The motors are 20 hp. each, with a 4 to 1 speed range. The cutting and return speeds are controlled independently, and any combination between them can be obtained within the speed ranges of the motor. The return speed range limits are naturally much higher than those assigned to cutting. Two dials on the contactor panel are connected with the rheostats which govern these two-speed functions. The desired cutting speed is set on one, the return speed on the others. The motor is reversed by automatic contactors governed by a pilot switch, actuated by the tripping of adjustable dogs on the cutter bar. The dogs are set by hand at locations that give the desired length and location of stroke. The maximum stroke is 38 in.

Another novel feature of the machine is found in the feed arrangements employed. Each head has its own motor for feeding and traversing the head along bed and the saddle along crossrail. This motor through gears and shafts engages with and revolves nuts on fixed screws along each side of the bed for the longitudinal feed and traverse of the head. The same motor is used for feeding and traversing the saddle along the crossrail through another gear train. The control and operation of both feed and traverse is electrical. A dial set at the desired feed point allows the feed motor to make one or more revolutions intermittently by means of which the desired feed is obtained. Throwing a switch allows the motor to run continuously, giving fast traverse of either head or saddle as desired.

Slotting at an angle too steep to be covered by the swiveling feature of the crossrails is necessary at the ends of some locomotive frames, and this requirement is met in this machine by combining long and cross-feeds for simultaneous action. By change gears and swing arms, combinations between these feeds may be effected to slot any angle up to 45 degrees.

These machines are built with from one to three heads and in any desired length of bed. The machine illustrated has a bed length of 60 ft. Each head is self-contained and independent in every way. The head comprises two principal members, the yoke and the crossrail. The latter can be swiveled in the horizontal plane for cutting tapers and angles. The openings in the yoke are 61 in. wide and 41 in. high, which accommodates six 6-in. frames or four 8-in. frames set on the bed for simultaneous slotting.

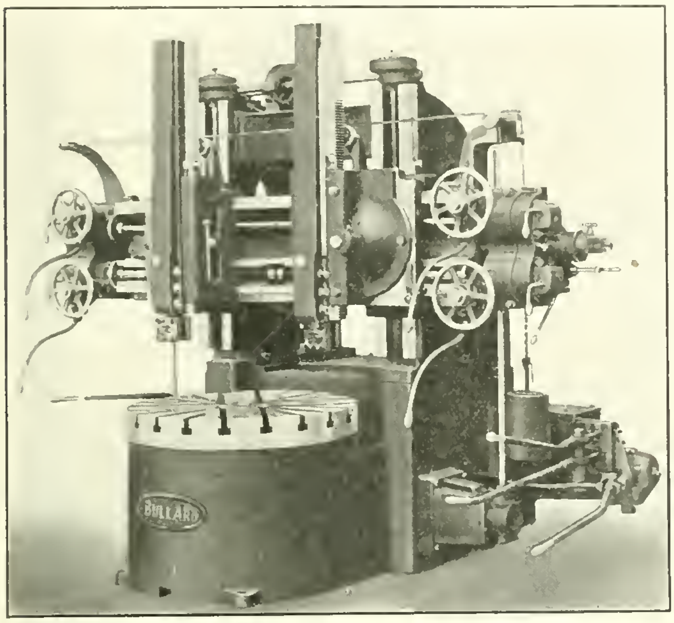
The extension tool bar is cylindrical in form, has a relief socket on the tool apron, and has its upper bearing in the cutter bar. The tool bar is revolved by a worm wheel gearing and hand wheels for setting tools or for cutting fillets.



Niles-Bement-Pond Locomotive Frame Slotter With Individual Reversing Motor Drive for Each Unit

Hand Feed Levers for Boring Mill

THE vertical boring and turning mill of today retains much of its original form, but facilities for quick change in a range of selective feeds and speeds, for more efficient and greater power application, and for convenience and accuracy in operation have made the machine of past decades into a modern production unit. Improvement in materials of construction, the use of heat-treated alloy steel in gears and shafts, continuous lubrication of all working parts, and the simplicity and convenience of control have aided in the development of a mill which far surpasses the older type of machine on any class of work.


Bullard Maxi-Mill Equipped with Hand Feed Levers

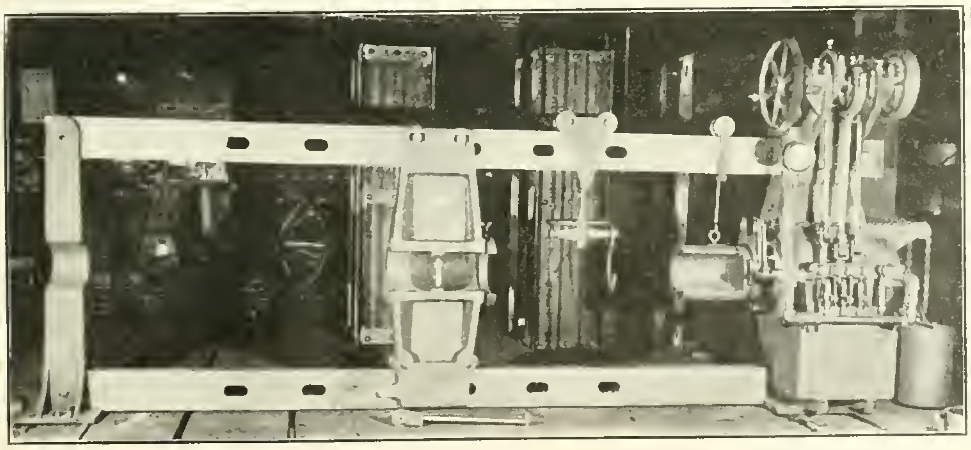
The Maxi-mill, a development of the Bullard Machine Tool Company, Bridgeport, Conn., embodies all of the above mentioned improvements in boring mill design and is now equipped with hand feed levers, a new feature which has proved extremely valuable in many classes of work. In many cases hand feed in heavy cutting is essential to high grade production both in quantity and quality, and definite aid to the operator not only conserves his energy but assures increased production and even greater accuracy. The many kinds of jobs done on the Maxi-mill in railroad shop and roundhouse work is one example of this. The tendency of the operator on any new work to start each cut by hand before throwing in the power feed is generally recognized. By using the hand feed levers the operator may stand in position to closely observe the cut while the greater leverage is of great advantage in holding the tool to the work against tough scale, or when machining chilled cast-iron or cast-steel. When the method of form templet and pointer attached to the tool slide is used, the levers permit the operator to watch this closely, guiding the cutting tool with greater ease and accuracy.

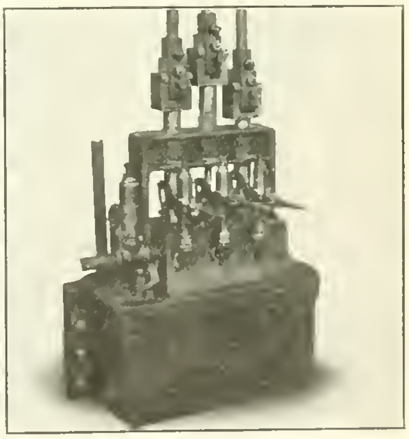
In construction each hand feed lever is pivoted on a free swinging collar mounted on the hammer hand wheel supporting bracket. Hardened steel clutch teeth, on the hub of the hand wheel and on the hand lever are engaged by a slight forward movement of the lever. When not actually held in engagement the lever automatically drops out of engagement, a feature assuring absolute safety in operation.

The advantages to be gained by using hand feed levers are apparent from the foregoing paragraphs and have been duly impressed by experience on anyone who has attempted to force a tool into a heavy cut by ordinary methods. The new feature is in line with modern developments for increased production, greater accuracy, and operating convenience.

New Pump for Hydraulic Wheel Presses

THE pumping unit of a hydraulic wheel press is more subject to deterioration on account of wear than any other part of the machine and with this fact in mind the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, has developed a new pump featured by extreme rigidity, and careful guiding of all reciprocating parts, with provision for take up or replacement of all parts subject to wear.


400-Ton Hydraulic Wheel Press Equipped With Improved Three-Plunger Pump


Close-up View of Pump

An assembly of a three-plunger high and low pressure type of this pump which is known as the Class SS vertical single-acting type is shown in the illustration applied to a 400-ton hydraulic wheel press. The cylinder block is mounted on a casting which acts as a cover to the self-contained reservoir. This cover is provided with machined pads for the forged steel cylinder block and the cast crosshead guide.

The cylinder block is a one-piece steel forging with plunger and valve cavities bored out, and renewable screwed-in bronze seats provided for the valves. Secured to the cylinder block and carefully alined with it is a one-piece cast crosshead guide provided with babbitted bearings of ample area. The crossheads are designed with a large diameter so that the bearing pressures resulting from side thrust from the connecting rods are extremely low. The crossheads are provided with wedge-type, brass-fitted, adjustable take ups. Grease cup lubrication is provided at this point. An adjustable spring-loaded safety valve of the latest type is used.

The Class SS pump is furnished in either two or three-plunger types, the former ordinarily being of the high pressure type while the latter is provided with one low and two high-pressure plungers. Both are provided with automatic knock-out or pump-unloading valves of the spring loaded type which are connected to the pressure chamber. The springs are set to balance a predetermined hydrostatic pressure and when this pressure is exceeded the springs compress and cause a system of levers to raise the suction checks from their seats thus rendering the particular cylinder which they serve inoperative. This is accomplished automatically and is particularly valuable in a wheel press since it permits the low pressure part of the stroke to be accomplished at high speed with all of the plungers of the pump operating. As the work in the press becomes more difficult and the pressure builds up, the knock-out valve on the low pressure cylinder functions as above described and holds the check off its seat rendering the cylinder inoperative during the balance of the high pressure stroke. The high pressure cylinders are also provided with knock-out valves which are adjustable and can be set to release at a predetermined high pressure point thus making it impossible to put an undue strain on the mechanism. This eliminates wear on the safety valve seats since that device is required to perform its duty only as an emergency safety appliance.

In addition to operating automatically the knock-out valves just described are provided with hand levers and may be thrown out thereby at the will of the operator. This permits a very minute control of the pressure stroke without changing the comparatively slow-moving operating valve and is particularly valuable at the completion of an accurate and difficult pressing operation. By the use of these hand knock-out levers, the movement of the press ram may be controlled down to one stroke of the pump. The hand levers in no way affect automatic operation of the knock-out valves.

The pump illustrated is arranged for direct-connected motor drive but it may also be provided with belt drive through tight and loose pulleys. The considerable distance between the eccentric shaft and the crosshead is an advantage since it reduces angular thrust on the crossheads. The eccentrics, driving the pump, are of exceptional size, thereby reducing the bearing pressures. They are provided for take up and equipped with grease cup lubrication. The eccentric shaft is a heavy steel shaft with the eccentrics keyed on. The Class SS pump is provided in four sizes from 7½ hp. to 15 hp. with considerable possible variation of capacity in each size made possible by a selection of plunger sizes. The entire stationary portion of the pump is rigidly tied together which maintains accurate alinement. All moving parts are amply guided. Wearing surfaces are provided either with antifriction metal or approved lubricating devices.

American Saw Table and Hand Jointer

The universal saw table, illustrated in Fig. 1 and made by the American Saw Mill Machinery Company, Hackettstown, N. J., has been equipped with motor drive. The main table tilts to an angle of 45 degrees, and it is also a rolling table for cut-off work. Two arbors are provided, either one of which can be quickly placed in cutting position. These arbors are carried in ball bearings. Convenient hand wheels provide for tilting the table and for adjusting the saws; a suitable guard is also provided for the saw, and all necessary ripping and cut-off and mitering gages. The table is 44 in. by 38 in. and saws up to 14 in. in diameter may be used. The shipping weight with the motor is about 1,600 lb.

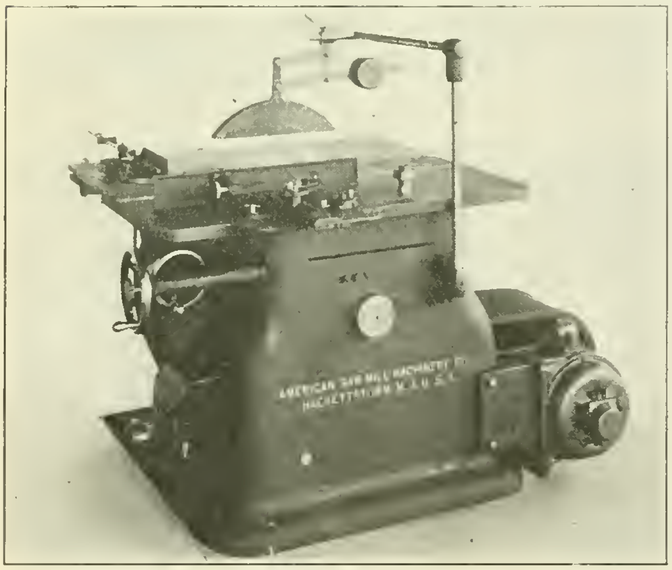


Fig. 1—American Motor-Driven Universal Saw Table

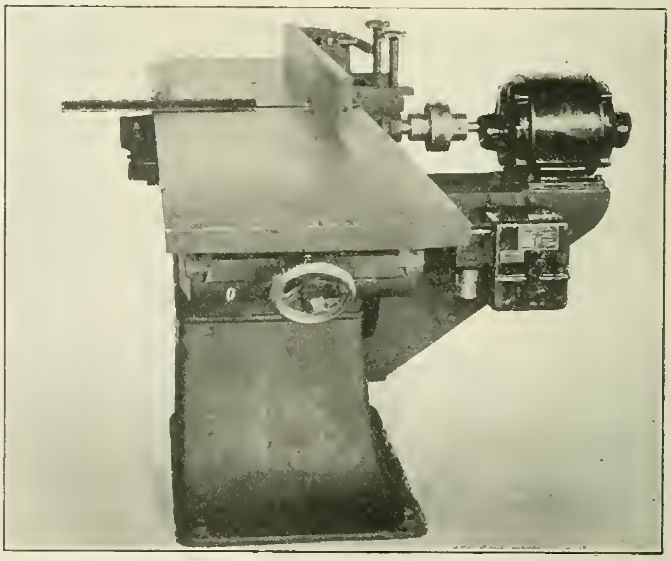


Fig. 2—Direct Motor-Driven Hand Jointer

This company also has developed a universal saw bench with tilting table, the table being 36 in. by 48 in., with hand wheel adjustment for raising and lowering and also hand wheel adjustment for tilting the table. The motor is direct connected to the countershaft, and from this same countershaft may be driven the mortising attachment, furnished with the machine on special order. Saws up to 20 in. may be used.

Fig. 2 illustrates an application of direct motor drive to the American hand jointer, the motor being mounted on a substantial frame attached to the side of the main jointer base. The motor is connected by means of a flexible coupling. This motor drive is applied to 12, 16 and 20-in. jointers. The jointers are provided with a new type of round safety four-knife heads.

The American bench jointer has also been improved, being more substantial than earlier models and equipped with a 1-hp. direct-connected motor, mounted on a substantial base which is part of the main jointer base, and connected to the cutter head by means of a flexible coupling. This machine carries four 8-in. knives fitted to a round safety head. The jointer table is 48 in. long overall and the machine is equipped with all of the adjustments of a standard hand jointer.

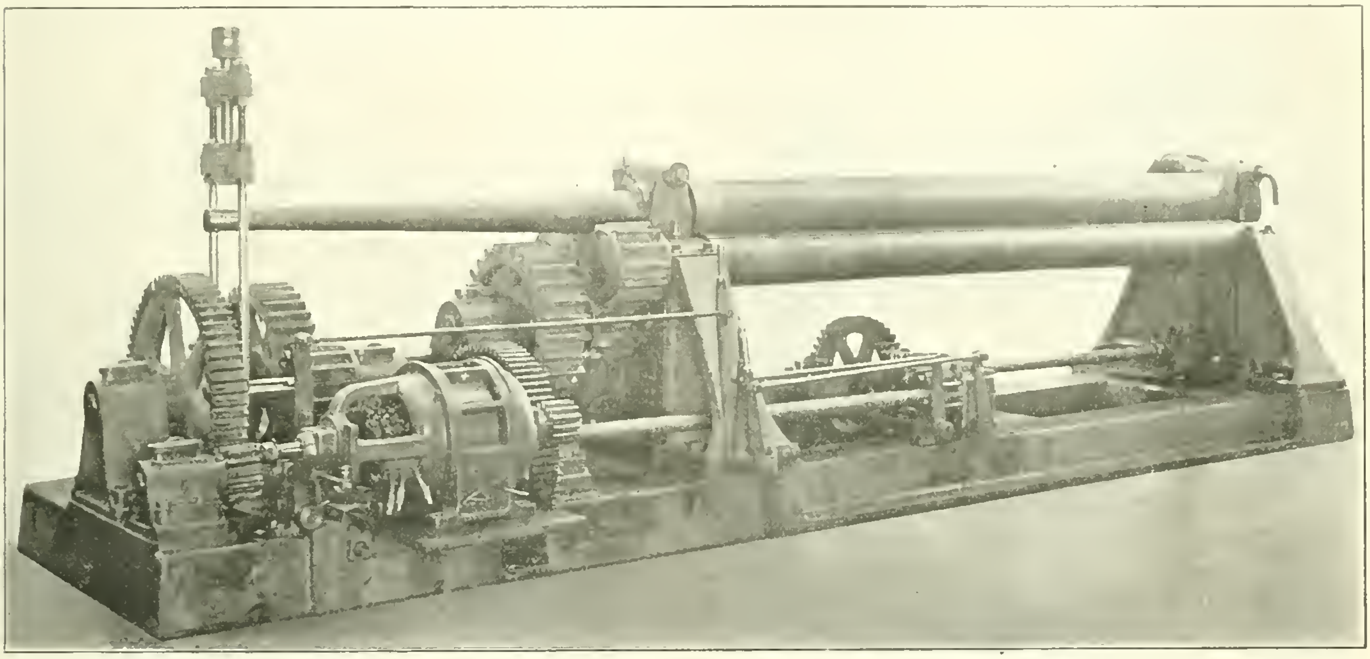
Direct-Connected Motor-Driven Bending Rolls

THE illustration shows a No. 2 Cleveland pyramid type bending roll, spaced 10 ft. 2 in. between housings, recently designed and built by the Cleveland Punch & Shear Works Company, Cleveland, Ohio.

This machine is direct connected, motor driven, entirely self-contained and is arranged for power raising and lowering of the top roll. One of the lower rolls (8 in. in diameter) has three splines; the other lower roll has two splines and a flanging groove. The upper roll is 11 in. in diameter. It will be noted that none of the gears protrude into the foundation, hence no expensive pit is required. Two clutches are provided so that either end of the top roll may be raised and lowered. An additional single clutch is used for starting the rolls.

This bending roll, as shown in the illustration, is featured by rigid construction and parts so proportioned as to stand the stresses imposed on them with an ample factor of safety. The roll boxes, yoke and elevating screws are all scientifically designed and made with a view to strength and durability.

When it is desired to drop the hinge at the right end, the cover plate can readily be lifted from the shoulder belts and the yoke dropped by one man.



Power Bending Rolls Recently Made By the Cleveland Punch & Shear Works Company—A Compact Motor-Driven Unit

Two New Developments in American Lathes

ONE of the two most important, recent lathe developments of the American Tool Works Company, Cincinnati, Ohio, is the new automatically-oiled, 12-speed, geared head illustrated in Figs. 1 and 2. On all sizes of American lathes up to and including the 36-in. medium pattern lathe this mechanism provides 12 mechanical spindle speeds in geometrical progression. All gears in the head are heat-treated manganese steel, of high tensile strength, and all speed change gears are hardened. The entire head is designed for maximum durability, low maintenance expense, and ability to perform the most severe service without appreciable deterioration.

Only three shafts are used in the new head. Therefore, the gear centers can be located farther apart, using larger diameter gears than in the average four-shaft head. The entire mechanism operates in a bath of oil, which in conjunction with the liberal proportions of the gears and shafts, and the carefully selected materials tends to insure long and satisfactory service with minimum wear.

As an example of the great power and rugged construction of the American automatically-oiled geared head, the 24-in. heavy pattern lathe is said to work a 20-hp. motor at its full capacity, while on the belt-driven head, the power is delivered to a 16-in. driving pulley by a 6-in. double belt.

The head is under instant control through either of two levers, one located at the right side of the apron, and the other at the left side of the head. These levers operate the powerful friction clutch incorporated in the driving pulley or the driven gear of the motor train, if motor driven. A powerful band brake operates in unison with the friction clutch, and is engaged when the friction is released, and vice versa. In order to remove the belt pull from the driving shaft the pulley is bronze bushed and mounted on a long steel sleeve of large diameter, which takes the belt pull. Another decided improvement is the gear tooth clutch used on the high speed drive, providing ease of engagement and durability.

The automatic oiling system employed is a new development by means of which a geared pump, accessibly located inside the head, pumps oil from a reservoir in the bottom of the head to a filtering and distributing tank in the head cover, from which every bearing in the head is lubricated. Oil cascades over the gear teeth, keeping them constantly lubricated. Every drop of oil used for bearing lubrication is thoroughly cleansed and strained, thus insuring perfectly clean lubrication.

The oil first flows into a settling tank (Fig. 2) in the lower head casting, where all heavy particles of foreign matter settle to the bottom. As the oil accumulates in this settling tank it overflows into a straining compartment, where it passes through a fine mesh metal gauze strainer into the pumping reservoir. From this point it is lifted by the pump into the filtering tank in the head cover, where it is filtered through a felt pad ½-in. thick before it reaches the distributing chamber, from which it is led to the various bearings located in the head.

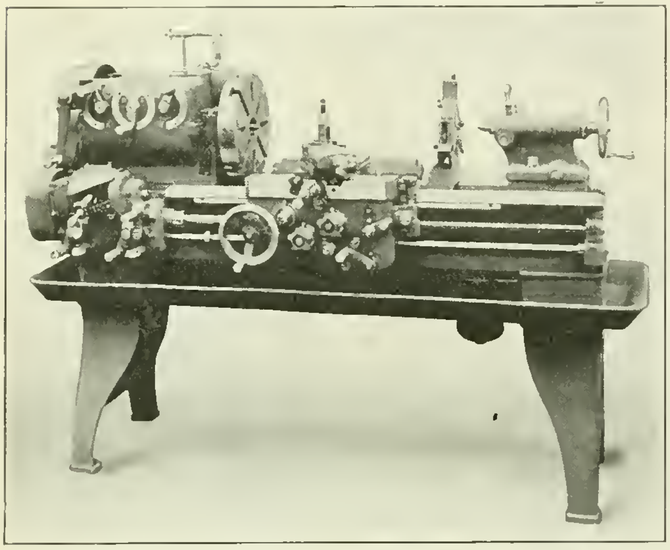


Fig. 1—American Lathe With Automatically Oiled Geared Head

A removable plug in the bottom of the settling tank provides means for removing the sediment from the tank, while a signal glass in the supply line from the straining compartment to the filtering tank shows the operator how the oil pump is working.

The new portable lathe illustrated in Fig. 3 is a recent addition to the American line. It has been developed primarily for railroad shop service and the factors of particular importance for such service have been given particular attention. The lathe is built in four sizes, 12-in., 14-in., 16-in., and 18-in. It is an exceptionally powerful and rigid machine, with the weight so distributed that it can be easily moved about the shop.

The motor is located in the leg under the headstock, thus bringing the center of gravity close to the floor, and minimizing the tendency to overturn when moved on an uneven floor. Power is transmitted to the twelve-speed, automatically-oiled, geared head through either a belt or chain, and the machine is under constant control through a mechanical apron control lever at the right side of the apron. This lever engages and disengages the starting friction, and also operates the brake.

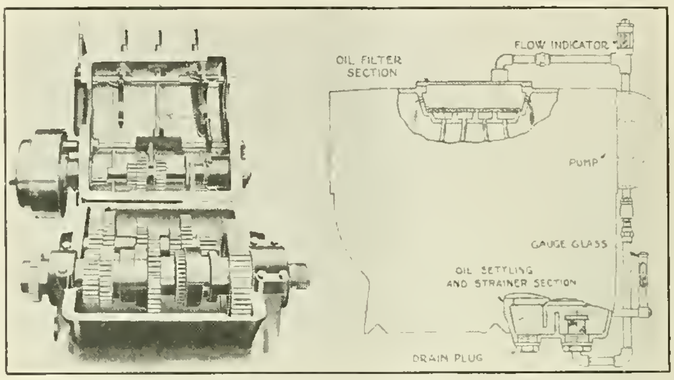


Fig. 2—Large Diameter Gears—Geared Head Oiling Diagram

The lathe is mounted on three substantial cast-iron wheels running on ball bearings, and is supplied with a long handle so counterweighted that when released it brings a shoe into contact with the floor, which prevents movement of the lathe while in the operative position.

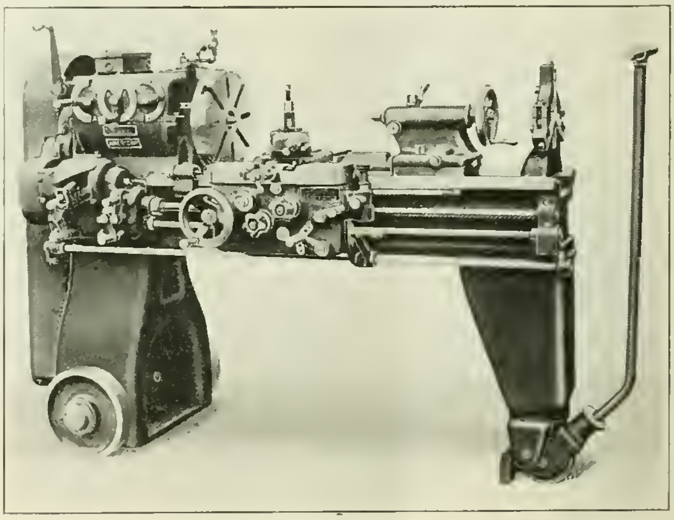


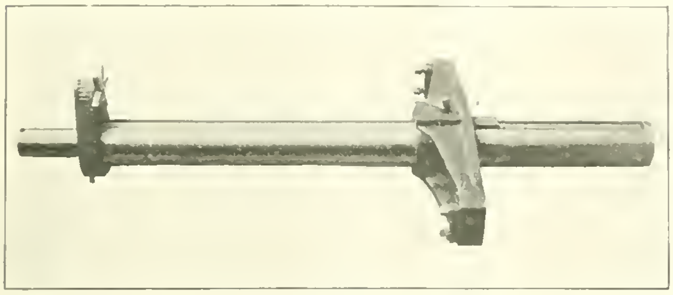
Fig. 3—Portable Lathe for Use in Railroad Repair Shops

For driving this machine either a direct or alternating current, constant speed motor may be used, or, if preferred, a four-speed, simplified geared head can be furnished in place of the twelve-speed head, which is designed for use with a 3 to 1 direct current, variable speed motor.

Stationary Boring Bar for Cylinder Bushings

An unusual boring problem has been solved by the Pedrick Tool & Machine Company, Philadelphia, Pa., in the stationary boring bar illustrated, having a cutter head which does not revolve but feeds along the bar. It was desired to bore large locomotive cylinder bushings on a relatively small vertical boring mill and this boring bar, shown in a horizontal position in the illustration but used vertically, enables the operation to be performed. The inside diameters of the bushings to be bored are 28 and 30 in. and the length 44 in. This made the distance under the tool post of the boring machine limited, greatly increasing the difficulty of designing a suitable boring bar.

Referring to the illustration, the greater part of the bar is like the standard Pedrick 4½-in. cylinder boring bar but with a shank turned down to fit into the toolpost. The end of the shank is cross slotted to receive the holder. The right end of the bar is bored for a pilot, held in the table of the boring mill. Hence the bar is supported both on the top and bottom, an essential feature in view of the dimensions of the bushings.



Pedrick Boring Bar Used for Boring Locomotive Cylinder Bushings

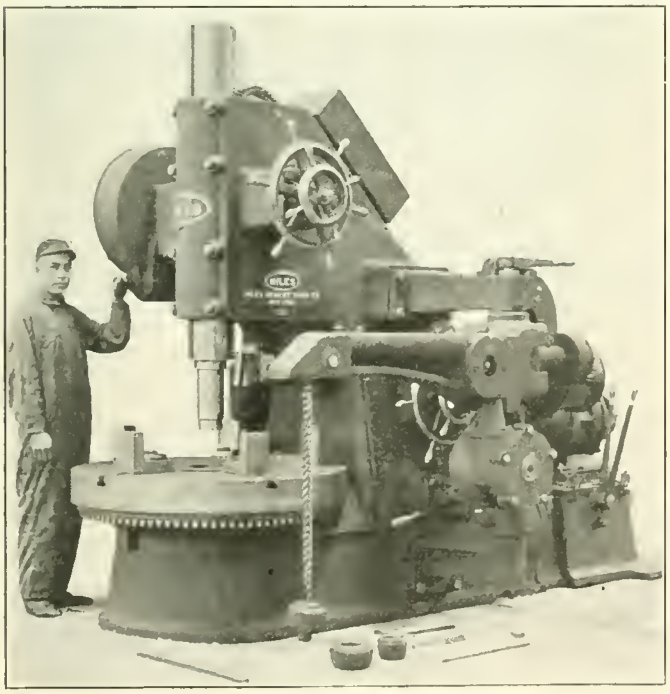
The provision of a feed mechanism was also something of a problem. It was found that merely affixing a star wheel to the end of the feed screw would necessitate such a deep slot or gash in the bar (owing to the let-in screw) that the latter would be less strong than necessary for the job. Furthermore, the bearing of the screw plus the star wheel would make the bar an inch or so too long.

The illustration shows the feed gearing arranged with axis parallel to the bar, and with the star wheel on the end where it can function without weakening the bar. The bushing being bored carries a knocker, which engages the star at each revolution and causes the cutter head to feed downward. On a test run it is said that this bar worked satisfactorily and that considerable economy resulted by boring the bushings in this manner on the same machine upon which they were otherwise machined. The boring mill was kept working to capacity and there was no rehandling and resetting of the work.

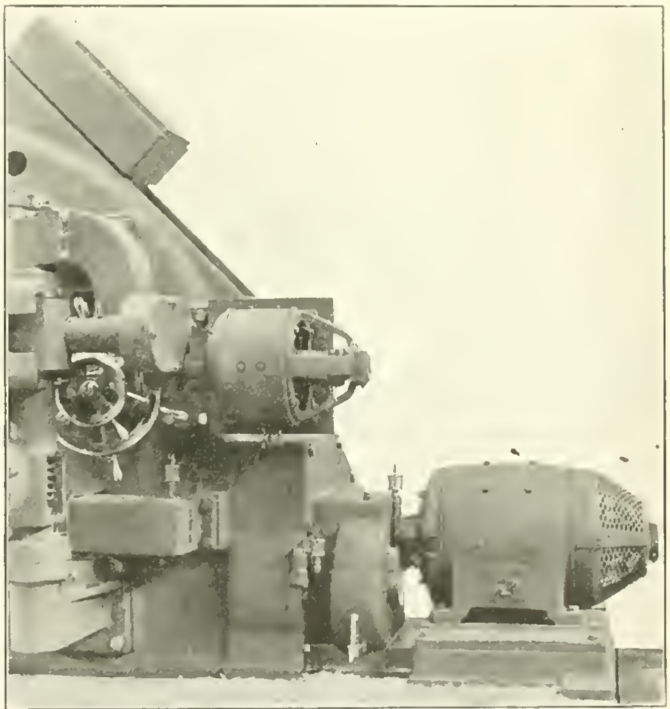
Forty-eight Inch Car Wheel Borer

The new 48-in. car wheel borer brought out by the Niles-Bement-Pond Company, New York, comprises several features which tend toward increased production and safety. The frame itself, all one casting, has been made heavier, which promotes output because of greater rigidity gained with the accompanying ability to take heavier cuts. The pattern of the frame has been altered in such a way as to give greater support to the hub-facing bar which also makes heavier cuts possible.

The automatic self-centering chuck is an interesting and time-saving feature of the new model. After the wheel to be bored has been swung into place on the table by the motor-driven crane supplied on each machine for that purpose, the motor is started at a slow speed in the regular way. A mechanism in the table causes the chuck jaws to move inward until they engage the wheel tread. When the job is firmly chucked, the table commences to rotate and the driving force employed after the cutting operation begins only serves to further lock the wheel in the jaws. When the job is finished, the motor is reversed and relative motion between the driving gear and table serves to loosen the jaws and withdraw them toward the periphery of the table after which the motor is stopped and the wheel removed by the crane.



An Automatic Self-Centering Chuck Is a Feature of the New Niles 48-in. Car Wheel Borer



View Showing Rugged Main Drive and Crane Motors

The boring bar counterweight operates down an incline on the back of the machine frame, and is so arranged that in the event of the support chain breaking, the counterweight is prevented from falling.

Where a shop is equipped with direct current, dynamic braking can be applied. For either direct or alternating current, the machine uses reversing motors, the different table speeds being obtained by using a variable speed motor in the case of direct current and a constant speed slip-ring motor operating through a speed change box where alternating current is used. No clutches are used in either case.

Although the machine can be furnished belt-driven for shops which are not able to provide individual motor drive, electric drive is recommended for economy of power consumption, dynamic braking, and reversing motor features as well as the use of a motor for operating the small crane.

Conveniently-Operated Heavy-Duty Slotter

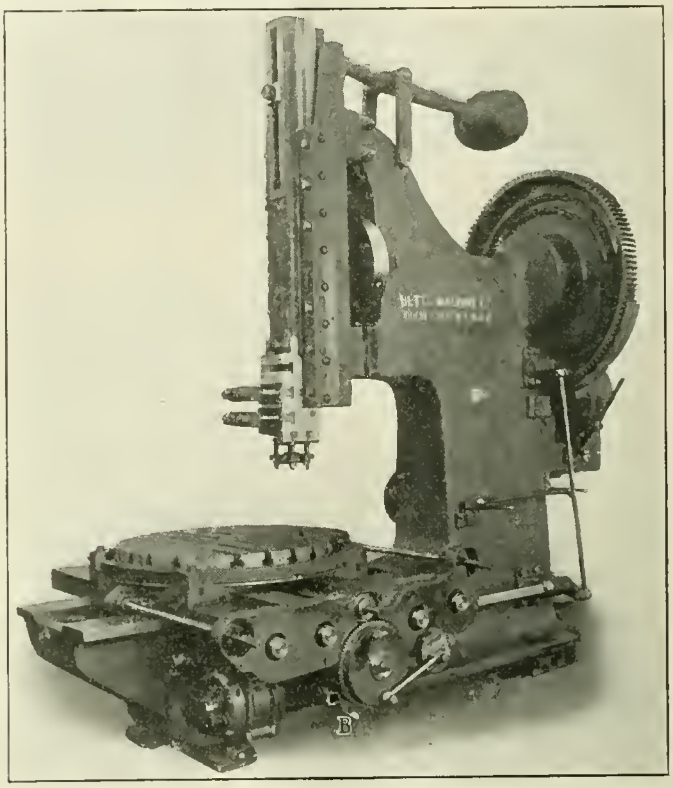
An 18-in. heavy-duty slotter of special interest on account of the features incorporated for convenience of operation has been built recently by the Betts Machine Works of the Consolidated Machine Tool Corporation, New York.

The ram is driven by a 7½-hp., alternating current motor, constant speed squirrel cage type, with a suitable range of ram strokes provided through sliding gears in a box on the back of the machine.

Quick stopping of the ram is accomplished by means of a friction clutch and brake mounted between the motor and speed gears. The clutch and brake are engaged and disengaged by means of a lever controlled from the operating position, making it unnecessary to stop the motor when stopping the ram. This saves drifting time common to alternating current motors. In other words, the ram can be stopped instantly in any position.

The tables are equipped with quick power rapid traverse driven by a separate 3-hp. motor. Lever *B* disengages the feed and engages the power rapid traverse, selective to either saddle or tables by sliding a slip gear into position. The motor has rotor windings of the high resistance type to provide for quick stopping, and is equipped with a reversing magnetic control panel. A push button station, providing for start, stop, reverse and jogging movements, is mounted in a convenient position. The small motor is mounted on the underside of the saddle out of the way. All the control levers are arranged for easy manipulation.

Other features include a relief tool apron made of steel, adjustable ram and ram guide for adjusting the stroke to suit the height of the work; large diameter feed cam requiring minimum of ram stroke for feeding action, one piece rigid frame designed to eliminate spring under heavy cuts, convenient arrangement of speed changes through sliding gears controlled from operating position, and adjustment of feed convenient for operation.



Betts 18-in. Heavy-Duty Slotter Easy to Operate

A New Material for Making Gears

A MATERIAL for making gears which possesses the qualities of quietness in operation, strength and practical imperviousness to oil, which is not affected by atmospheric changes, which is elastic and long lived, which makes the use of metal shrouds unnecessary and which is vermin proof, has recently been devised and placed on the market by the General Electric Company, Schenectady, N. Y. It is known as Textoil gear board and consists of layers of an especially strong, closely woven canvas, highly compressed and permanently held in compression by means of a compound with which the whole mass is fully impregnated and finally set by a curing process. These boards are 35 in. square, the thickness ranging from ¼ in. to 3 in. (both inclusive).

Textoil Gear Board Designed to Make Strong, Quiet Gears

The refinements made for increasing machine efficiency have increased speeds to the extent of producing excessively noisy gear trains. Gears of Textoil board are said to have proved highly effective in quieting them. Shocks and vibrations of surrounding parts are also largely eliminated where this material is employed, because of its elasticity. The elasticity which characterizes it is due to special treatment of the fabric that leaves the finished board with live cotton fibers.

Textoil is nearly as strong as cast iron and runs equally well meshed with cast iron, steel or bronze. Its oil and water absorption being practically zero, it may be run in hot oil or under conditions in which it is splashed with oil, with complete success, while it is also proof against atmospheric changes. It neither shrinks nor swells in extreme dryness or dampness, and may be stored indefinitely without damage.

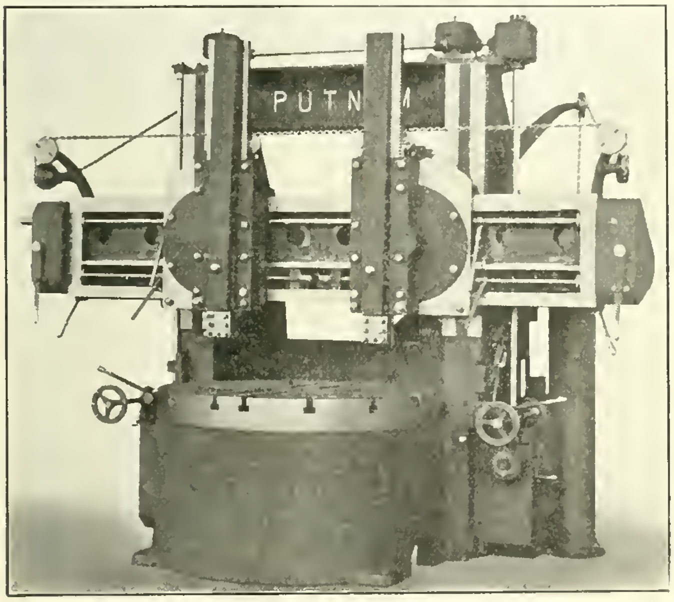
The use of Textoil gears is advisable in gear trains running 700 ft. or more per minute at the pitch line. For general applications the maximum speed should be kept within 2,000 ft. per minute as usually figured for metal gearing. Under suitable conditions of design of surrounding parts, the speed may be much higher.

Common types of machinery on which Textoil gears are used include fractional horsepower motor drives and machine tools. For the manufacture of small gears, and as a general utility gear material, Textoil gear board is especially adapted. As it can be stored indefinitely, it provides an immediate supply of gear material from which finished gears can be quickly made. Miter gears or bevel gears with the pitch angle even greater than 45 degrees can be made satisfactorily from it.

Putnam Heavy-Duty Boring Mills

THE Putnam Machine Works of Manning, Maxwell & Moore, Inc., New York, has recently developed an improved model heavy-duty vertical boring and turning mill in several sizes ranging from 44 in. to 74 in. swing. The drive, speed changes, hand manipulations, feed and rapid power movements of heads, operation of clutch and brake are all centralized and controlled from both sides of the machine with equal convenience. All gearing is of steel and all bearings are bushed with bronze.

The table is exceptionally heavy and provided with finished parallel T-slots and additional radial slots. The table spindle is of large diameter, accurately ground and runs in two long bushed bearings in the bed. The table also carries a conical seat which absorbs vertical and side thrusts and automatically preserves the spindle alinement. The spindle and the conical seat run in a flood of oil. An adjustable nut at the lower end of spindle resists any lifting tendency. The table drive is by bevel gearing which also runs in oil.



Putnam Mill Featured by Massive Proportions and Duplicate Control

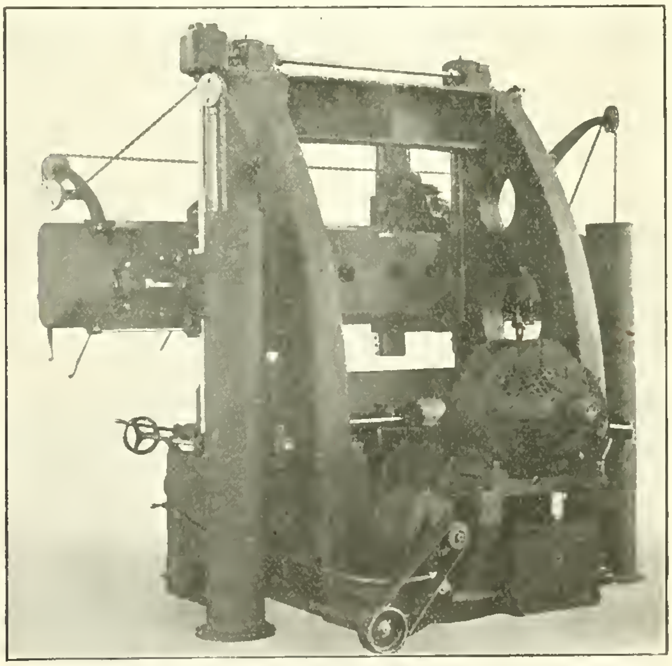
The crossrail is of the three-track type with the traversing screws always in tension and located between narrow guiding surfaces at the bottom. The crossrail is raised and lowered by power with stops to automatically limit the up and down travel. The saddles are fitted with taper gibs for taking up wear. The bars are of rectangular shape fitted with gibs for adjustment, and each bar is arranged to swivel 45° on either side by means of a worm, controlled by a ratchet.

Binder bolts lock the saddles or bars when desired. Ratchets are located on the heads for hand operations and final tool adjustments, large micrometer dials facilitate accurate and duplication tool setting. Twelve positive feeds ranging from .005 in. to ¾ in. cover all requirements. A safety clutch prevents accident, in case heads or bars meet an obstruction while feeding or fast traversing.

Belt drive is by constant speed single pulley and multiple dry disc clutch. Constant speed motor drive is by motor of about 1,100 or 1,200 r.p.m. mounted above the gear box and directly geared to it. A gear box, embodying a powerful multiple dry disc clutch and brake, gives twelve selective all-geared speeds which are operated by only two levers. The friction clutch and control levers are in duplicate, permitting full control of speeds with equal facility from either side of the machine.

All gears are alloy steel, heat treated and hardened, running in a bath of oil. The shafts are of large diameter, running in ball bearings of extra large size, thereby reducing friction and its attendant wear and upkeep expense, and permitting a greater proportion of the power used to be delivered at the cutting tool and converted into useful work.

When driven by an adjustable speed motor of 3 to 1 ratio the motor is directly geared to a three-speed gear box. The speed changes are operated by only one lever, which is in duplicate, permitting full control of speeds from either side of the machine.



Rear View Showing Adjustable Speed D. C. Motor Drive

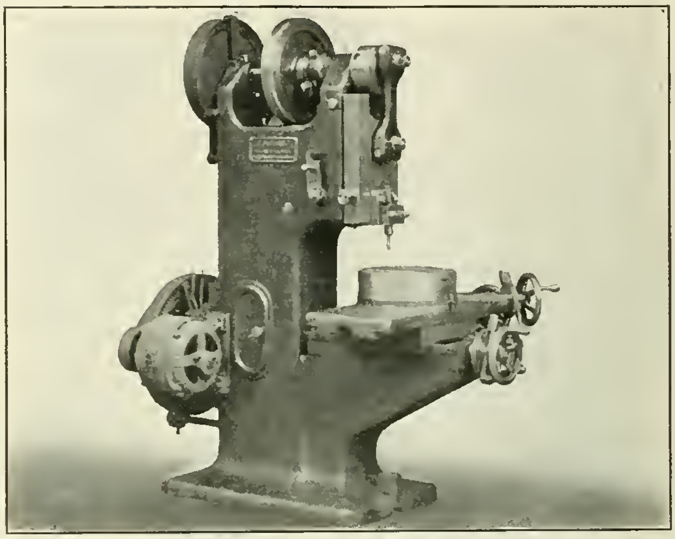
A separate motor as shown in the accompanying illustration drives the power rapid traverse and elevates the crossrail. This motor is only used when the machine is driven by an adjustable speed motor. It will be noted that the motors are located on the base rather than high on the housings.

Bossert Vertical Die Slotting Machine

ARRANGEMENTS have recently been made by the John Steptoe Company, Cincinnati, Ohio, to build the improved Bossert die slotting machine. This is a vertical slotting machine designed especially for use in making round, square and irregular shaped punches and dies. Its purpose is to eliminate as much as possible, the hand work in connection with die making. Two sizes are now being manufactured, one having a length of stroke up to four inches and the other up to six inches. The machine is of simple construction and there are no complicated parts to get out of order. The ram is driven by a crank, connected at the upper end of the crank pin to the crank disk on the main shaft. The crank pin is adjustable so that the length of stroke can be adjusted from 0 to 4 in. on the smaller machine and from 0 to 6 in. on the larger machine. The ways are hinged on the upper end in such a way that they can be set at a slight angle to obtain the required amount of clearance in die opening. The ways are fitted with taper gibs. The crank arm at the lower end is attached to a pin located in a slot in the ram, the position of this pin being adjustable in order that the location of the ram path may be altered to suit the work in hand.

The lower end of the way may be connected by the manipulation of a pull-pin to a toggle-joint mechanism operated by an eccentric on the main shaft. When connected, this mechanism moves the ram over a curved path on the down stroke, thus enabling it to take curved cuts in dies. The mechanism also causes the tool to clear the cut on the up stroke, the amount of clearance being adjustable to suit the requirements. When the toggle-joint mechanism is disconnected, the mechanism is set for taking straight cuts.

This improved die slotter can be furnished with cross, longitudinal, and circular hand feeds and also with power feeds if wanted. A variable-speed gear box, mounted inside the column furnishes three changes of speed, these being secured by means of a shifting lever, conveniently located on the outside of the column. The machine is arranged with a circular table graduated in degrees, provided with an index pointer.

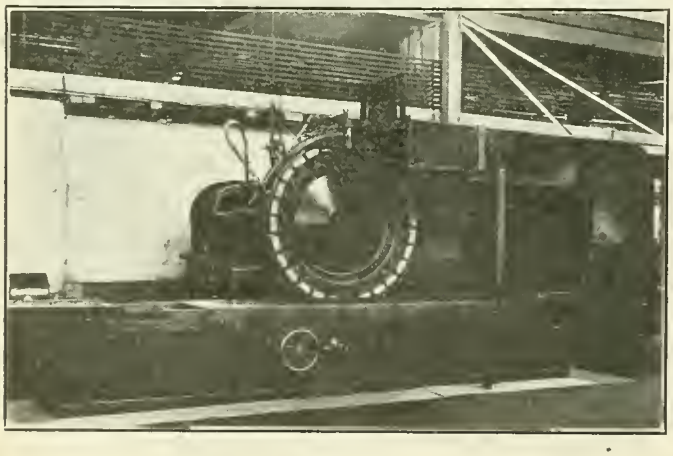


Bossert Die Slotting Machine of Improved Design

The illustration shows the machine arranged for motor drive; it can also be arranged for belt drive, which is furnished with tight and loose pulleys.

Face-Grinding Machine with 66-Inch Wheel

THE Diamond Machine Company, Providence, R. I., has recently built for the United States Radiator Corporation, Detroit, Mich., a face-grinding machine designed to grind boiler sections having a height of 60 in. To grind work of this height, the machine is equipped with an abrasive wheel having an outside diameter of 66 in. This is said to be the largest wheel ever put on a face-grinding machine.



Diamond Grinder with Wheel of Unusual Power and Size

In conformity with the standard design for Diamond face-grinding machines, the abrasive wheel is of the sectional type. There are 28 separate blocks of 2-in. face and 7¼-in. depth, each held with absolute rigidity in a special chuck. The design of the chuck will allow the use of 90 per cent of the abrasive material in the blocks before it is necessary to replace them with a new set. A wheel dresser built on the machine may be used while the machine is operating and without stopping production.

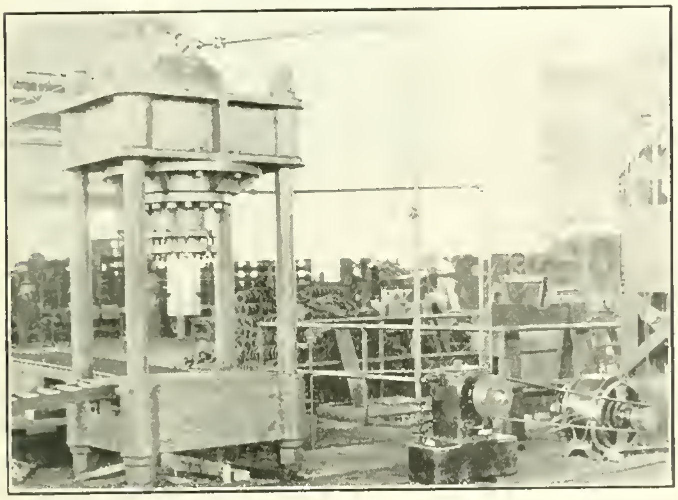
A tremendous cutting power is available at the face of this wheel due not alone to the driving force of a 75-hp. motor, but also to the kinetic energy stored in the rotating wheel, chuck and spindle. The drive from motor to wheel is through a Morse sprocket and silent chain and gives a speed of 180 r.p.m. to the wheel. The wheel spindle has a maximum diameter of 9 in. and is provided with ample bearings for rotation and end thrust.

Two large nozzles deliver an easily adjusted supply of cutting solution or water to the wheel. Substantial sheet metal guards prevent splashing and protect the bearings of the machine. A complete automatic system is provided for pumping the solution from a 140-gal. tank at the rear of the machine, collecting it after it has passed the wheel and settling out the solid material before the solution is circulated again.

The traveling table for passing the work across the rotating wheel has a platen 36 in. wide and 110 in. long with numerous slots for attaching the fixtures and work. The table speed is 22 ft. per min. Control of the motion of the table is provided at the front of the machine and also at the operator's position behind the table. Reversal of the motion of this heavy table is accomplished with slight shock by means of a patented arrangement of belts and pulleys within the bed of the machine. The total weight of the complete machine is about 40,000 lb.

Variable-Speed Drive for 150-Ton Press

The advantages of hydraulic variable-speed drive in perfect control of speed, absence of coasting, elimination of peak loads and low maintenance have been demonstrated in the 150-ton press installation illustrated.


Type W Oilgear Variable-Delivery Pump Driving 500-Ton Press

This press has been equipped recently with hydraulic variable-speed drive by the Oilgear Company, Milwaukee, Wisconsin, being used for assemblying spring buffers for draft gears. With the new variable delivery pump the press averages 35 spring buffers an hour. The draft gear contains heavy coiled springs which must be compressed at a certain point so that iron bands can be put on the assembly. This operation requires perfect ram control in both directions as well as the ability to stop at a fixed point under load, while the bands are applied, the load being then gradually released.

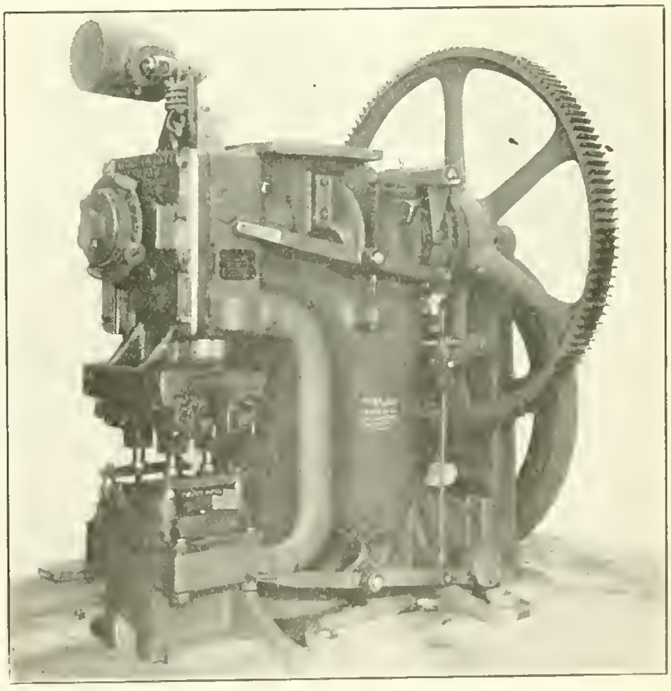
The type W Oilgear variable delivery pump which operates this press (shown in the right foreground of the illustration) is well adapted to these conditions. The control handle at the corner of the press is so connected to the pump that the pump stroke can be varied from zero to a maximum in any direction. Changing the length of the pump stroke regulates the amount of oil that is pumped into the press cylinder and thus controls the movement of the ram with great accuracy.

This pump is featured by light weight and takes up considerably less room than a water pump. It is driven by a constant speed electric motor. The diameter of the press cylinder in this case is 19 in., the ram diameter being 10 in.

Tie Plate Punch on Reclamation Work

Modern features of construction have been included in the tie plate punch illustrated which has been developed recently at the Hilles & Jones Works of the Consolidated Machine Tool Corporation, New York. This machine is now used in a prominent railroad shop for repunching tie plates in reclamation work. After service the tie plate holes become worn and in order to utilize these old plates, two new holes are punched at one time, diagonally opposite each other, the tie plates then being replaced in service. In addition to the four punch attachment to the machine a cross cutting attachment with knives for shearing flat, round, or square bars is also provided. Two machines of this type are now being used on reclamation work.

Referring to the illustration, the rugged construction and powerful drive of the machine will be evident. The throat depth from the center of the sliding head is 12 in. The machine has a capacity to punch six square inches and is ample for punching at one stroke, two ¾ in. square holes through material ¾ in. thick. Round bars 2¼ in. in diameter or flat bars 1½ in. by 7 in. made of mild steel can also be sheared. The machine is shown in the illustration fitted with four ¾ in. square punches, each controlled by a separate hand gag. The punches are adjustable both ways 3½ in. to 6 in. parallel with the main shaft and 3 in. to 8 in. at right angles to the main shaft. The vertical opening of the jaw is 26½ in. The two filling blocks bolted to the bottom of the sliding head, punch holders, die block holders and die blocks are all made of steel. The die blocks carry dovetail dies, grooved to accommodate the rib on the tie plate. The ties are adjustable to correspond with the adjustment of the punches. There are two plate strippers, and an adjustable guide at the back of the die holder for locating the holes. The stroke of the machine is 1¾ in. the speed being 25 strokes a minute. All gearing has machine cut teeth. The clutch is controlled by an automatic stop. All shaft bearings are bronze bushed. A ratchet spider fitted on the front end of the main shaft provides for bringing the head down by hand. Ten horsepower is required to drive this machine.

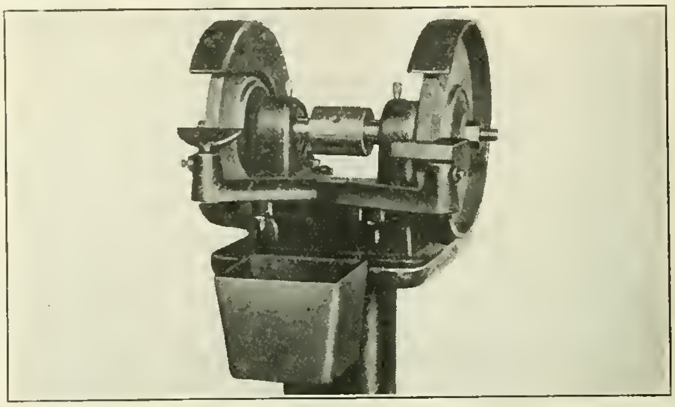

Hilles & Jones Tie Plate Punching Machine

Tool Grinder Driven from Main Shaft

As a rule tool grinders in railroad as well as other shops are for everybody's use, and too often nobody cares enough to give them the little attention needed to keep them in good condition. When a tool has been ground the shifter is given a careless slap and the operator walks away often leaving the grinder still running. The result is that with plain bearings in the grinder and also on the countershaft, wear frequently develops to such an extent that the grinders become noisy, out of true and cannot be used to grind tools accurately.

With these facts in mind the Fafnir Bearing Company, New Britain, Conn., has developed a ball-bearing tool grinder, designed to run continuously from any line of shafting, doing away with all countershafts and loose pulleys. Fafnir alloy steel ball bearings are used, providing long life and practically frictionless revolution of the grinding wheel spindle. These grinders can run all the time that the plant is running without harm to the bearings, being ready for instant use at all times. The only attention required is a few drops of oil about once in two weeks, and the only time the grinders need to be stopped is in changing wheels.

Railroad shops as a rule are equipped with an insufficient number of tool grinders of the type illustrated and many of those available are not maintained in good condition as regards bearings and cutting surfaces of the abrasive wheels in view of the importance of sharp cutting tools.



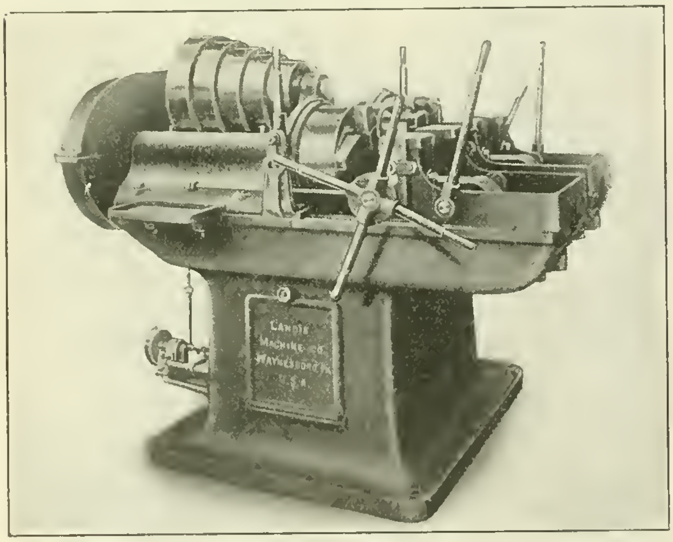
Fafnir Ball Bearing Tool Grinder No. 3

Pipe Machines with Internally Tripped Die Heads

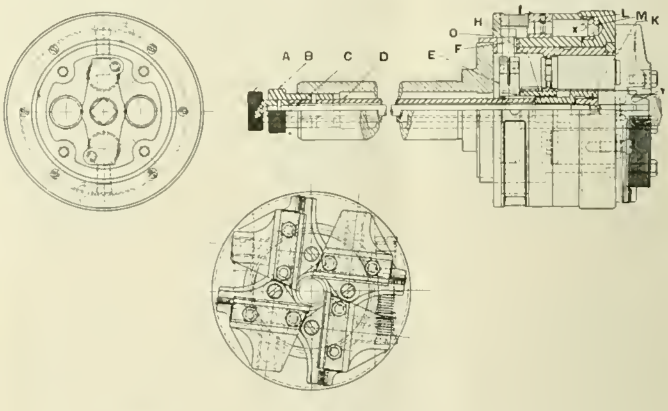
The Landis Machine Company, Waynesboro, Pa., is now making an improved type of pipe and nipple-threading machine with internally tripped die head. This type of head automatically insures a uniform length of thread on nipples and eliminates the necessity of gaging each nipple by hand. The new machine will thread, ream and chamfer both pipe and nipples.

The drawing illustrates the principles of operation of the Landis internally tripped die head. The knurled collar *A* and the clamping rod *C* are integral. The clamping rod *C* is threaded on one end which screws into a tapped hole in the shank of the reamer *K*. Knurled collar *B* is integral with the tube *D* which is threaded on one end and screws into the spider *E*. Spider *E* has a square hole through it and furthermore is tapped part of the way to fit tube *D*. This gives thread bearings on the four sides of the square hole. The reaming portion of the hole in the spider is plain, to afford a bearing for the driver *H*. Driver *H* has a square hole in the end to receive the shank of the reamer *K*.

To set the reamer to the correct position, the knurled collar *K* is drawn tightly by hand. This clamps together in one unit, tube *D*, driver *H* and reamer *K*. The surface *Y* on reamer *K* has no cutting edge. Therefore, as the nipple is being threaded and the end begins to bear on reamer *K*, the units *D* and *H* transmit the pressure to spider *E*. Through the medium of pins *F* in spider *E*, rings *G* and *I* are carried backward for a distance *X* or until pin *M* is disengaged from bushing *L*. The full opening movement is then completed by a spring in the adjusting ring.



Landis Pipe and Nipple Threading Machine



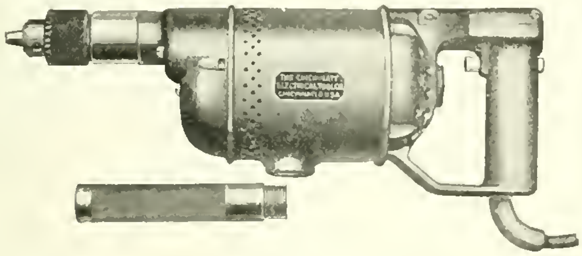
Drawing Showing Construction of the Internally Tripped Die Heads

To adjust reamer *K* longitudinally, the clamping rod *C* is unscrewed by turning knurled collar *A* to the left. Collar *B* is adjusted to right or left for either forward or backward movement depending upon the length of the thread to be cut.

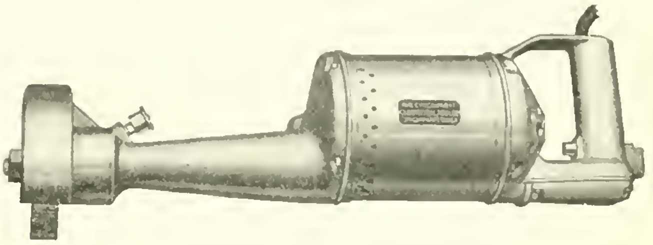
This new Landis internally tripped die head and machine, employing Landis high speed steel chasers and chamfering reamers, is made in the ½ in., 1¼ in., 2 in. and 4 in. sizes and in both single and double spindle types.

Ball Bearing Hand Grinders and Drills

THE Cincinnati Electrical Tool Company, Cincinnati, Ohio, has recently added to its line of portable electric drills, grinders and buffers a new series of improved high-power drills, in ¼-in., 5/16-in. and ⅜-in. capacities, all of which are equipped with ball bearings and air cooled. They are high-speed, production tools for continuous duty, with universal motors, for use on either direct or alternating current. The housings and end caps are constructed of aluminum to give the lightest weight possible.



Portable Electrical Hand Drill—Air Cooled, Ball Bearing



Cincinnati Universal Motor Hand Grinder and Buffer

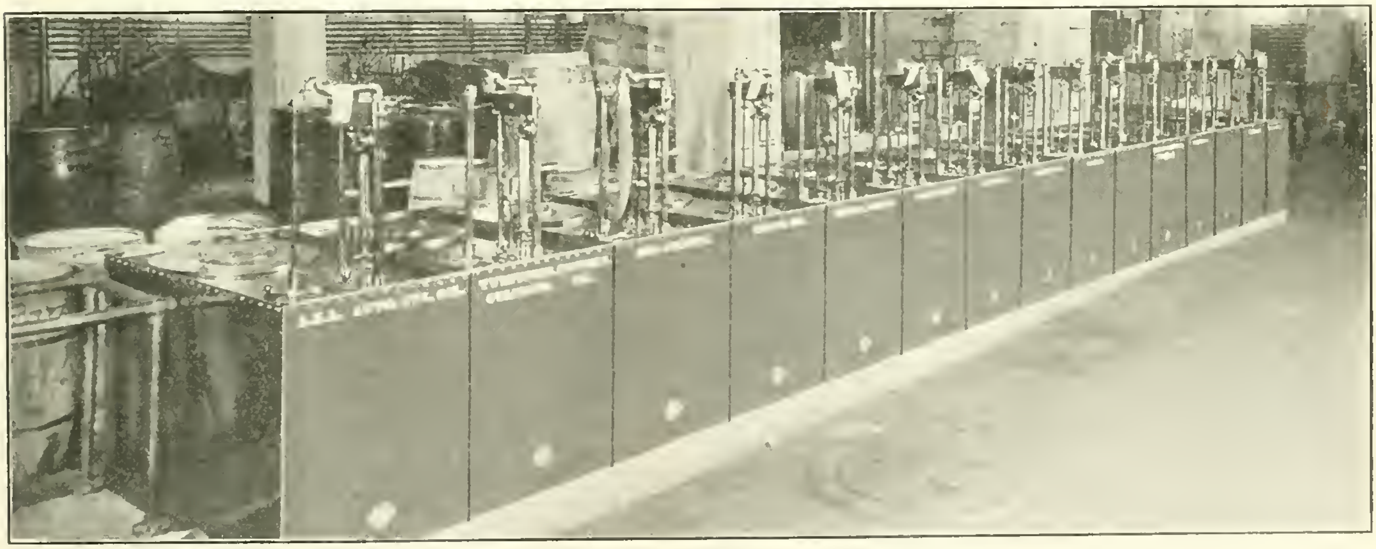
The armature shaft and also the gear studs are mounted on ball bearings to reduce the friction load to a minimum and increase the power. A patent make-and-break switch is conveniently located in the pistol grip handle, and has a 50 per cent overload allowance.

These drills are furnished complete, with a three-jaw geared chuck, rubber-covered cable, steel-clad non breakable attachment plug and extra detachable side handle. They are sent out complete, ready for the work. It will be noted from the illustration, that they are particularly adapted for close corner work.

The Cincinnati Electrical Tool Company, has also developed a series of universal motor hand grinders and buffers, in ¼ and ½-hp. capacities. The housings, end caps, extension and wheel guard, are made of aluminum, as in the case of the drills to give the lightest weight possible. They are equipped with ball bearings throughout, so as to reduce friction and give the maximum power. These machines are particularly adapted for grinding, buffing and polishing of all kinds, and any kind of wheel, buff, or wire brush can be used.

An Effective System for Storing Oils

THE oil storage system, shown in the illustration, has been developed recently by the Milwaukee Tank Works, Inc., Milwaukee, Wis., and proved effective in saving leakage, spillage and time of workmen who handle oil out of the different containers. In these items alone the installation illustrated is said to have paid for itself in a single month. The oils are kept in separate containers in battery formation, each tank being stenciled to indicate the kind of oil it contains and equipped with either a gallon or quart pump. This system also keeps oils clean and free from any grit. With the Milwaukee System, whereby the correct amount of oil can be measured out, waste is eliminated, and the different oils are kept in the purest and cleanest condition.



Milwaukee Oil Storage System Said to Have Paid for Itself in a Month by Preventing Leakage, Spillage, Deterioration, etc.

A manhole is provided on each tank so that at any time the tank can be thoroughly cleaned. Evaporation losses which are always large when oils are stored in barrels are prevented, this system being evaporation proof. All the battery systems are made in the same size as to length but vary in capacities. This system is also sometimes installed in railroad cars so that the different stations can be supplied with any class of oil which they are using in quantities desired. In this manner one man can handle a carload of oil and distribute it among the different stations along the line without waste.

Experience has shown that on the average where oils are handled in barrels, two per cent is lost by lack of draining, five per cent by leakage from barrels in storage, one per cent by spillage, two per cent by deterioriation and contamination. Also four cents per gallon is lost by not buying in bulk, insurance is 25 cents a 1,000 gals. higher and 10 min. per gal. is lost on oil handled from barrels. These losses are largely eliminated by the oil storage system illustrated.

An Unusual Gang of Milling Cutters

INTERLOCKING milling cutters which are made entirely interchangeable as to position and can be used in sections or as a complete set-up, are somewhat out of the ordinary. Fig. 1 shows such a gang of cutters recently manufactured by the National Twist Drill & Tool Company, Detroit, Mich. It will be noted that the entire set-up consists of six cutters; two right-hand spiral and two left-hand spiral plain milling cutters, also one right-hand and one left-hand side milling cutter.

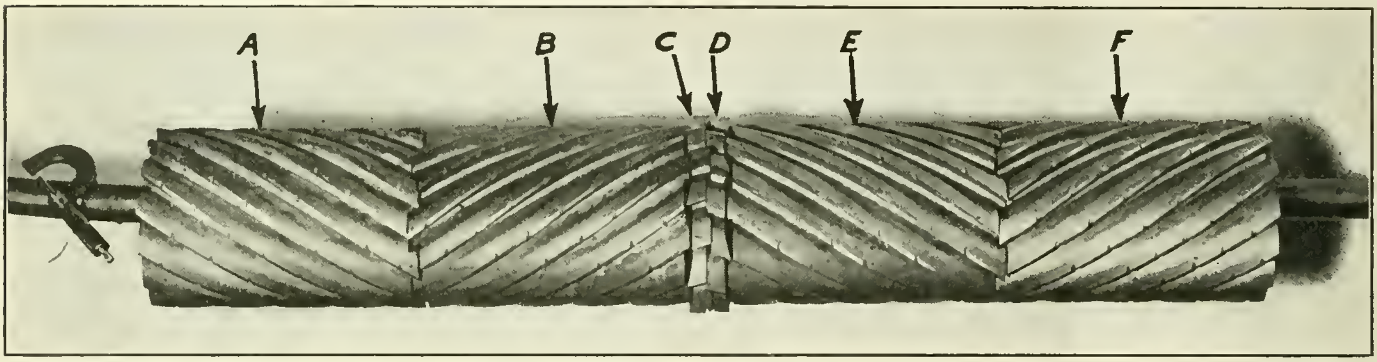


Fig. 1—Gang of Interchangeable Milling Cutters with Parabolic Shaped Teeth

On a certain portion of the work to be milled, the groove produced by the two cutters *C* and *D* was not wanted. The gang was, therefore, so constructed that these two cutters could be removed and cutter *B* interlock with cutter *E*, producing a plain surface the full width of the entire gang. This width was about 32 in. with the center cutters removed. Later it was also found that only two of the cutters, *A* and *B*, or *E* and *F*, could be used to advantage on certain operations.

The arrangement of interlocking lugs is shown in Fig. 1, which also shows the chip breakers introduced on all the plain milling cutters. The angle of spiral used is about 35 deg., this being found from experience to insure maximum smoothness of operation. All of these cutters are made with the parabolic form of tooth now used as standard by the National Twist Drill & Tool Company.

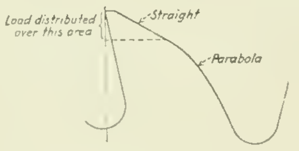


Fig. 2—Outline of Parabolic Milling Cutter Tooth

The parabolic principle is to make the teeth in a milling cutter of such shape that they possess uniform strength throughout. The cutter tooth is considered a cantilever beam with the load applied over a small portion of the beam near its extreme end. The resulting shape is illustrated in Fig. 2. The section opposite where the load is distributed becomes wedge shaped, while the remainder of the tooth is in the form of a parabola.

In its practical application this shape has several advantages. First, it gives a tooth of uniform strength throughout. This in turn means that there is no excess metal at any point which might encroach on the very necessary chip space. Second, it assures maximum grinding life due to the straight portion immediately behind the cutting edge. Fig. 3 shows the parabolic shape of tooth superimposed over some of the designs in general use at the present time. Full lines indicate these designs, while the parabolic shape is shown in dotted lines. At *a* it can be seen that the straight back tooth is very weak in the middle, having no adequate section at this point to take care of the load at its outer end. The tooth *b* has the necessary strength, but here is found an excess of metal at *p* which is present at the expense of chip space and which will also hinder the easy egress of chips. The same can also be said of the tooth *c*, there being excess metal at *r*. In this case the distribution of the excess metal also causes another disadvantage. After repeated sharpenings to a point *s* it will be seen that the width of land is equal to *k* for this shape, while the width of land on the parabolic tooth is only equal to *m* when sharpened back to the same point. When this land has reached a certain width the cutter must be snagged out in order to work efficiently. The advantage of the parabolic shape from this and other points of view is therefore obvious.

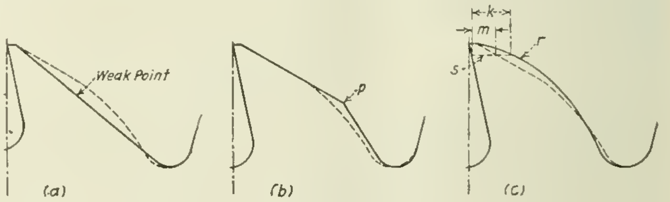
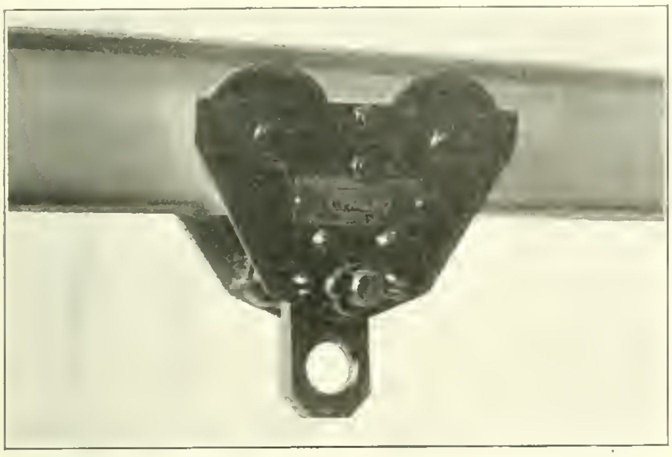


Fig. 3—Parabolic Shape Superinposed on Three Common Tooth Shapes

Strong and Flexible Steel Plate Trolley

As a rule trolleys that possess unusual strength are rigid, and those that have the necessary flexibility are weak. The Yale & Towne Manufacturing Company, Stamford, Conn., has recently developed a trolley designed to be strong and flexible enough to meet every industrial requirement. In order to demonstrate the strength of Yale trolleys the following test was performed.

A Yale two-ton steel-plate trolley was tried successively under various over-loads until finally it supported 14½ tons without breaking. At this load the 10-in. I-Beam track on which this trolley ran, bent down so that the load was deposited on the ground. A careful examination of this trolley, after supporting a load 7¼ times its rated capacity, showed that the wheels, axles, bearings and other important parts of the trolley were the same as new.


Yale Steel Plate Trolley Combines Strength and Flexibility

Ease of operation or flexibility is a deciding factor in making many installations, and the new Yale Steel-Plate trolley, in the 1-ton size, can be run on a minimum 21-in. radius curve without binding, since the non-rigid construction permits each wheel flange to take a position at all times suited to the curve of the I-beam flange.

The wheels are mounted on roller bearings, attached to the side plates, and the side plates in turn are connected together by a single equalizing pin which supports the shackle plate. The spreader castings are riveted to each plate. These give a large bearing surface for the equalizing pin and are so shaped as to protect the trolley and act as a bumper which engages the track-stop on the lower flange at the end of the I-beam track. The strength of this construction is such that a full-load may be safely carried on either plate.

The roller bearings are heat treated, hardened and ground to assure easy lateral motion and the grease chamber design prevents dust from reaching the bearings. The axles are pressed into the wheel-hubs and supported by an inner bearing plate, are subjected to practically no bending strain. The wheels with chilled iron treads conform to the shape of the I-beam flange, greatly increasing wheel life due to the resistance which this surface offers to dust and grit.

A single equalizing pin of cold-rolled steel supports either the shackle eye or clevis, and where every inch of headroom is needed the chain block can be hooked directly over the equalizing pin.

Strength, safety, interchangeability, flexibility and "rollability" are the oustanding features claimed for Yale steel-plate trolleys.

Locomotive Hoist with Individual Motor Drive

Two interesting developments in screw jack locomotive and car hoists, recently brought out by the Whiting Corporation, Harvey, Ill., are shown in the illustrations.

The locomotive hoist, shown in Fig. 1, is similar in design to the standard Whiting locomotive hoist which has proven valuable in unwheeling and wheeling locomotives in railroad shops. The main difference is that each jack is operated by a small individual motor, mounted on the jack unit, with one spur gear reduction between the motor and hoist worm. This eliminates all line shafting, line shaft bearings, bevel gears, etc. It also simplifies the construction of the pit and reduces erection expense materially.

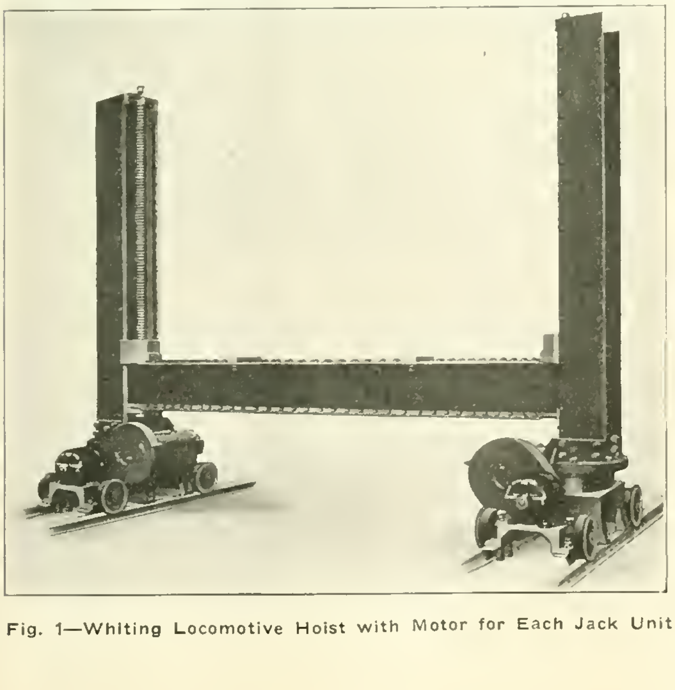


Fig. 1—Whiting Locomotive Hoist with Motor for Each Jack Unit

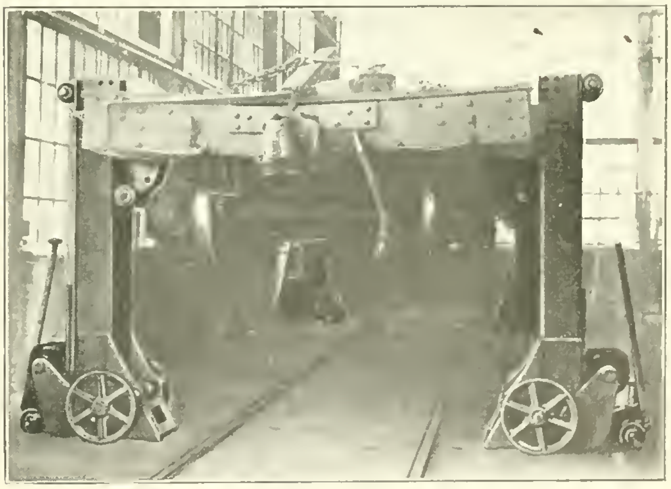


Fig. 2—Portable Screw Jack for Lifting Freight Cars and Coaches

Each motor is provided with a control panel which allows adjustment of any one of the jack nuts. In handling a locomotive all four jacks are operated by a master switch. Separate switches may also be used to control the jacks in pairs. The movable jack is carried on four wheels which normally carry the jack slightly above the rails. As soon as a load is applied to the jack, the coil springs under the axle bearings are compressed slightly and the main frame of the jack is grounded securely on the rails.

This type of hoist may consist of one pair of movable jacks and one pair of stationary jacks, of two pairs of movable jacks, or of other combinations, including three or more pairs of jacks.

Fig. 2 shows a portable screw jack hoist designed to handle coaches or freight cars of any size or weight. No special foundation is required, although the flooring on either side of the track should be level and capable of sustaining the loads.

This hoist also employs the screw jack principle of design. The body of the car rests directly on a substantial step supported by rollers on both sides of the I-beam columns and resting on the bronze nut. The screw is driven by a large worm gear resting on a heavy roller thrust bearing. Each jack is driven by its own motor through a silent chain drive. When hoisting, each jack is completely grounded, the base of the jack extending in well under the step and the wheels relieved of their load.

Whenever it is desired to move the jack, the hoist nut is lowered, depressing the forked lever, which raises the jack clear of the ground. When this position is reached, the current is cut off from the motor by the limit switch. The jack is moved from place to place by the long tongue attached to the small front truck. This truck swivels under the jack base, allowing the operator to turn in very close quarters.

Spiral-Fluted Boiler Staybolt Tap

A STAYBOLT TAP, designed for long life and having special construction and operation features, has been developed and patented by W. L. Brubaker & Brothers Company, Millersburg, Pa. In producing this tap Brubaker engineers utilized the vast amount of data on boiler staybolt tapping collected over the period of nearly forty years in which this company has been active in attempting to eliminate the troubles common to staybolt taps.

After the design was completed, taps were put in use in shops all over the world and tested through a period of three years, in order to determine the value of the tap in service. The results obtained indicated that the new tap had a decided advantage over any tap that the Brubaker Company has made prior to this time.

Due to the special taper with which the tap is designed, the life of the tap, as nearly as can be determined from tests, has been increased about 20 per cent. This taper is so designed that it distributes the work along the entire length of the tap, thus making each part of the tap perform the same amount of work as every other portion. At high speeds, it is claimed that vibration is very greatly reduced, thus permitting more holes per day to be tapped and decreasing the man power required to hold the tap in place while in operation.

The tap has a free cutting edge and it has been found that the motor speed can be increased without injuring the tap, because of the reduced friction. The results of overheating taps are too well known to require comment. By reducing friction, the heat generated during the tapping operation is decreased and consequently the dulling action which takes place when the heat softens the tap in spots. Reducing friction also brings about a saving in power.

This tap has a special standardized relief which is uniform for every tap. It is a combined machine and hand relief. Another feature of the tap is that it is made of a special steel having a composition that gives long life and eliminates breakage under ordinary service conditions. The tap is specially tempered so that it is kept within the lead tolerances after machining, and so that the cutting quality is in no way impaired. The temper is standard for all taps giving a proper cutting quality and a soft center.

Brubaker Spiral-Fluted Staybolt Tap in Action

The new Brubaker staybolt tap is made in all styles and to meet all tapping requirements.

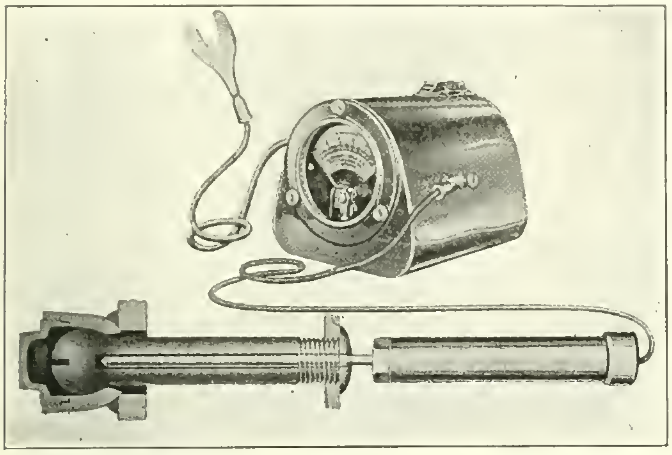
New Method of Flexible Staybolt Inspection

As far back as 1916 a method of testing flexible staybolts was developed by the Flannery Bolt Company, Pittsburgh, Pa. At that time, however, the method had not progressed beyond the experimental stage and it has taken seven years to bring the method to its present state of perfection. Actual locomotive service tests covering the past three years are said to have demonstrated that the method as now developed is a positive means of determining the conditions of flexible staybolts in service.

No method of testing that depends upon the human element should be satisfactory where danger to human life is concerned, and innumerable reports can be produced to prove the uncertainty and inefficiency of present methods. This point is substantiated by an article published on page 174 of the March issue of the *Railway Mechanical Engineer* in which the author says: "In my opinion, in going over a boiler on a staybolt test, the inspector cannot get all the broken and cracked bolts."

The human element is practically eliminated by the new method of inspection which requires no change in the standard parts of a flexible staybolt assemblage with the exception of providing a bolt with a tell-tale hole extending from the inner end into, but not through, the head of the bolt.

Inspection is accomplished by establishing electrical contact at the extreme inner end of the tell-tale hole by means of a device consisting of a meter, batteries, an indicating rod and connection to the boiler. The apparatus is simple and compact and requires no particular care except the occasional renewal of a dry cell battery.



Flannery Equipment for Testing Flexible Staybolts

Reference to the illustration will indicate how the tester works. The connection to the boiler may be made at any point where good contact can be secured and the indicating rod is inserted in the tell-tale hole. As soon as the tip of the rod has reached the end of the tell-tale hole, the electric circuit is completed and is registered on the meter, thus insuring the tell-tale hole being open its full length and properly functioning. If the indicator rod is stopped before the meter indicates contact, this shows the hole to be obstructed in some manner. In this event, the hole is cleaned by means of a drill and small motor until contact can be established.

The method of testing is simple and there is no phase of the test that depends upon the human element, except the simple act of inserting the testing rod into the tell-tale hole. If the bolt is fractured, this will appear in the hydrostatic test which is applied after electrical contact has been made with all the bolts. The tell-tale holes being clean will immediately indicate a fracture by water leakage from a bolt that is defective.

To insure clean tell-tale holes a fireproof, easily removable, porous cement is provided to seal the end of the tell-tale hole after the bolts are installed and riveted. Occasionally a mechanic may neglect to seal a hollow Tate bolt with the porous cement and in that event a small drill should be used to bore out the tell-tale hole preliminary to inserting the testing rod for inspection of the stay bolt.

If the tell-tale hole has been sealed with the porous cement, sediment or any other obstruction that would prevent contact between the testing rod and the end of the tell-tale hole can only come from a fractured bolt. This will be readily indicated when the hole is cleaned and when the hydrostatic test is applied.

Recent Developments in Coated Abrasives

RECENT developments in the coated abrasive industry make it now possible for the master painter to secure better work, lower sanding and rubbing costs, and better satisfied workmen, by means of scientifically developed sandpapers and cloths. In the following paragraphs are outlined several of the more recent developments in sandpapers by the Manning Abrasive Company, Inc., Troy, N. Y.

Waterproof speed-grits, placed on the market last September, are primarily designed for water sanding on painting materials where speed of operation and fine finish are wanted. The coating of the grit side is thoroughly waterproof so that even soaking the paper in water for a period of hours will not cause the grit to shed or come off. The backings are of a high-grade Manila rope paper, medium in weight and sufficiently waterproof to resist wear, yet not slippery or hard to handle.

The grit used for coating Waterproof speed-grits is a pure, artificial abrasive made in the electric furnace. It is hard and tough, yet not excessively sharp, and while designed to cut rapidly the hardest and toughest of painting materials, it also produces a fine commercial finish. Waterproof speed-grits are made in seven grit sizes: Nos. 120, 150, 180, 220, 240, 280 to 320 the latter being very fine. Tests are said to have proven conclusively that these papers for water sanding will outcut the rubbing brick and pumice, and at the same time produce the desired finish; also their use does not require a great amount of experience in order to secure satisfactory production and finish. This is a feature of importance.

Surfacing materials (putty, etc.) can be well and quickly smoothed with waterproof speed-grits; also varnishes and enamels requiring much labor to surface with pumice and water. Little or no rubbing slush is created, eliminating much of the usual clean-up time necessary with the pumice method.

The High-Speed Coating

Another development is the high-speed coating with cutting grits so placed on the backing as to allow for chip clearance. In other words, the grits are not heavily piled on the sheet, but placed with spaces or clearances between each cutting grain. This method of coating is something new in the coated abrasive industry, and the development was the outgrowth of a demand for a paper that would not rapidly load or ball on the cutting face. Garnet and artificial papers are made with the high-speed coating, the grits covering a wide range from coarse to very fine. The back-

Operation of Water Rubbing on Varnish

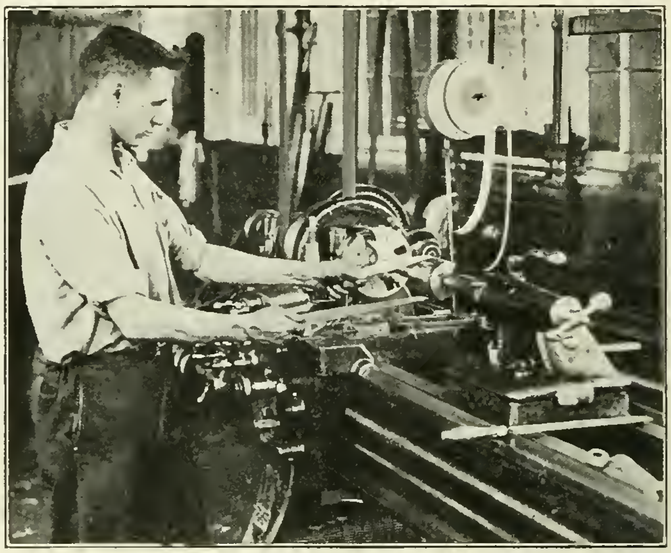
ings range from light finishing papers to the heavier roll stock.

High-speed papers load down into the sheet, and, until all the clearance spaces are filled, there is little tendency for heavy loading or balling on top of the cutting face of the paper. This is a marked advantage in dry or oil sanding. The open coating gives to the sheet extreme flexibility, which on many operations is a desirable factor. With the high-speed coatings, it is also possible to place the grit on the backing in such a manner that the maximum number of the grits' sharp edges are standing up and exposed for cutting. This feature gives the high-speed coatings very fast cutting action.

Speed-grits papers with high-speed coating are especially well adapted for sanding surfacing materials, varnishes and enamels, and where this work is being done on a production basis, the performance of these new coatings will prove most interesting.

Metal Working Abrasive Cloths

In railroad shops abrasive cloths are used for many surfacing and polishing operations on metal. There have been two important improvements in products for this work. First, emery has been largely replaced with Metalite, a pure, hard, tough and sharp electric furnace abrasive. Second, Metalite products are now available in a wider range of backings than heretofore. Flexible Metalite is a comparatively light weight, soft, pliable, limp sheet, for work which has a number of difficult places to reach. Ream Metalite is another type, a medium weight product well adapted for general all-around work. Roll or X-Metalite is a stiff, heavy backed product used for the heavier machine operations, such as belt and disc sanding.

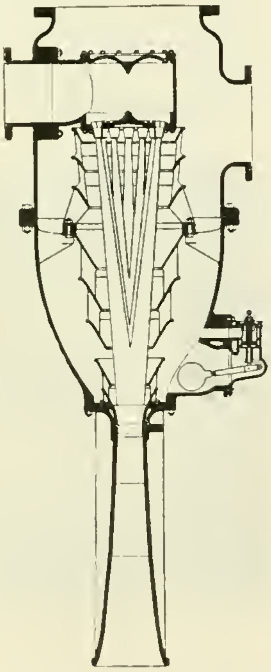


Abrasive Cloth Used for Surfacing Operation

While Metalite is slightly higher in first cost than emery, it is claimed that this difference is more than offset by the additional production and longer working life of the product.

Jet Condenser for Power Stations

CONDENSERS are ordinarily divided into two classes, (a) surface condensers in which the exhaust steam and the cooling water are separated by metallic heat transmitting surface, and (b) jet condensers in which the steam is brought into direct contact with the cooling water and condensed: And the condensate, water, air and non-condensible gases are removed either by gravity, by so-called air pumps and removal pumps, or by means of the kinetic energy of the cooling water.



Low-Level, Multi-Jet Condenser

The selection of the proper condenser is a comparatively simple matter and depends essentially upon the quantity and quality of the cooling water available. If the supply is abundant, and if the water is suitable for boiler feeding purposes, the best condenser to install is a jet condenser. This is the cheapest both in first cost and maintenance charges.

The jet condenser should also be used in instances where the condensing water is suitable for boiler feeding, but where the supply is limited and comparatively expensive to obtain a recooling system should be installed whereby the warm condensing water from the hotwell can be recooled sufficiently and used over and over again.

If the condensing water is unsuitable for boiler feed, then a surface condenser must be used. This is so whether the supply of water is abundant or limited. A water purifying system or evaporator is ordinarily used if the make-up water is to be taken from the cooling water supply. Furthermore a recooling system is installed in instances where the supply of water is comparatively difficult and expensive to obtain.

A type of jet condenser, known as a low-level multi-jet condenser has been developed by Schutte & Koerting, Philadelphia, Pa., as shown in the illustration. It has several outstanding features, the principal one of which is that the condensed steam, water, non-condensible gases and air are discharged from the condenser by the ejector action of the water jets. Air pumps and so-called removal pumps are entirely dispensed with. Since the centrifugal injection water pump delivers the water to the condenser under pressure it can be designed for low or moderate suction lift and therefore operates at high efficiency.

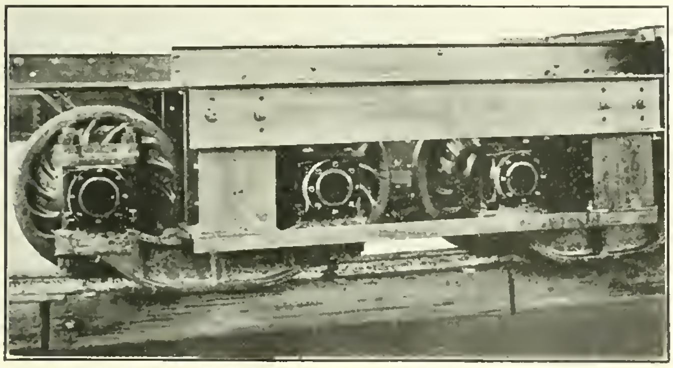
The condenser consists essentially of a cylindrical casing, a water nozzle case, a combining tube, and a tail pipe or diffuser. The sectional cut shows these parts. Both top and side steam inlets are provided either of which may be used. The injection water is delivered into the water nozzle case at about 9 lb. pressure (equivalent to 21 ft. of water column), whereupon it is discharged through the several nozzles, passed through the combining tube where it is brought into contact with the steam, and finally discharged through the tail pipe into the hotwell. The steam is drawn through the annular passages between the tapering rings constituting the combining tube, and condensed by the water jets. The condensate together with the air and non-condensible gases is removed by means of the kinetic energy of the water jets. The condenser acts to create the vacuum by condensing the exhaust steam and maintains it by removing the condensate, together with the air and gases.

The multi-jet condenser is built in 30 standard sizes for steam units ranging from 100 kw. capacity to 10,000 kw. capacity. Single condensers are used up to 5,000 kw. and twin arrangements for larger units. The largest single multi-jet condenser built to date is designed to handle 14,000 gals. of water a minute. This condenser has a 66 in. top steam inlet, 30 in. water connection, is 18½ ft. high and 8 ft. in diameter and weighs about 11 tons.

Turntable Rolling Resistance Reduced 50 Per Cent

An 85-ft. twin-span turntable equipped with Stafford roller bearings has recently been built by the Dominion Bridge Company, Montreal, Canada, for the Canadian National Railways.

Judging from experimental and service tests, the use of properly designed roller bearings for car journals reduces journal resistance 90 per cent with a resultant saving of 25 to 50 per cent in train resistance and a corresponding saving in fuel used for motive power. Turntable resistance can be reduced in practically the same proportion by the use of roller bearings, and in the turntable, illustrated, it has been found possible to use a motor of only 15 hp., whereas a similar turntable equipped with standard friction type journal bearings would require a 30-hp. motor for satisfactory operation. This shows that the power saving may run as high as 50 per cent.


Turntable Equipped with Stafford Roller Bearings

Turntables are not in constant operation. They are subject to exposure variations of temperature, snow and water, and it has been found necessary at some points to encircle the pits with steam lines in order to keep turntables in satisfactory operation during cold weather. Even where heating is installed for the purpose of keeping the pit clear of snow and ice, the roller bearings will still be of very decided advantage. If roller bearings were subject to freezing as journal friction bearings are, a 15-hp. motor would not be sufficient to take care of cold weather conditions, but since roller bearings do not freeze, practically no more power is required for winter than for summer operation. Oil application is required at very infrequent intervals, possibly once in three to five years, which means a saving in maintenance costs.

The bearings on the turntable illustrated are Stafford roller bearings, 5-in. by 9-in. in size, which are subjected to a 48,000 lb. impact load per bearing when a locomotive comes on to the table. The ability of these bearings to carry such a tremendous load is due to their special design. The rollers are in two races, staggered and this design eliminates the continual raising of the load as each roller approaches the crown of the bearing.

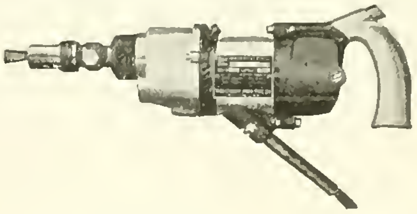
The definite results already shown in the use of this type of bearing have resulted in several steam and electric installations, and many other installations are under contemplation.

Screw Driving on Rapid Production Basis

Driving screws has always been more or less of a problem, as the common methods by which screws are driven in wood or metal have invariably slowed down production. To overcome this difficulty the engineers of the Independent Pneumatic Tool Company, Chicago, Ill. have developed and perfected a device for the rapid driving of screws in production work. This device, known as the Thor screw driver attachment, is fastened to the spindle end of a small size portable electric drill, which has a speed suitable for driving not only wood screws, but also cap screws and any other machine screws. It will drive screws of all sizes, a No. 6 or a No. 18 wood screw equally as well, with one size attachment. Above the No. 18 screw, a heavier attachment is used. It has been demonstrated in various shops that any man, without special mechanical ability, can after short practice drive 50 to 60 ordinary No. 14 wood screws a minute.

In construction the Thor screw driver is simple, consisting of but two units. The first unit, or body, is connected to the drill spindle and revolves at all times when the drill is running. The second unit is the part that holds the screw driver bit. This has a long sliding bearing which fits into a similar sized hole in the body. Each unit has a shoulder, milled so as to form a dog clutch. The clutch is engaged, forming the driver, by a light pressure of the operator's hand, and is disengaged by a coil spring in the back end of the body. When screws or bolts are drawn up tight, the clutch will automatically release. The screw driver bits are held in a square hole and can be removed by simply pulling out a flat spring which is concealed and out of the way when the bit is held in the attachment.

The Thor screw driver attachment is also made with a bell shaped or self-centering finder, and with this type it is not even necessary for the operator to place the bit in the screw head slot, as by placing the bell finder over the screw head, the bit will automatically find the slot. This also prevents the screw driver bit from sliding off the screw as it is likely to do when grease or oil is used around it.


Thor Electric Drill and Screw Driver Attachment

The Thor screw driver attachment is well adapted for use in freight and passenger car shops, and in fact wherever there are screws, nuts, studs, or anything having threads to drive.

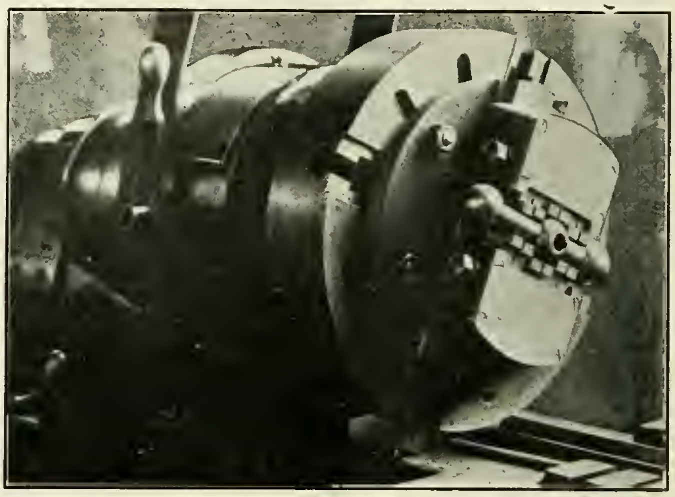
The Thor electric drill with screw driver attachment is in reality a several purpose machine, as the screw driver attachment can be removed in a few seconds, and replaced with a drill chuck, or other attachment so that the same electric drill may be used for drilling, reaming, woodboring, and similar operations.

Universal Vise of Interesting Design

FALSE jaws, split vise chucks, clamps and bolts and in many cases jigs and special settings, used in chucking irregular shapes, are made unnecessary by the new universal vise illustrated. This device, of Swiss manufacture and sold by Bruce, Dawson & Company, London, E. C. 2, England, will with a single movement firmly grip any work no matter how irregular its shape. Owing to the fact that the work is gripped all over, it is held securely so that it can be subjected to severe action in any machine tool without danger of the work loosening.

The manipulation of this device is simple and it can be used as readily by an unskilled as a skilled mechanic. Referring to the illustration it will be noted that the vise contains a number of jaws, all of which enter into operation automatically at the same time simply through the action of turning the handle. The jaws, subjected to individual spring action, are tightened up until they touch the piece all over or at least at a sufficient number of points. After this the two large nuts on the sides are tightened so that the relative position of the loose jaws becomes fixed. The piece is then fully tightened by a turn of the vise handle. All similar parts can afterwards be gripped by a half turn of the handle. If work with machined faces or faces which can easily be damaged has to be secured, these faces are protected by cardboard or similar material.

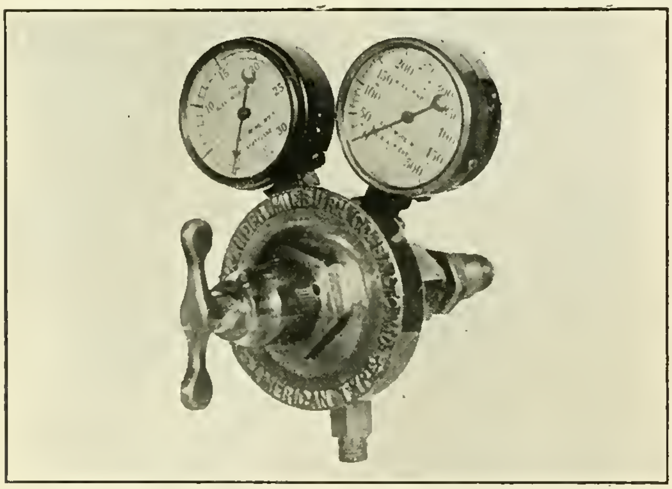
This universal vise can be bolted direct to the bed, table, or slide of any standard machine tool, in exactly the same way as an ordinary vise. The vise is supplied in three different types, *A* with a rectangular base for use in all classes of machine tools, *B* as shown in the illustration for use on lathes and *C*, which is a special attachment to a bench vise.



Swiss-Made Vise for Gripping Irregular Work

Regulator for High Pressure Gases

THE American type regulator, illustrated, is for the control and delivery of acetylene, oxygen, hydrogen, and other high pressure gases in gas cutting and welding operations. The regulator maintains a constant, predetermined pressure regardless of fluctuations in the initial high pressure line and variations in consumption at the torch.



Alexander Milburn High Pressure Gas Regulator

The regulator comprises a front cap, containing an adjusting key, top spring button and tension spring. The body contains in front a flexible metal diaphragm, soldered on. Over the diaphragm is screwed a bronze diaphragm plate or spring button to hold the tension spring. Inside the body is a fixed nozzle, containing a loose operating pin. Over the nozzle is loosely assembled the valve sleeve which has a row of gas ports drilled around its circumference and carries the valve seat. The seat closes against the nozzle.

The loose operating pin inside the nozzle is actuated at one end by depression of the diaphragm and at the other end by pressure of the valve seat. The seat of the regulator closes with instead of against the pressure and this enables the seating to be effected by a small pressure. The closing of the seat is independent of the diaphragm.

A perfect balance or equilibrium of pressure is maintained at all times in the regulator, throttling the supply when the desired pressure is built up, and instantly responding with increased supply when consuming requirements lower the delivery pressure.

The main operating part, comprising only a pin and nozzle and a seat-carrying sleeve, is almost immediately accessible for examination, cleaning or renewal.

By improved design the regulator is simplified in every particular and reduced in size and weight. The valve seat is subject to much less wear or chance of damage, and, being held in perfect alinement, it tends to retain its accuracy many months longer than the seat of an old-style regulator.

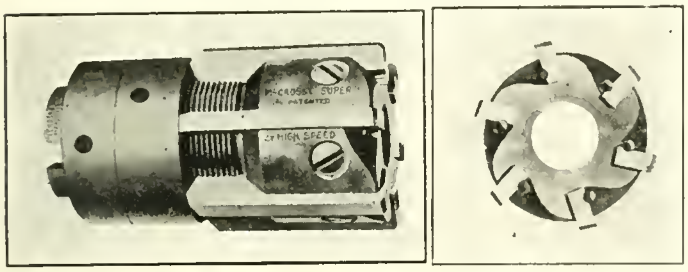
Neither volume of gas nor accuracy of regulation is sacrificed by the simple construction. On the contrary, the regulator acts with more directness and regulates within closer limits. By the mere change of the gages and the rear connection the regulator is immediately adapted to the various gases and types of containers for same.

This regulator was invented by A. F. Jenkins, and is manufactured and sold by the Alexander Milburn Company, Baltimore, Md.

Adjustable Reamer with Valuable New Features

THE ability of McCrosky-Super reamers made by the McCrosky Tool Corp., Meadville, Pa., to ream holes accurately and economically has been strengthened by two important improvements as follows:

(1) The McCrosky design for clearance and support. By this design the reamer body in front of the cutting edge of each blade has been relieved to provide ample space for chip clearance and lubrication. This feature removes any possibility of chips clogging along the cutting edge of the blade. This clearance makes it possible to shorten the projection of the blades over the end of the reamer body, consequently more support is provided back of the blade where it is needed. Thus, the design gives at once extra clearance and support.



McCrosky Adjustable Reamer with Two Important Improvements

(2) The reamer body is hardened all over. This feature increases the resistance of the reamer to hard usage and prolongs the life of the body, permitting many sets of new blades to be inserted in the original body.

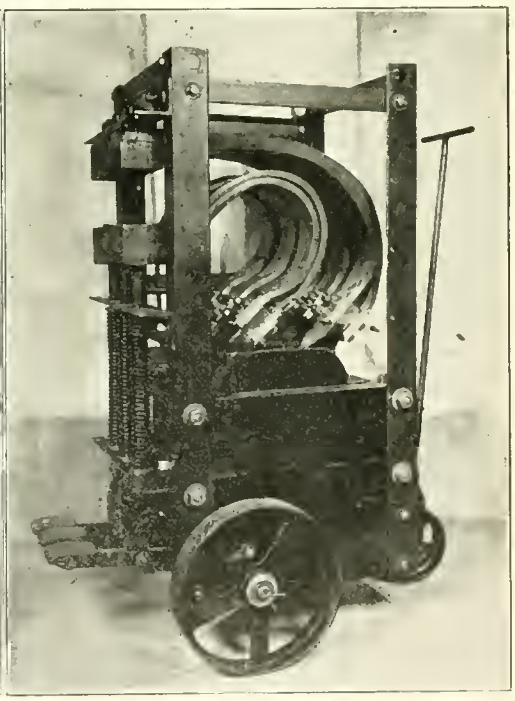
These improvements are additions to the other well-known features such as forward adjustment, large range of adjustment, simplicity of construction, and the patented McCrosky locking device.

Calorac Portable Electric Rivet Heaters

THE latest types of electric rivet heaters, manufactured by the Humil Corporation, New York, have a number of distinctive features, the most important of these being flexibility in operation, permitting the efficient heating of a wide range of sizes without the usual burning of the smaller rivets on machines of the higher ratings, and at the same time permitting the heating for non-continuous service of the largest rivets on the smallest machines.

Low power consumption, or high efficiency, has been secured by generous proportioning of copper and iron in the special type transformer, also by heavy cross sections in the long flexible leads that are autogeneously welded into the pure copper electrodes or heads. This latter arrangement marks a radical departure from previous practice in that the contacts and leads can be readily renewed without disassembling the machine. Their length and high flexibility are such as to permit operation at the foot pedals at between 10 and 15 lb. pressure, thus avoiding the tiring effort of pressing against a heavy spring and preventing squashing or upsetting the ends of the rivets being heated.

Calorac 3-Head Portable Rivet Heater on Boiler Work



Side Plates Removed Showing Rugged Construction

Regulation against heavy power surges on starting the heating action, and the maintenance of high power factors (79 to 94), are obtained by means of air gaps in the transformer magnetic circuit. The high efficiency and power factor is also maintained through placing the transformer low in the machine and remote from the radiated and conducted heat from the rivets. Air spaces, provided between the coils, permit a constant stream of cold air to pass up through the transformer, cooling it constantly and enabling it to maintain high efficiency under continuous full load.

All of the coils are positioned around a separate center core, the secondary coils of heavy cast copper completely enclosing the core, except for a small gap at the top to provide the open circuit necessary. This design provides for the complete cutting of all magnetic lines by both primary and secondary coils. The primary coils are wound with bare strip copper, insulated with asbestos and mica tape. This provides for rapid dissipation of the heat to the vertical air spaces and at the same time eliminates high voltage between layers of windings.

Stability and portability are secured in the Calorac heaters by keeping the center of gravity low in the frame and mounting the machine on large traction wheels. Provision has also been made for lifting by crane.

Close regulation of the power applied to the rivets is obtained by a five-speed controller, so mounted as to be readily accessible to the operator, thus permitting him to govern his production rate accurately. On the smallest two-contact Type A-2-H machine, rivets ¼ in. by 1 in. can be heated at the rate of 720 per hour, while in the same machine rivets ⅝ in. by 2¼ in. are said to have been heated at the rate of 150 per hour. This same machine is also capable of heating much larger rivets. The large Type C heaters, when equipped with three or five sets of heating contacts, are capable of reaching a high production of hot rivets of the largest sizes. These machines are well adapted to heating the large mudring rivets used in locomotive boilers.

Rivets heated by this process are hotter at the cores than on the outside, as the heat is generated within the rivets themselves, and consequently it follows that they hold their heat considerably longer than rivets heated by external application methods. The avoidance of currents of oxidizing gases produces rivets free from scale, and this, with the hotter and more plastic central zones characteristic of rivets heated by this process, ensures faster, tighter, and cleaner riveting with less chance of loose rivets.

Referring to the illustration, the simple, rugged design of this heater is apparent. Hard usage with small expense for up-keep were prime considerations in its design. Built entirely of steel, iron, copper, asbestos and mica, it is practically fire-proof. Heavy impregnation of all coils with the highest grade of insulating varnish render this heater waterproof as well. Safety of the operator is secured by the shielding of all live primary parts, while the electromotive force at the heads is so low that it cannot be felt by bare hands, this voltage never exceeding 3 volts. The machine is designed to be fool-proof and fire-proof. The comfort of the operator as well as that of other men in the shop is assured by the absence of smoke and fumes, with a resultant favorable effect on output.

Small Direct-Connected Air Compressor

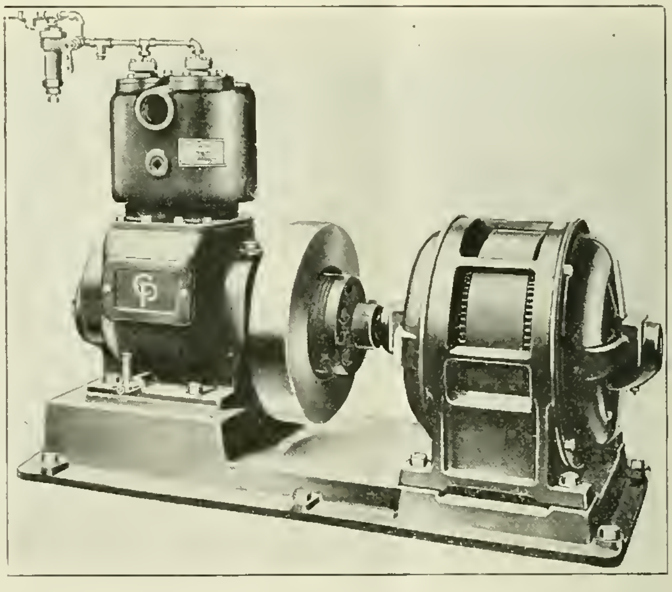
A SMALL air compressor which can be run at high speed and direct connected to an electric motor or internal combustion engine, has recently been developed by the Chicago Pneumatic Tool Company, New York, as shown in the illustration.

The compressor is of the vertical, duplex, single-acting, water-cooled type and is fitted with Simplate flat disk inlet and discharge valves. The lift of these valves is straight and uniform, affording a maximum of valve area, thereby increasing the speed at which the compressor may operate and allowing the use of direct drive.

The machine is built in three sizes, having piston displacements of 128, 160 and 210 cu. ft. per min. Each is suitable for working pressures of 150 lb. per sq. in. and is designed to run at a speed of 600 r.p.m. Standard equipment includes a hand starter for the motor and an inlet valve unloader for the compressor.

If an intermittent supply of air is demanded, the motor can be furnished with an automatic starter which starts and stops the unit within predetermined pressure limits. With this type of starter, the compressor is equipped with a centrifugal unloader which automatically relieves the compressor of its load while the motor is starting up or shutting down. This condition is said to be essential to the successful operation of an automatically controlled compressor.

A water control valve is also furnished, which is operated by air pressure governed by the centrifugal unloader. Since the lubrication is accomplished by a combination pump and splash system, the complete unit is automatic in every detail, as it controls the electric current, air delivered, circulating water and lubrication.



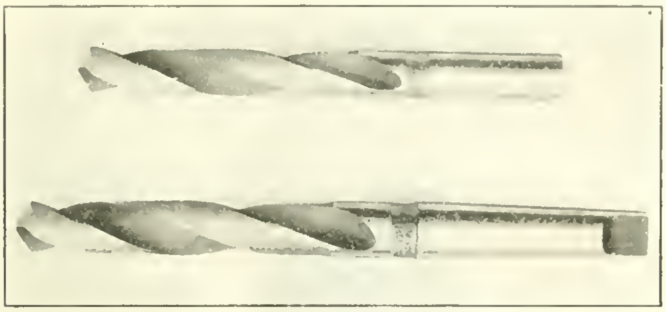
Direct-Connected High Speed Air Compressor

A New Development in Drill Making

FOR the past few years high speed drills have been made by two methods, first, by twisting a flat bar, or second, by milling from a round bar. The first involves a hot working process to form the flutes, followed in turn by a machining and a twisting process, or by a simple twisting process without the machining. In both cases the web is usually not central and efforts are made to return it to the correct position by a straightening process, a flute grinding process, or by both.

In spite of the additional toughness imparted to the drill by these methods, the second type of drill made from the full round bar by the milling process, has continued to be the one made and sold in largest quantities, and therefore the one most suitable to the general requirements of the metal-working industry.

The continued preponderance of the milled type of drill may therefore be attributed to the fact that the webs of such drills are centrally located by the milling machine. The drills are uniform and will therefore drill more uniform holes.



Cle-forge Drills Designed to Combine Toughness and Accuracy

The drill point grinding machine insures that points of drills are ground correctly, and such machines should be in more general use than they are. This machine is, however, only a machine and can grind correctly only such drills as are made accurately and uniformly. If the web of a drill is not central, the point of the drill cannot be accurately ground in a point grinding machine. Drills with the web off center can be ground out at the point so as to bring the web central at that place, but this is a more skilled operation than point grinding by hand and it is one which is seldom, if ever, well done in the average machine shop.

It therefore follows that the ideal twist drill is one having the toughness of the hot-worked drill and the accuracy of the milled drill. It enables drills to be properly ground by machine and assists in removing the prejudice which apparently exists among mechanics against using these machines.

As a large manufacturer of both milled and forged drills the Cleveland Twist Drill Company, Cleveland, Ohio, has been experimenting with a view to placing on the market a single drill which would embody the advantages known to be possessed in part by the forged drill and in part by the milled drill. A process, said to accomplish this result, has been perfected and given the trade name Cle-forge. Cle-forge drills are hot worked where necessary to impart toughness and are afterward machined in the same manner as a milled drill. In fact they cannot be distinguished from the former milled product by mechanical inspection. Briefly, Cle-forge drills are intended to unite in one tool all the advantages of both forged and milled drills so that their cutting quality and strength will surpass that of any former type of forged drill and their accuracy be equal to that of the milled drill.

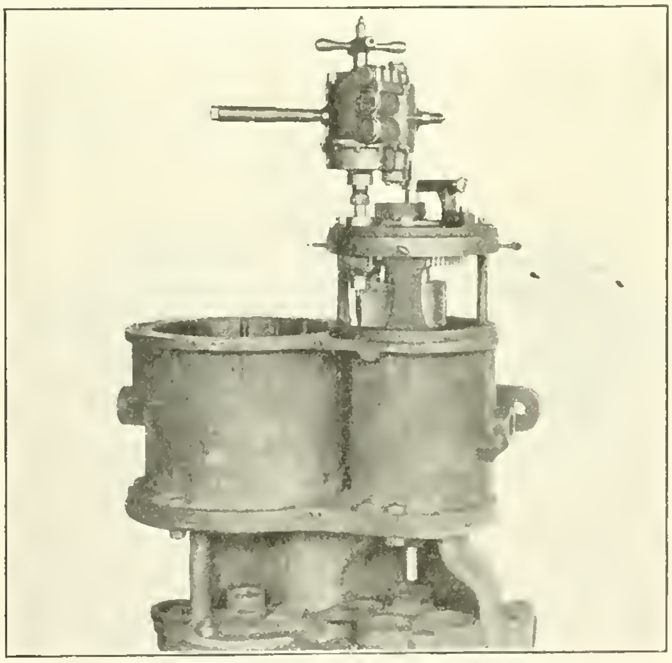
Portable Bar for Reboring Air Cylinders

THE latest development in the line of portable tools made for railroad shop use by H. B. Underwood & Company, Philadelphia, Pa., is the portable boring bar equipment, illustrated. This equipment is used for reboring locomotive air compressor cylinders and pump cylinders used in railroad shops and power plants. In the former case cylinders can be bored in the repair shop, or without removing the air compressor from the locomotive, an important advantage. Due to its light weight and compactness the equipment can be used in close quarters.

This boring bar equipment is notable for rugged construction, accuracy, simplicity of design, involving few parts, adaptability to limited spaces, and the ease and speed of setting up and operating. The bearing plate carries a boring bar driving spindle and feed screw, mounted on a clamping ring, and a cutterhead. The pilot guide is screwed on the stuffing box and the bar placed in the cylinder, a clamping ring being securely fastened to the top flange of the cylinder by studs and nuts. Any inaccuracy in the position of the studs in the cylinder flange is readily overcome by means of the four thumb screws for accurately alining the bar. The tool is adjusted and rigidly held in the cutterhead by tightening the collar screw, which clamps the tool to the cutterhead by means of a simple and substantial tool clamp; the tool may be as readily released when the cutterhead is at the lower end of the cylinder, when it is so desired.

In boring cylinders to a certain diameter the use of calipers is entirely dispensed with. By means of a gage, furnished with each bar, a simple and practical method of setting the tool to the required position is used. In this manner a number of cylinders can be bored to accurate dimensions without loss of time due to regrinding tools, etc.

The driving spindle is provided with a Morse taper shank to fit the air motor and drives a pinion which meshes with a gear keyed to the boring bar, providing a simple and efficient drive. Keyed to the feed screw is a feed gear which meshes with a reverse gear journaled on a pin centered in the boring bar; the reverse gear turns freely on this pin unless prevented by the feed pawl being engaged, which holds the reverse gear stationary relative to the bar and causes the feed gear to revolve the feed screw and advance the cutterhead into the work. To return the cutterhead to the top of cylinder the air motor is placed on the shank of the reverse gear which rapidly returns the cutterhead.



Underwood Boring Bar Set Up to Bore High Pressure Air Cylinder

Reboring both ends of a 9½ Westinghouse air pump accurately to size with this equipment is said to have been done in the following actual time:

Setting up on steam end	7 min.
Reboring time	16 min.
Setting up on air cylinder	8 min.
Reboring air cylinder	15 min.
Removing machine	7 min.
Total time	60 min.

This tool is regularly made in sizes suitable for reboring cylinder and bushings of standard air compressors and may be readily adopted to other sizes by changing the cutter-heads.

The weight of an equipment of this character with capacity to bore from 8½ in. to 11 in. in diameter by 12 in. stroke without air motor is approximately 140 lb.; for the compound compressors 8½ in. to 14½ in. by 12 in. stroke, the device weighs about 200 lb.

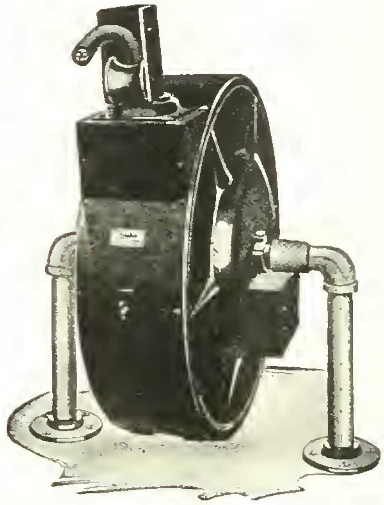
Heavy-Duty Extension Cable Reel

THE heavy-duty Reelite, recently developed by the Appleton Electric Company, Chicago, is a self-contained device for paying out and automatically retrieving electric conductors for power and light. It is especially adapted for machinery requiring a varying length of cable. This will permit operation of the machinery at any distance within a radius equal to the length of cable contained in the reel. An important advantage of this device is the protection to the cable which is thereby afforded a long life free from service interruptions for cable repairs.

Among the machines with which this device can be used may be listed cranes, dredges, magnets, electric motor buckets, etc. It can also be used extensively in foundries, blacksmith, machine and car shops, and electric welding shops.

The device is furnished without brackets but with 1-in. male-threaded hubs so that it is easily adaptable to any requirement. The power cable is connected to it by means of heavy brushes operating on commutators. The wire is connected to the commutators, eliminating wear and tear on connectors and always insuring a perfect contact.

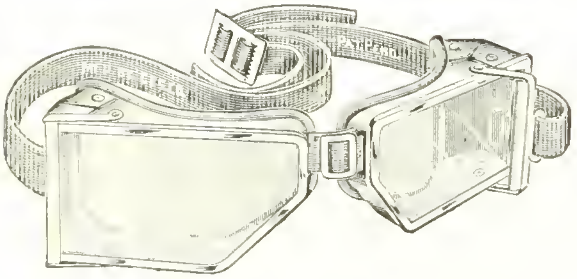
The heavy-duty Reelite can be furnished in various widths, all of the same diameter and with two or three wire commutators, as may be required. In ordering, it is necessary to specify the amperage and voltage so that proper commutators and brushes will be installed.



Reelite Protects the Cable, Giving Uninterrupted Service

Wide Vision Straight Lens Goggles

TO fill the need in shops and manufacturing plants where a straight lens is preferred to ward off flying rivets or particles that will strike the lens, the Chicago Eye Shield Company, Chicago, has recently brought out the No. 224 goggles illustrated. These goggles can be furnished with non-shattering lenses which will multiply the protection where the danger is unusually great. The fit is readily adjusted to any wearer by the buckle adjustment at the bridge. Lenses will not fall out of the frame as they are double locked by a special end but they are easily interchangeable at will. The frames are made of non-corrosive white metal darkened on the inside to prevent glare. They are regularly furnished bound in heavy rubber which gives the greatest satisfaction.



Straight Lens Goggles Providing Wide Vision

Some grinders and industrial workers who need protection against dust or flying chips prefer cup goggles. The No. 505 S goggles made by the Chicago Eye Shield Company are of this type, being provided with unusually shallow cups, which allow a wide range of vision. An adjustable nose bridge assures a fit best adapted to each wearer and the safety flange gives protection in the event that the lens should be broken, as it can not be pushed back into the eye. These lenses also can be readily interchanged through the screw top. The heavy rubber binding used is comfortable and gives a maximum or sanitary protection. These goggles can be furnished with colored lenses for use in welding.

Regulator for Oxygen and Acetylene Gas

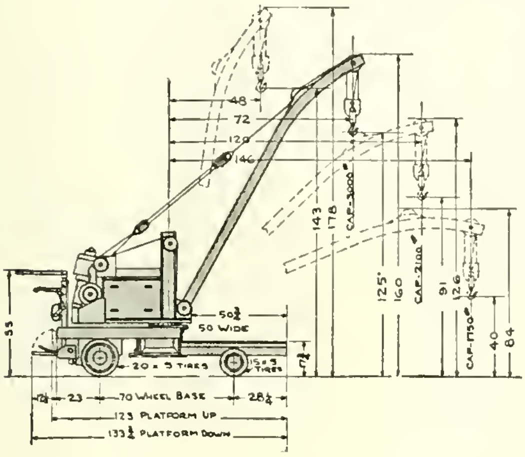
THE Torchweld Equipment Company, Chicago, has produced a new style of regulator for holding a constant back pressure with oxyacetylene cutting and welding equipment. This regulator is sturdy throughout, and an important improvement is the arrangement for the regulator seats or diaphragms to be easily replaced when necessary by the operator without sending the regulator to the manufacturer for attention.

The construction is such that the regulator holds a constant pressure and does not fluctuate when the valves are closed, the back pressure in the regulator body itself not exceeding 2½ to 3 lb. due to the improved construction. Welding regulators are 3 in. in diameter; cutting regulators, 2½ in.; and regulators for lead burning purposes, 2 in. An important point in the construction of this regulator is the provision of three diaphragms of graduated sizes, enabling the regulator to control gas pressures properly. The diaphragms are not soldered to the regulator body but are held in position by means of bonnet screws.

Regulator leakage has heretofore been due in many instances to gas leaking through the nozzle and past the seat but the Torchweld construction provides for the yoke, holding the regulator seat, to slide over the nozzle itself thereby keeping the nozzle and seat in accurate alinement at all times which prevents improper functioning of a regulator due to vibrations or shock.

Crane Truck with Power-Swiveling Attachment

UNUSUAL interest attaches to the new three-way crane truck made by the Baker R. & L. Company, Cleveland, Ohio, owing to the power swiveling attachment. This feature greatly increases the utility of the machine and enables the driver to operate it with far less exertion and accomplish more work in a given time. Another feature of importance is the double drum hoist. This hoist is driven by a single motor, the power being applied to either drum by means of magnetically operated friction clutches. This makes the change from one drum to the other very smooth, and the construction is such that the drum which is not working is firmly held by a large-sized brake.



Proportions and Lifting Capacity of Baker 3-Way Crane

On the Baker three-way crane truck illustrated two-wheel drive and four-wheel steer is provided, the capacity being as indicated in the illustration. The traveling speed without load is 530 ft. per min. or 6 miles per hour and with a rated load of 3,000 lb., 395 ft. per min. or 4½ miles per hour. The new load hoisting speed is 30 ft. per min. and with a rated load of 3,000 lb. the hook rises 7 ft. per min. Three speeds forward and reverse are obtainable by means of the controller which is of the continuous tongue drum type, totally enclosed.

The slewing unit is pillar mounted and turns on ball bearings. A worm and spur gear, reduction unit, transmits power from the slewing motor, provided with a magnetic brake. The slewing motor is compound wound, totally enclosed, operating at 24 volts and 32 amperes with a speed of 1,700 r.p.m. It has a high overload capacity. Control of the slewing motor is by means of a drum-type reversing controller mounted on the dash. Limit switches are provided, positive in action and automatically controlling the hoisting and reverse motions of the boom, hoisting motion of the load hoist and slewing motion. The boom is fabricated from structural steel and can be made to any length required within reasonable limits.

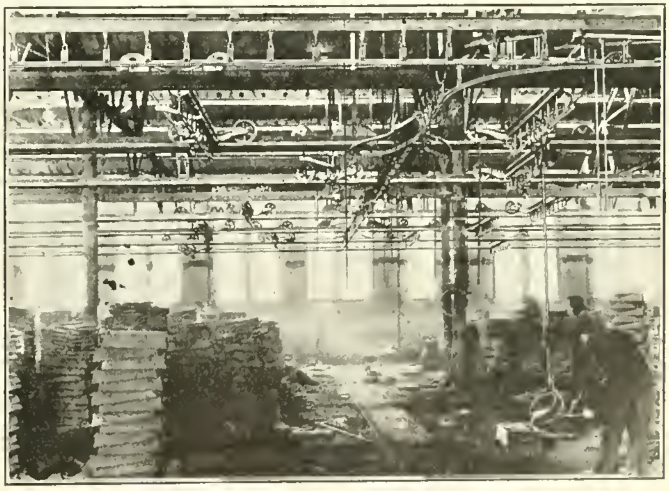
Push and Pull Traveling Cranes

IMPROVED push and pull traveling cranes, in capacities of 1,000 lb. and 2,000 lb., have been placed on the market recently by the Louden Machinery Company, Fairfield, Ia. The bridge consists of two rolled steel channels set back to back, with track hangers bolted rigidly between them. The ends of the channels rest on the malleable iron end trucks to which they are securely fastened by bolts.

Each end truck is a single certified malleable iron casting, with both ends forked to straddle the track wheels, thereby providing bearings on both sides of the wheels. The track wheels are gray iron and deeply flanged, the end truck projecting down to within a half inch of the runway track. It is practically impossible to throw the crane off the track, but even if it should be thrown off, it cannot drop more than ½ in. without resting directly upon the rails. In no case would the entire crane fall and endanger the workmen underneath.

The operation of these cranes is easy under light or heavy loads, a slight push or pull being sufficient to move them. Eight Hyatt roller bearings are used, one on each side of each wheel, in dust-proof housings, fitted with compression grease cups. Louden end trucks also are specially designed for 1,000-lb. and 2,000-lb. loads and in this respect are different from many other light cranes which merely have light bridges, but use the same heavy end trucks designed for cranes of larger capacity.

Spans for the 1,000-lb. crane are available up to 20 ft.; for the 2,000-lb. crane, span up to 30 ft. (The span is figured from center to center of the T rails.) The head room is 19⅝ in. on 1,000-lb. cranes; 21⅝ in. on 2,000-lb. cranes.



Louden Push and Pull Cranes in Foundry

Ample safety factors are used, being from 4 to 8. The cranes can be connected up with any number of off-running overhead carrying system tracks, from either side of the craneway. The crane is latched into alinement with the connecting track by a positive type of latch. When latched into position the crane cannot be moved away until a chain is pulled to unlatch it. Should the latch be thrown in when the crane is not close to alinement, the crane automatically throws the latch out as it passes. The method of alining these Louden cranes is designed to be positive, prevent accidents and make possible a quick connection.

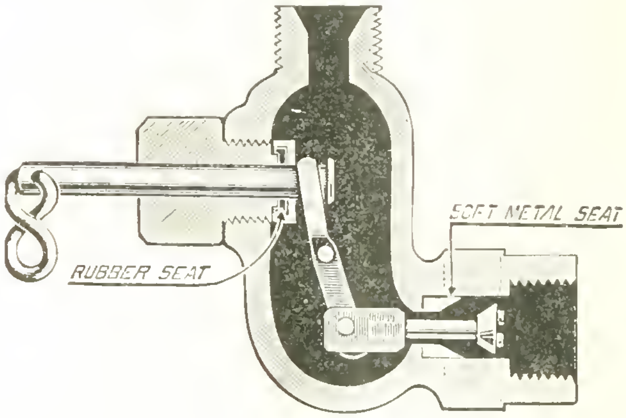
Safety Valve for Gas Welding Apparatus

DESIGNED to safeguard the welder, and reduce fire hazards and losses, the safety valve illustrated has been developed recently by the Mattingly Automatic Valve Company, St. Louis, Mo. This valve is applicable to oxyacetylene welding and cutting outfits, being applied between the hose and the gas tanks. It closes instantly and automatically in case the hose line becomes ruptured or disconnected, thereby preventing the escape of gas and the danger of fires or personal injuries to the welders.

This safety valve does not in any way interfere with the operation of the torch or regulator and one of its most important advantages is the feeling of security given to the welder. The regular stock valve is made to work on any outfit using hose lines from 10 to 60 ft. in length. These valves will not always give the best results on longer lines and special valves can be provided for any length of hose that may be specified.

Referring to the illustration, the operation of this valve will be evident. It consists of a right-angle body, the valve and soft metal seat at the right being next to the regulator. (The upper connection is to the hose.) This valve is connected through a pivoted lever to the stem extending to the left. In operation the stem is pulled to the left until pressure is built in the hose line thereby holding the valve open. It is obvious that should the hose become ruptured or disconnected, the pressure will suddenly drop in the right angle body when the rush of gas from the tank will close the valve against its soft metal seat.

A feature of the Mattingly safety valve is the absence of any packing. The escape of gas around the stem when the valve is open is prevented by a soft rubber-seated valve which seats against the cone-shaped bushing through which it operates. The rubber may be removed as often as necessary by simply unscrewing the bushing which allows the stem to be lifted out and a new rubber replaced. This prevents the escape of gas.



Mattingly Valve Designed to Increase Safety of Gas Welding Operations

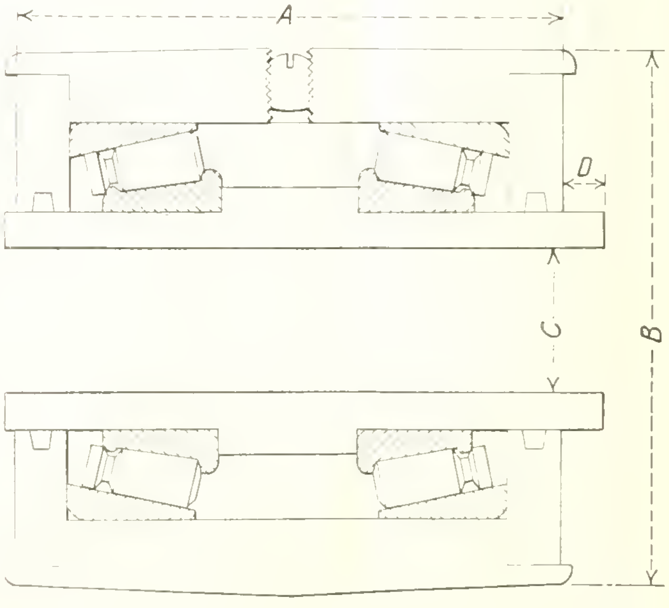
Loose Pulley with Taper Roller Bearings

WITH the purpose of providing a loose pulley which should be practically frictionless, have provision for taking end thrust and also afford a long life, the St. Louis Machine Tool Company, St. Louis, Mo., has developed the pulley shown in the drawing. The objection to the old type straight roller bearing was the absence of provision for wear adjustment and end thrust and in the case of ball bearings, the cost has been high in addition to the structural disadvantage of the large outside diameter in relation to the bore. This eliminated them from use in arbor pulleys on many high-speed machines where the pulleys are necessarily small.

The comparatively recent advent of the adjustable taper roller bearing with provision for taking end thrust largely overcomes these difficulties. The races can be so thin that loose pulleys as small as 2½ in. in diameter can be made by mounting the bearings directly on the shaft. It is preferable, however, to mount them on a sleeve as shown in the illustration. Where this construction can be used, it is often possible to save the old and worn shafts or arbors which are sometimes worth as much as the pulley and in some cases more.

Pulleys of the type illustrated are being supplied by the St. Louis Machine Tool Company for replacement of all kinds of machinery, any size from 2½ in. to 22 in. in diameter being available. Hanger boxes in countershafts can also be equipped with these bearings to advantage.

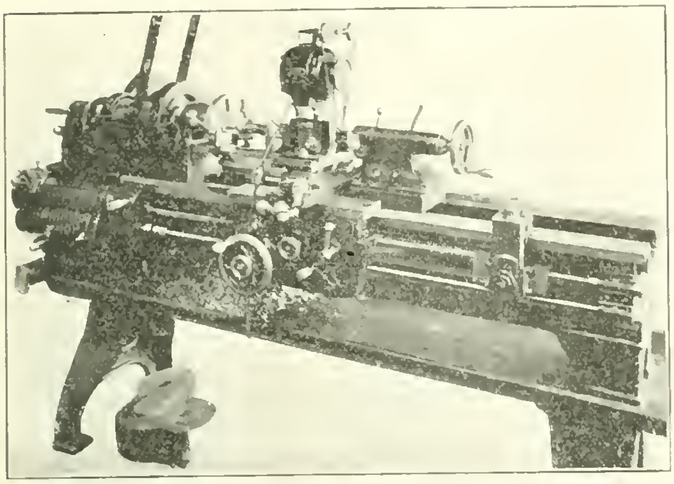
The design and location of loose pulleys has an important effect on machine efficiency and belt wear, and the provision of a loose pulley with taper roller bearings adjustable for wear, as illustrated, should prove decidedly helpful in solving any loose pulley problem presented to railroad men.



Loose Pulley Adjustable for Wear and Able to Resist End Thrust

Precision Grinder and Thread Lead Variator

IMPORTANT features of the 1923 model multi-graduated Precision thread grinder made by the Precision & Thread Grinder Manufacturing Company, Philadelphia, Pa., include a redesigned spindle, improved index, dust cap and oiling devices.



Multi-Graduated Precision Grinder and Thread Lead Variator Used on Toolroom Lathe

The spindle and driving pulleys are machined in one piece from solid stock of special heat-treated alloy steel. This eliminates lost motion or slippage due to loose pulleys. The rear bearing is so constructed that should there be any elongation of the spindle due to increased temperature, it is subject to floating, thereby eliminating any extra duty on the bearings. The new spindle is heavier and more sturdily built and has many advantages over the old construction. Norma ball bearings are used, as formerly.

A ¼-hp. motor, fully enclosed, ball bearing, statically and dynamically balanced, is now furnished. This motor eliminates all possibility of chattering. An improved index for setting the helix angle with larger graduations has been installed on the grinder. Ball bearings are furnished in the idler pulleys. A dust cap is now supplied on the grinder which precludes all dust, grit, etc., from entering the spindle housing. Improved oiling devices have also been installed.

The illustration shows a multi-graduated Precision grinder and thread lead variator installed on a 14-in. by 6-ft. toolroom lathe. This lead-variating device is used for obtaining precision lead from the ordinary lathe lead screw; also to elongate the lead on parts which are subsequently to be hardened to compensate for the approximate shrinkage in lead, eliminating correction grinding in non-precision work and reducing the correction grinding necessary in precision work, such as thread gages, taps, hobs, dies, chases, etc. Metric threads and any threads of odd or unusual lead may be cut by the use of the variator without requiring special or translating gears.

Three New Westinghouse Products

DURING the past year, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed several heaters of the type illustrated in Fig. 1, to be used for heating offices, shops, watchman's shanties, etc. They are safe, neat in appearance and convenient. They are not affected by varying gas, pressures and can be installed in the most desirable location without regard to steam or gas lines. The heat is easily regulated by means of a convenient three-heat switch. The cost of installing this form of heating apparatus is much less than that of most other forms and the operating cost is relatively low.

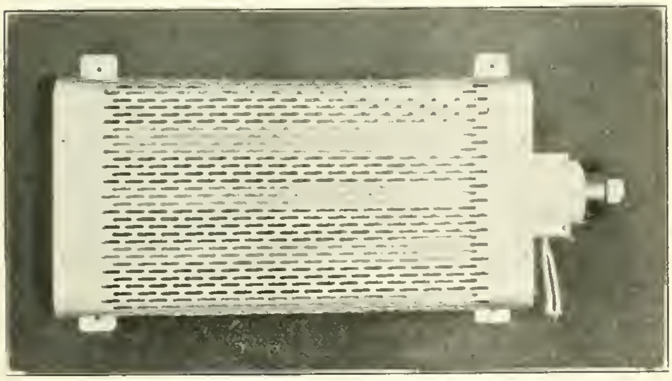


Fig. 1—An Easily-Regulated Electric Heater

Westinghouse electric glue pots (Fig. 2) are light, sturdy and safe. They may be used for heating materials with low melting points such as paraffin, beeswax, etc., as well as glue. They are being used in many industries where the features of safety, convenience, dependability and uniformity of operating conditions are important. They are of the dry type to eliminate the danger of boiling dry and burning out the heating element, the inconvenience and sloppiness of constantly refilling the water bath, and to reduce the amount of current used in operating the pot.

The most important feature of the new electrically-heated solder pot (not illustrated) is convenience, combined with the elimination of the fire hazard. Westinghouse small electrically heated solder pots are made in 10 and 30 lb. sizes and may be used to heat solder, babbitt, battery compound and other materials having a low melting point. They are equipped with three-heat switches, which permit the solder to be quickly melted on the high heating rate and kept at the proper temperature on a lower rate, without further attention. They are built to withstand hard usage and be dependable in operation. The heating chamber is thoroughly insulated, making the pot economical in operation and comfortable to work around.

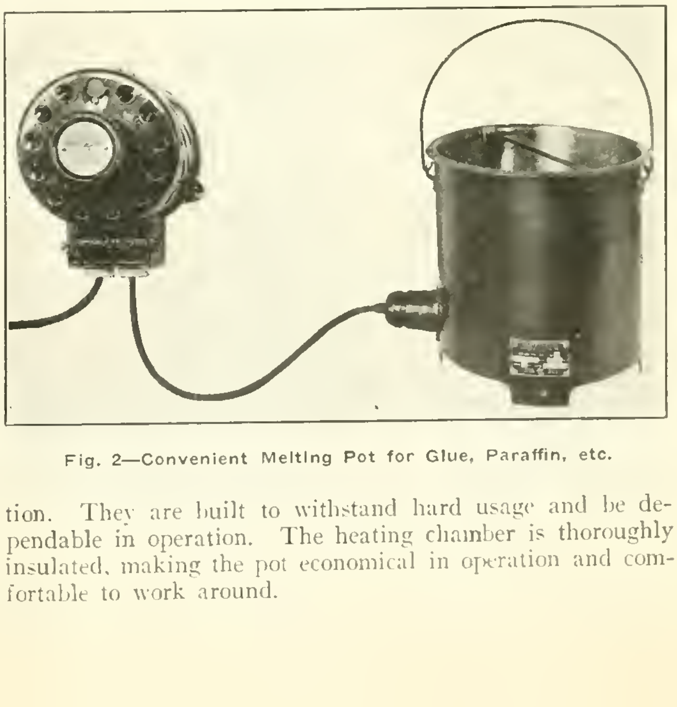


Fig. 2—Convenient Melting Pot for Glue, Paraffin, etc.

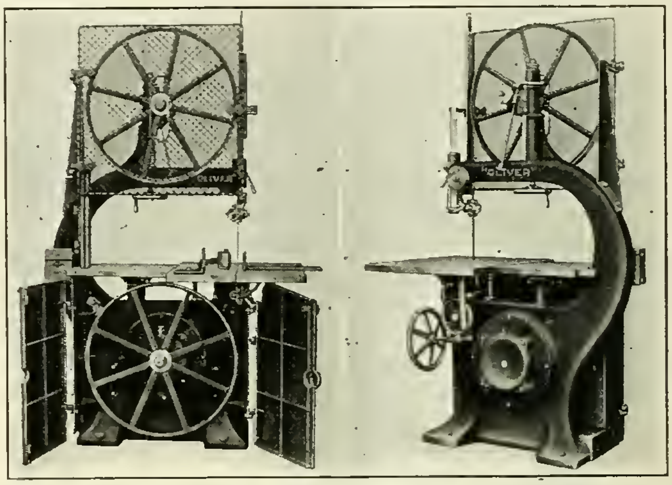
Band Saw with Direct Motor Drive

SIMPLICITY, fewer parts and increased efficiency usually result from the application of direct motor drive to machine tools and with the idea of benefiting to the fullest possible extent from these advantages the Oliver Machinery Company, Grand Rapids, Mich., has provided direct motor drive for many of its woodworking machines as described in recent issues of the *Railway Mechanical Engineer*.

Referring to the illustration, the method of applying direct motor drive to the Oliver No. 16 band saw will be evident from the two views. The rotor of the driving motor is keyed to the lower wheel shaft which runs in two ball bearings supported by the two end bells. These end bells have finished concentric tongues which fit accurately inside the finished rings of the band saw frame as well as the stator, assuring accurate alinement and easy accessibility. This is a simple and efficient construction, the band saw taking up little floor space and having few moving parts, which tends to reduce vibration to a minimum. The motor is fully enclosed but by means of the air gap running up into the column there is sufficient circulation of air within the enclosure to keep the motor cool.

The lower wheel has a positive non-changing alinement with the frame of the machine. The upper wheel has a simple 12-in. vertical screw adjustment for tensioning the saw and an unusual delicate micrometer screw-tilting device for tracking the saw on the wheel. All adjustments are controlled by hand wheels. The guides are of the frictionless roller type, one above and the other below the table. The saw runs against the outer edge of a hardened wheel, which is arranged to revolve against a ball bearing. The hardened steel side guides or lips are adjustable to prevent turning the saw sidewise.

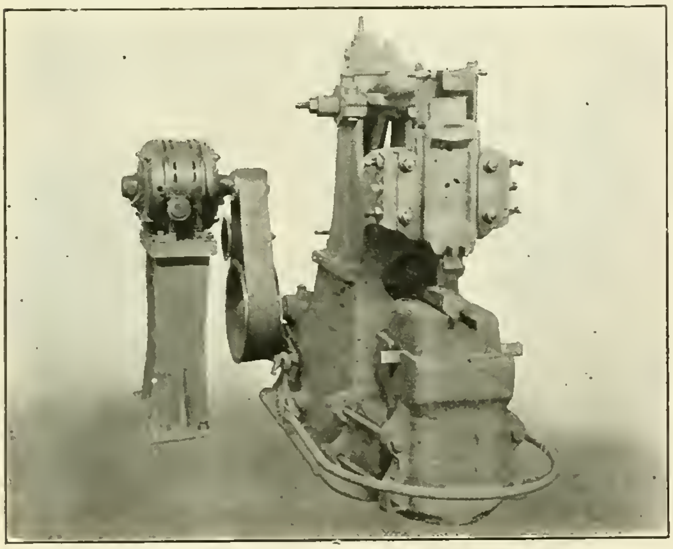
An important feature of any band saw is the method of safeguarding the operator. Two safety guards are provided in this case, one at the rear, U-shaped, made of wood and one at the front L-shaped, made of steel with wood facing. These guards cover the blade at all points except the part doing the sawing between the guide and table. The lower wheel is encased by two iron doors preventing danger to the operator and confining the saw dust to a limited area. The upper wheel is covered by a heavy wire mesh door or guard, supported on a cast-iron hinged bracket attached to the column of the machine and locked with a spring clasp. The band saw table is of cast-iron 36 in. by 30 in. and 40 in. high. From three to five horsepower is required to drive this machine, depending on the work.



Oliver No. 16 Band Saw with Direct Motor Drive

New Motor Drive for Helve Hammers

THE style of electric motor drive for upright helve hammers, made by C. C. Bradley & Son, Inc., Syracuse, N. Y., and described on page 232 of the June, 1922, *Railway Mechanical Engineer*, has been recently changed to that shown in the illustration. In the original design, the hammers were arranged with the idler head of the driving pulley and the motor set on a block two or three inches above the floor base. The constant revolution of the motor pulley on the drive belt caused the belt to heat and burn and require frequent replacement. This difficulty has been overcome by installing the idler back of the drive and the motor in such a way as to allow the hammer to run as if the belt were connected to a countershaft, this construction being clearly shown in the illustration.



Bradley Helve Hammer With New Motor Drive

Nine sizes of electric motor are used on Bradley upright helve hammers, from 1½ hp. for the 30-lb. hammer to 15 hp. for the 500-lb. hammer. On one of the intermediate sizes, the 125-lb. hammer, for example, a 5-hp. motor is used running at 1,200 r.p.m., the speed of the hammer being 350 r.p.m. This hammer is fitted to handle 2-in. stock.

THE SOUTH AFRICAN RAILWAYS have just awarded to the Natal By-Products, Ltd., manufacturers of "Natalite," a gasoline substitute, a six months' contract for motor fuel for use throughout their motor transport service, according to a report to the Department of Commerce. Natalite, which is a sugar cane distillate made largely from waste material, will be supplied to the South African Railways at one shilling four pence per imperial gallon (26.7 cents per U. S. gallon) free on rail at Mearbank, near Durban. It is understood that this is about one-third under the lowest bid for gasoline. The producers of Natalite claim that their product is 90 per cent efficient as compared with gasoline, and it is evident that even discounting this figure, the substitute must be reckoned with in the future. This is the first large contract that has been secured by any gasoline substitute, and the outcome of the trial will be awaited with interest.

GENERAL NEWS

The machine shops of the Esquimalt & Nanaimo at Wellington, Vancouver Island, were completely destroyed by fire on April 30. The loss is estimated at $80,000.

Pay Increase on the P. R. R.

The Pennsylvania has made a general increase in the pay of employees at the Altoona shops, said to amount to three cents an hour. The increase is retroactive to May 1, and piece-workers as well as other employees are advanced, the estimated total number of men affected at Altoona being 10,000.

Power Brake Investigation Reopened

The Interstate Commerce Commission has ordered that its investigation of power brakes and appliances, on which weeks of hearings were held and on which the arguments were submitted some time ago, be reopened for the purpose of a test by the commission of the brake of the Automatic Straight Air Brake Company upon the Norfolk & Western.

Credit to the Southern and Southwestern Railway Club

On page 275 of the May, 1923, issue of the *Railway Mechanical Engineer*, there appeared an article entitled "Locomotive Boiler Water Circulation," by Mr. C. A. Seley, consulting engineer, Locomotive Firebox Company. This article is an abstract of a paper which Mr. Seley read before the March meeting of the Southern and Southwestern Railway Club at Atlanta, Ga. Through an oversight, proper acknowledgment as to its source was omitted at the time it was published.

Wage Statistics for February

The number of employees reported by Class I roads for the month of February, 1923, was 1,783,555, an increase of 4,039, or 0.2 per cent, as compared with the returns for January, 1923, according to the Interstate Commerce Commission's monthly summary of wage statistics. The total compensation was $230,416,541, a decrease of $19,635,245, or 7.9 per cent. This decrease in compensation, notwithstanding the increase in employment, is explained by the fact that February had only 23 working days while January had 26.

Railroads in New York City Limits Required to Electrify by 1926

Governor Smith has signed the act which has been passed by the legislature requiring the substitution of electric for steam locomotives within the city limits by 1926. The roads most seriously affected under the act are the New York Central, The New York, New Haven & Hartford, the Baltimore & Ohio and the Long Island. Two or three other roads which operate steam switching locomotives at their New York piers are also affected to some degree.

Large Railway Repair Shop in Southern France

The locomotive and railway rolling-stock construction and repair shops located near Marseilles in 1919 by the Chantiers et Ateliers de la Capellette comprise the most important industry established in the south of France since the war. The plant covers about 32 acres and has, in addition to a large diversity of factory buildings and sheds and about 7½ miles of track. The shops are equipped to repair 400 railway carriages at a time, and one building, 255 ft. by 575 ft., is able to handle 36 locomotives simultaneously. A large number of electric traveling cranes, some having a capacity of 60 tons, are in use; the entire equipment is said to be complete and modern in every way. Much of the repair work of the Paris, Lyons & Mediterranean Railway and of the Midi Railway, as well as that of the smaller local lines, is handled by this plant.

A. F. of L. Shop Craft Workers Seek Increases

Railroad shopmen belonging to or affiliated with the American Federation of Labor have sent notices to a number of prominent roads proposing a general increase of pay because of the increased cost of living; the application being based also on an assertion that men in similar classes of work outside the railroad service are now receiving rates which justify the request for an increase. The first road concerning which this notice was made public was the Pittsburgh & Lake Erie, but it appears that the leaders intend to make the same request on all roads which settled last summer's strike with the brotherhoods.

Austrian Locomotive Industry Thrives

Recent orders for locomotives from Yugoslavia, Rumania, and Hungary, in addition to those of the Austrian State Railways, are sufficient to keep the Austrian locomotive factories busy for some time, according to the Neues Wiener Journal, as reported by Consul Weingartner at Vienna.

The Austrian government has ordered 17 electric locomotives for the Arlberg and Salzkammergut railways. The Italian State Railways have placed an order in Austria for 200 locomotives to be delivered within 3 years. The Neue Freie Presse reports this to be the first order of Italian State Railways placed outside of Italy.

Locomotive Conditions in April Best Since July, 1922

Interstate Commerce Commission's monthly report to the President is the best since July, 1922. In April 5,266 locomotives were inspected by the Bureau of Locomotive Inspection, of which 3,049, or 58 per cent, were found defective and 511 were ordered out of service. The percentage of those inspected found defective is the lowest that has been reported for any month since the shopmen's strike began last July. For the months of August, September and October, 1922, the percentage was 71. During the same month (April) 96,940 freight cars were inspected by the Bureau of Safety, of which 7.3 per cent were found defective and 1,983 passenger cars, of which 1 per cent were found defective. In April, 1922, 4½ per cent of the freight cars inspected were found defective and 0.9 per cent of the passenger cars.

Arbitration Courts to Deal with Labor Matters in Argentina

The Argentine government has issued several decrees providing for the constitution of arbitration courts which are to deal with all questions arising between railways and their employees, and specifically, with the claims of the shop employees to an annual vacation of eight days on full pay. The railway companies have presented on their part a joint memorial to the Minister of Public Works objecting to the proposed arbitration procedure—alike in the case at issue and as a general principle—on the ground that it is unconstitutional. The companies in the concluding portion of their memorial quote recent utterances by the present Minister of the Interior, formerly Solicitor General. The Minister, Doctor Matienzo, replying a few weeks ago to a question in the Chamber of Deputies said that the decrees governing the matter were not at all in accord with the law.

Proposed Locomotives for Australia

The new chief commissioner of railways in South Australia (W. A. Webb), after giving attention to the haulage capacity of the State's locomotives, has written to the leading English, Scottish, Australian and American builders, asking them for suggestions for new types of locomotives, more particularly of the following classes: Mountain type passenger locomotive with tractive force of 41,000 lb. to 43,000 lb.; Pacific type passenger locomotive with tractive force of 32,000 lb. to 35,000 lb.; Mikado type freight engine, 50,000 lb. to 55,000 lb. tractive force; Decapod type freight engine, 60,000 lb. to 65,000 lb. tractive force, and Santa Fe type engine, about 60,000 lb. tractive force. The most powerful locomotive running in South Australia at present has a tractive force of 20,000 lb. The commissioner says that tenders for the proposed new types are not being called at present, but on receipt of suggestions from locomotive builders requests will be placed for definite designs.

Students in Central of Georgia Shops

Students of the Georgia School of Technology, Atlanta, Ga., will be able henceforth to earn their way through school. By an arrangement between the school and the Central of Georgia Railway the student will be enrolled in what is known as the "Co-operative Plan of Engineering," and will alternate between four weeks of classroom work and four weeks in the Central of Georgia shops. The "co-operative plan" leads to graduation in five years, instead of the usual four years. The railway pays the students 30 cents an hour upon entrance, and this is increased at each six-month period throughout the five years. The student apprentices are regular employees of the railway and are entitled to transportation, group life insurance, pension benefits and other features that make employment with the Central attractive. Young men who reside in the cities where the Central has shops may spend half of their time at their homes, during their college course, and their earnings will be sufficient to pay their expenses at school during the time they are on the campus.

Shop Wage Negotiations in Britain

The British railway companies have modified their shop wage reduction proposals to the unions to provide for a 2s. ($.50) per week reduction immediately and an additional reduction of 1s. ($.25) a week during the following month. The proposal so far has been presented only to the shop craft unions and not to the National Union of Railwaymen.

The shop craft unions are the regular metal trades unions, and include both railway shopmen and mechanics from outside industries in their membership. The National Union of Railwaymen is an industrial union which "caters" to all classes of railway employees. The shopmen are about equally divided in their affiliation with the craft unions and the N. U. R.

The purpose of the proposed wage reduction is to reduce the operating expenses of the railways so that further decreases in freight and passenger rates may be possible. The wages of metal trades workers in other industries are 6s. 6d. ($1.60) lower than those of men doing similar work for the railways.

Chaining Standing Cars Is Not a "Coupling" Within the Law

A car with a defective coupler was waiting with others on a dead track for transfer to the repair shop, attached to the next car by a chain. A foreman of car inspectors, passing, went between the cars to shorten the chain, without setting out a flag, as the rules required. The movement of another car on the track caused a collision, resulting in his death. The Circuit Court of Appeals, Sixth Circuit, holds that the proximate cause of death was the failure to set out the flag, and not the defective coupler, and the company was not liable under section 4 of the Safety Appliance Act.

To chain together two cars which have stood for hours and may stand for hours more untouched upon a track unused save as a receiving station for the car hospital is of course, in a certain broad sense, to "couple" them; but the word usually describes the operation which accompanies the approach of one car to the other. A crushing impact is the expected incident of the normal coupling, and safeguards are constantly necessary; not so, necessarily of a "coupling" which calls for no impact.—McCalmont v. Pennsylvania, 283 Fed. 736.

Group Life Insurance on the Central of Georgia

The Central of Georgia Railway has adopted an arrangement under which its skilled employees may avail themselves of group life insurance at low rates. The amount is to be based upon the employees' annual pay from a minimum of $1,000 to a maximum of $3,000. Provision is made for compensation in cases of permanent disability. The premium to be paid by the employee is 60 cents per month per thousand of insurance. The remainder of the premium is paid by the railway company.

This is in addition to the pension system, the benefits of which the company extends without cost to the employee. President William A. Winburn, in a circular announcing the scheme to employees says:

"These matters are apart from the underlying desire of the company to provide continuous employment at fair compensation. Thought is given at all times toward making conditions surrounding work for this company safe and comfortable. These are some of the things that make work for the Central of Georgia attractive. The task of providing dependable transportation for the public is one of dignity and importance. It offers interest, opportunity, and compensation to those engaged in it. I feel sure that all of you in the service take pride in your work. You need have no hesitation in letting the public know of your reasons for this pride in your calling and in your company."

Earliest Locomotive in America Traced

Wholly lost sight of for nearly a hundred years and with its fate still unrecorded in detail, the first steam locomotive ever seen on the American continent has within a few weeks past been traced by one of its members, the right-hand cylinder, which has just been authoritatively identified in the National Museum at Washington. This locomotive, the "America," was built in 1828 on an order from the Delaware and Hudson Canal Company by George Stephenson of England, who soon after designed and built the famous Rocket, and was in nearly all respects, except that it did not have the multitubular boiler, the pattern for the more famous engine.

The "America" was brought to New York by the Delaware and Hudson Company in January, 1829, and after being demonstrated under steam was sent up the company's new canal towards Honesdale, where it was to be tried out on the first railroad in the country, connecting Honesdale and Carbondale. From the time the "America" passed the eastern terminus of the canal all documentary record of it ceases. But a few weeks ago an official of the Delaware and Hudson Company, while arranging with the National Museum at Washington for the loan of a model of the "Stourbridge Lion," another Delaware and Hudson locomotive, which was the first to be tested on a railroad track in America, found among the unmounted locomotive parts which had been supposed to belong to the "Lion," a cylinder whose design and measurements showed it beyond question to be one of the cylinders of the missing locomotive "America." Curator C. W. Mitman, of the division of Mechanical Technology of the Museum, declared, after a careful comparison of this cylinder with historical data, that the identification could not be questioned. It is hoped that with this clue established, other parts of the "America" may be recovered, as the "Stourbridge Lion" itself has been gradually re-assembled in nearly all parts, from various sources along the lines of the Delaware and Hudson Company.

MEETINGS AND CONVENTIONS

Program for American Society for Testing Materials

The American Society for Testing Materials will hold its 26th annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N. J., on June 25-29. Because of the increased volume of reports and papers to come before this meeting, 13 sessions have been arranged beginning on Monday evening and closing on Friday evening.

General Foremen's Convention

A program of topics for discussion at the 1923 convention of the International Railway General Foremen's Association, which will be held at the Hotel Sherman, Chicago, September 4-7, has been arranged as follows: Topic No. 1—Shop Efficiency, Locomotive and Car Departments—(a) Apprentices, Training and Developing; (b) Relation of Foremen and Employees; (c) Methods of Increasing Efficiency of Supervisors and Employees; (d) Discipline; (e) Increased Output per Man Hour. Topic No. 2—Costs—General Repair Methods and Maintenance of Valves, Valve

Gears and Power Reverse Gears; (b) Engine, Tender and Car Trucks; (c) Air Brake Appliances on Passenger and Freight Equipment; Topic No. 3—General Repair Methods and Maintenance of Stokers, Coal Pushers and Air Firedoors; Topic No. 4—Shop Kinks, Locomotive and Car Departments; Subsidiary Topic No. 1—Welding Flanges on Driving Tires, Engine Truck and Tender Wheel Tires.

Annual Meeting of C. I. C. I. & C. F. A.

The Chief Interchange Car Inspectors' and Car Foremen's Association has selected October 3, 4 and 5 as the dates for the annual meeting which will be held at the Hotel Sherman, Chicago. It is planned to have the papers by A. J. Mitchener and W. J. Owen, which were awarded the prizes in the *Railway Mechanical Engineer's* competition on car inspection read at this meeting. Further details of the program will be announced later.

New Officers of Canadian Railway Club

At the annual meeting of the Canadian Railway Club at Montreal on May 8 the following officers were elected: H. R. Naylor, assistant works manager, Angus shops, C. P. R., president; C. E. Brooks, chief of motive power, C. N. R., first vice-president; J. A. Shaw, general electric engineer, C. P. R., second vice-president; W. A. Booth, chief draughtsman, mechanical department, C. N. R., secretary; and P. C. Reynolds, chief clerk to chief of motive power, C. P. R., treasurer.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting, Orchestra Hall, 220 South Michigan Ave., Chicago, beginning June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purcases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 30 Church St., New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa Annual meeting, Chalfonte-Haddon Hall Hotels, Atlantic City, N. J., beginning June 25, 1923.

American Society for Steel Treating.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio. Eastern sectional meeting June 14 and 15, Bethlehem, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August at Windsor Hotel, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting monthly, Hotel Iroquois, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting, Hotel Sherman, Chicago, October 3, 4 and 5.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in each month, except June, July, August and September, Copley-Plaza Hotel.

New York Railway Club.—H. D. Vought, 26 6Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in each month, except June, July and August.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Whitman & Barnes Manufacturing Company has moved its New York office to 99 Chambers street.

The Link Belt Company, Chicago, will construct a one-story machine shop 125 by 135 ft. to cost approximately $85,000.

The Locomotive Lubricator Company has moved its offices from 6 North Michigan avenue, Chicago, to 2443 Sheffield avenue.

Elisha H. Talbot, retired publisher and founder of the Railway Age, died at his home in New York on May 22 at the age of 83.

The Jones & Laughlin Steel Corporation has purchased 319 acres of land near Hammond, Ind., on which a plant will be constructed.

The Nathan Manufacturing Company, New York, has removed its Chicago office from 707 Great Northern building to 14 East Jackson boulevard.

The American Car & Foundry Company will construct a one-story assembly building at 2416 South Paulina street, Chicago, at an approximate cost of $100,000.

H. E. Reynolds has been appointed district manager of the Pittsburgh, Pa., office at 1222 Fulton building of the Whiting Corporation, to succeed S. C. Wilson.

E. A. Thornwell, Candler building, Atlanta, Ga., has been appointed sales representative of the Edgewater Steel Company, Pittsburgh, Pa., vice John Hyland, deceased.

W. B. Fraser, one of the partners in the Coale-Fraser Lumber Company, Lytton building, Chicago, has assumed charge of the company's West Coast office, Tacoma, Washington.

The National Lumber Manufacturers' Association of Chicago has removed its office from the Harris Trust building to 2017 Conway building, 111 W. Washington street, Chicago.

The Morton Manufacturing Company, Chicago, manufacturers of railway appliances, is building an addition to its Chicago factory which will give 18,000 sq. ft. of additional floor space.

Dr. Schuyler Skaats Wheeler, president of the Crocker-Wheeler Company, of New York and Ampere, N. J., died suddenly on April 21, at his home in New York City.

Charles B. Yardley, who formerly represented Jenkins Brothers, New York, with all railroads in its New York distributing district, will again become railroad representative for the same district.

The Daniel Woodhead Company, Chicago, representatives for fans, lighting units for electrical departments and Keller pneumatic tools and reflectors, has moved its offices to 15 North Jefferson street.

The Gibb Instrument Company, Bay City, Mich., manufacturers of electric welding equipment, have been appointed distributors of the General Electric Company's arc welding electrodes in the middle west.

H. B. Doerr, chief mechanical engineer of the Scullin Steel Company, with headquarters at St. Louis, Mo., has been promoted to general superintendent, succeeding L. C. Perry, resigned to engage in private business.

W. C. Thatcher, assistant superintendent of construction of the National Boiler Washing Company, with headquarters at Chicago, has been promoted to general superintendent of construction, succeeding J. M. Weir, resigned.

S. W. Hall, chief material inspector of the New York Central, with headquarters at Cleveland, Ohio, has resigned to become a representative of the railroad department of the Wolf Brush Company, with headquarters at Chicago.

Poultney Gorter, heretofore in the contracting department and various other departments at the shops of the Pullman Company, has been appointed assistant to the eastern sales manager of the Pullman Company, 25 Broadway, New York City.

The Detroit Steel Products Company, Detroit, Mich., will establish a branch factory at Emeryville, Cal., which will have 83,000 sq. ft. of space. A. Lum has been appointed manager of the plant and will have charge of sales on the Pacific Coast.

J. H. Cross., formerly western manager of the service department of the Railway Age and allied publications and later advertising representative for these publications, died on May 22. In 1918 Mr. Cross left these publications to form an advertising agency.

R. W. Wentworth has been appointed district manager of sales of the Interstate Iron & Steel Company, with headquarters in the Merchants National Bank building, St. Paul, Minn. The company was formerly represented in the Northwest by the Paul J. Kaulman Steel Company.

Paul Llewellyn, vice-president and general sales manager of the bar division of the Interstate Iron & Steel Company, with headquarters at Chicago, has been promoted to vice-president in charge of all sales, with the same headquarters, and will be succeeded by H. F. Schroeder, representative at New York.

The Texas Company, Houston, Tex., has organized a western sales department, with headquarters at Denver, Colo., and established stations and other marketing equipment throughout the new territory. Fred W. Freeman has been appointed general western manager and H. W. Dodge has been appointed western sales manager.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has removed its Pittsburgh, Pa., office of the Central district from the Farmers Bank building to rooms 950 to 953 Century building, on Seventh street between Penn avenue and Duquesne way. A. G. Pierce is manager of the Central district, with headquarters in Pittsburgh.

Harry S. C. Folk and Donald Weaver have joined the railway department of the Electric Storage Battery Company as assistants to Howard S. Mills of the New York City office. Mr. Folk was previously in charge of the industrial truck and locomotive department and Mr. Weaver was formerly connected with the general office staff in Philadelphia, Pa.

W. D. Creider has been appointed sales manager of the Oilgear Company, Milwaukee. Mr. Creider was formerly in charge of the Milwaukee, Wis., office of the Federal Machinery Sales Company of Chicago. A. L. Ellis, for the past year acting sales manager of the Oilgear Company, has been appointed eastern representative of the company with headquarters in New York City.

Stanley H. Smith, who was formerly sales agent for the Pennsylvania Steel Company in Chicago and Cleveland and sales agent of the Bethlehem Steel Company in Cleveland has recently opened a shovel warehouse for The Wyoming Shovel Works at 422 Frankfort avenue, Cleveland, Ohio, where he also represents Harrisburg Pipe & Pipe Bending Company, The National Lock Washer Company and The Stevens Metal Products Company.

The Jones & Laughlin Steel Corporation has work under way on an extension of the south power station at its Aliquippa works near Woodlawn, Pa. The construction has been started by Dwight P. Robinson & Co., Inc., New York. The improvement includes preparation of site, foundations and condenser well, and the erection of an extension to the building to house a 10,000 k. w. steam generator unit with condenser and all other appurtenances.

The Independent Equipment Corporation, McCormick building, Chicago, has been incorporated to lease and repair railway cars. M. P. Krafftmiller, formerly vice-president and treasurer of the General American Tank Car Corporation, is president; G. A. Schoemaker, formerly general manager of the Allegheny Steel Company, is vice-president; A. E. Higgins, formerly of the National City Bank, Chicago, is treasurer, and J. E. Bittus is secretary. The corporation will have a plant at Chicago and is now operating one at Warren, Pa.

Scott R. Hayes, vice-president of the New York Air Brake Company, New York City, died on May 6 in the Ossining (N. Y.) hospital while physicians were preparing to operate on him. Mr. Hayes was born on February 8, 1871, at Columbus, Ohio. In 1890 he left Cornell University to go with the Thompson-Houston Company with headquarters at Cincinnati, Ohio. In 1892, when the General Electric Company was formed, Mr. Hayes was placed in charge of its Cleveland office and remained in that position until the latter part of 1894. During 1895 and 1896, he was in the electrical supply business at Cleveland, Ohio, under the firm name of Hayes & Arthur. In 1897, he was appointed agent for the Scott Spring Company with office at Cleveland and one year later he went to Chicago as representative for that company. When the Railway Steel Springs Company was organized in 1902, he was transferred to the New York office as assistant sales agent, subsequently serving as general sales agent and vice-president. He resigned from the latter position in March, 1914, to become assistant to the president of the New York Air Brake Company and subsequently become vice-president of that company. He was a son of former President Rutherford B. Hayes.

Robert H. Gwaltney has been appointed vice-president of the T. H. Symington Company, New York. Mr. Gwaltney was born in Raleigh, North Carolina. He entered the service of the T. H. Symington Company in 1912 as sales agent and remained in that position until 1917, when he was appointed to the position of manager of eastern sales. Mr. Gwaltney now becomes vice-president of the same company with headquarters at New York City in charge of eastern sales, and he will also have supervision of the southern territory formerly handled in Baltimore, Md., by T. C. deRosset, deceased.

R. H. Gwaltney

The Sprague Electric Works of the General Electric Company has consolidated its district and local offices with corresponding offices of the General Electric Company. The manufacture and exploitation of Sprague products will be continued in the name of the General Electric Company in the recently organized merchandise department. The Sprague conduit products section and the Sprague apparatus section of the merchandise department will, for the present, continue offices at 527 West Thirty-fourth street, New York City.

Charles E. Sheldon, for many years connected with the Whitman & Barnes Manufacturing Company, died on May 1, 1923. He was born in Fitchburg, Mass., April 14, 1850, in 1867 became identified with the Whitman & Miles Manufacturing Company, afterwards consolidated with other plants and the name changed to Whitman & Barnes Manufacturing Company. He became superintendent of the Fitchburg works in 1872 and was transferred to the Akron plant in 1877, serving the latter as director, treasurer, general manager, vice-president and president. In 1915 he was elected chairman of the board of directors, which position he held at the time of his death.

Joseph T. Ryerson & Son, Inc., with main plant and offices in Chicago, has bought the plant, stock and good will of the Cincinnati Iron & Steel Company, Cincinnati, Ohio. The Ryerson Company now has steel-service plants in Chicago, St. Louis, Detroit, Buffalo, New York and Cincinnati. The plant of the Cincinnati Iron & Steel Company occupies a full city block at Front & Freemont streets, with about 110,000 ft. of floor space. Lewis E. Skinner, who has been for eighteen years with the Ryerson Company and for a long time in charge of the Ohio business, is now in charge of the plant. He will be assisted by C. A. Parnell, former assistant to Arthur Allshul, manager at the Ryerson Buffalo plant.

The Railroad Supply & Equipment Exchange Corporation has been incorporated in Illinois for the purpose of erecting, in Chicago, a building to be used as the central headquarters for the railway supply trade of the United States. The company expects to erect and operate a building which will be large enough to house permanent and transient exhibits of railway equipment and supplies, office space for supply manufacturers and club rooms. Harry Vissering, president of the Harry Vissering & Co., Chicago, is president; T. G. Kroehler is vice-president and R. W. Lyons is secretary and treasurer. It is planned to design the building for exhibits that will remain in place for long periods. The first floor will be given over to freight and passenger cars and locomotives. The second floor will hold lighter machinery, tools, signaling devices and other railway supplies. About 14 floors above the exhibition floors will be allotted to offices for supply companies at a rental which it is calculated can be made much less than present rates in many offices. The upper floors of the building will be made into from 300 to 350 rooms with sleeping accommodations; also a swimming pool and a gymnasium. It is also planned to arrange on one of the upper floors an auditorium which may be used by conventions. The district favored for the location of the building is north of the Chicago river and near the Municipal pier. Arrangements have been made for financing the construction of the building and these will be put into effect when tentative leases have been secured.

Oliver W. Loomis, manager of sales of the National Malleable Castings Company, Cleveland, Ohio, has been appointed manager of the company's malleable plants at Chicago with office at 2610 West Twenty-fifth place. Mr. Loomis succeeds O. J. Fehling, who has resigned. James A. Slater, assistant manager of sales, has been appointed manager of sales with headquarters at Cleveland to succeed Mr. Loomis. Oliver W. Loomis was born in Bloomington, Ill., but spent his early boyhood in New Haven, Conn., before going to Cleveland. He has been connected with the National Malleable Castings Company since March, 1891, having served consecutively in the accounting, manufacturing and sales departments. He was manager of sales at the time of his recent appointment as manager of the malleable plants at Chicago. James A. Slater, the new manager of sales, has been in the service of the National Malleable Castings Company continuously for the past 26 years. He served in various capacities both at Cleveland and at Chicago, in the purchasing and the sales departments and in his new position as manager of sales, with headquarters at Cleveland, he will have charge of both the railway and the miscellaneous sales of the various products of the National Malleable Castings Company.

O. W. Loomis

J. A. Slater

The Uehling Instrument Company, Paterson, N. J., has appointed Charles J. Schmid in charge of sales in Greater New York and Long Island with headquarters at Paterson. Mitsui & Co. have just been appointed exclusive representatives in Japan and China. The head office of Mitsui & Co. is at Tokio and its New York City branch office is at 65 Broadway. John E. Arnold, 15½ South Fourth street, Tulsa, Okla., has been appointed agent in charge of territory in the state of Oklahoma, and H. R. N. Johnson, 917-A Marquette avenue, Minneapolis, Minn., has been appointed agent, whose territory includes Minnesota, North Dakota and South Dakota.

TRADE PUBLICATIONS

Taps.—The Geometric Tool Company, New Haven, Conn., has just issued a 26-page booklet which is devoted exclusively to illustrations and a description of the construction and operation of its line of adjustable collapsing and solid adjustable taps.

Precision Tools.—A 15-page booklet, supplementing No. 28 and listing new and useful tools for the machinist, toolmaker and garage mechanic, has recently been issued by the Brown & Sharpe Manufacturing Company, Providence. Among the tools listed are Rex micrometer calipers, micrometer cases, stainless steel rules, gages, etc.

Electric Drills and Reamers.—Details of Hisey electric drill and reamer construction and electric drill and reamer motor characteristics are described and illustrated in Bulletin No. 106 which has recently been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The bulletin contains 16 pages and supersedes bulletins Nos. 105-155.

Cranes.—Catalog No. 165, superseding No. 158, has recently been issued by the Whiting Corporation, Harvey, Ill. In this booklet various types of cranes, including electric traveling, bucket-handling, gantry, transfer, handpower cranes, etc., are described and illustrated. Tables of clearances for several types of cranes are also included, as well as a brief outline of the company's facilities for building cranes.

Hoists and Cranes.—The Link-Belt Company, Chicago, has recently issued a comprehensive and instructive treatise on electric hoists and overhead cranes. The book is not only profusely illustrated with photographs of actual Link-Belt installations, but with line and wash drawings, the subject of proper installation and efficient operation is fully covered. Practices and methods employed by users in widely divergent fields are also outlined.

Southern Pine.—The Southern Pine Association, New Orleans, has issued a large-sized, 12-page, illustrated bulletin of technical and general information on Southern pine and its uses. The text deals with the availability, distribution and grading rules for Southern pine lumber; the method of laying and caring for wood block and other types of flooring; and a number of tables of strengths of green and air-dried timber, approximate changes of properties with changes of moisture content, etc.

Tube Cleaners.—Air, steam or water-driven tube cleaners for fire tube and water tube boilers, fuel economizers, condensers, evaporators, feed-water heaters, etc., are illustrated and described in a neatly arranged booklet of 32 pages which has recently been issued by the Roto Company, Hartford, Conn. A chart, outlining a practical method of finding the per cent of fuel saved by keeping boiler tubes free from scale, is also included. The booklet is indexed so that information regarding any of the Roto tube cleaning machines can be quickly and easily located.

Portable Loader.—The Link-Belt Company, Chicago, has issued a 33-page booklet describing and illustrating its line of portable loaders for general and special uses. The bulletin includes descriptions of conveyor loaders equipped with bag filling devices as well as portable machines adapted for use in series with each other and for indoor or outdoor work. Some attention is also given in the bulletin to the Link-Belt crane. Specifications of the machines are furnished, together with a large number of half-tone illustrations showing the machines in various kinds of work.

Arc Welding and Cutting.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued special publication No. 1659, in which the subject of electric arc welding and cutting is treated in a thorough and interesting manner. The booklet, which contains numerous illustrations, begins with a chapter on the reasons for organizing and standardizing the welding organization, the training of arc welders and the inspection of metallic electrode arc welds. This is followed by chapters on the principles of arc welding, the physical characteristics of arc metal, the use of the graphite electrode, and cost and application data. Several pages are then devoted to a brief description of Westinghouse arc welding apparatus.

EQUIPMENT AND SHOPS

Locomotive Orders

The Lehigh Valley has ordered 10, 4-6-2 type locomotives from the American Locomotive Company.

The Missouri Pacific has ordered 40, 2-8-2 type and 10, 4-6-2 type locomotives, from the American Locomotive Company.

The Seaboard Air Line has ordered 2, 2-8-2 type locomotives from the American Locomotive Company. This is in addition to the 20, 2-8-2 type ordered from the same builder reported in the April *Railway Mechanical Engineer.*

Passenger Car Orders

The Atlantic Coast Line has ordered five dining cars from the Pullman Company.

The Atchison, Topeka & Santa Fe has ordered 25, 70-ft. baggage cars from the Pullman Company.

The Canadian National has ordered 30 steel sleeping cars from the Canadian Car & Foundry Company.

The Seaboard Air Line has ordered four combination baggage and mail cars from the Pressed Steel Car Company.

The National Railways of Mexico have ordered five narrow gage passenger coaches from the Pullman Company.

The Florida East Coast has ordered 15 steel baggage cars, two mail cars and one dining car from the Pullman Company.

The Atlantic Coast Line has ordered 25, 74-ft. steel coaches, 15, 70-ft. steel baggage cars, 5, 70-ft. combination mail and baggage cars, and 2 mail cars from the Standard Steel Car Company.

Passenger Car Repairs

The Missouri Pacific has ordered repairs to 25 passenger cars from the American Car & Foundry Company.

The New York Central has also let a contract to the Merchants Dispatch, Rochester, N. Y., for repairs to 100 baggage cars.

The Missouri Pacific is having repairs made to 50 passenger cars at the shops of the St. Louis Car Company and to 50 cars at the shops of the American Car & Foundry Company.

Freight Car Orders

The Seaboard Air Line has ordered 28 caboose cars from the Magor Car Corporation.

The McMan Oil & Gas Co., Tulsa, Okla, has ordered 15 tank cars from the Standard Tank Car Company.

The Imperial Refining Company, Tulsa, Okla., has ordered 50 tank cars from the Standard Tank Car Company.

The Ford Motor Company has ordered 25 steel gondola cars of 70 tons' capacity from the Standard Steel Car Company.

The Louisiana & Arkansas has ordered 20 ballast cars from the American Car & Foundry Company.

The Atlantic Coast Line has ordered 50 ballast cars of 50 tons' capacity from the Rodger Ballast Car Company.

The Matheson Alkali Works, New York, has ordered from the Standard Steel Car Company 25 special cars for hauling chlorine.

The Chicago & Northern Western has ordered 40, 10,000 gal. capacity tank cars from the American Car & Foundry Company.

The Elgin, Joliet & Eastern has ordered 300 steel underframes from the Ryan Car Company and 200 from J. W. Heggie & Sons, Incorporated.

The Mexican Petroleum Company, New York City, has ordered 50 tank cars of 10,000 gal. capacity and 25 tank cars of 8,000 gal. capacity from the Standard Tank Car Company.

The Southern Carbon Company, Monroe, La., has ordered 25 tank cars from the Standard Tank Car Company.

Freight Car Repairs

The American Refrigerator Transit Company has ordered repairs to 200 refrigerator cars from the Koppel Car Repair Company, Koppel, Pa.

Machinery and Tools

The Chicago Great Western has placed an order for a car wheel borer.

The New York, Ontario & Western has placed an order for a car wheel borer.

The New York Central has placed an order for a journal turning axle lathe.

The St. Louis-San Francisco has placed an order for a 600-ton wheel press.

The Illinois Central has ordered one 150-ton wrecking crane from the Industrial Works.

The Atlantic Coast Line has ordered one 80-ton coach hoist from the Whiting Corporation.

The Central of Georgia has ordered one 150-ton wrecking crane from the Industrial Works.

The Pennsylvania has ordered one 30-ton locomotive crane from the McMyler Interstate Company.

The Chicago & North Western has ordered two electric turntable tractors from the Whiting Corporation.

The Atchison, Topeka & Santa Fe has ordered one 20-ton locomotive crane from the Browning Company.

The Wabash has placed orders for a car journal turning lathe, a car wheel borer, and a locomotive journal turning lathe.

The Chicago, Burlington & Quincy has ordered one, 25-ton electric traveling crane for use at Beardstown, Ill., from the Whiting Corporation.

The Southern Railway has placed orders for a 90-in. driving wheel lathe, a 600-ton wheel press, a 600-pound hammer, and a 100-ton bushing press.

The Southern Pacific has ordered three 25-ton locomotive cranes, one each from the Browning Company, the McMyler Interstate Company and the Industrial Works.

The Denver & Rio Grande Western has ordered four, 120-ton, six, 15-ton and four 10-ton electric traveling cranes and one, 100-ton transfer table for use at its Denver, Colo., and Salt Lake City, Utah, shops from the Whiting Corporation.

The Pennsylvania has recently purchased from the Westinghouse Electric & Manufacturing Company a 20,000 kv-a, turbine generator complete with condensers, auxiliaries, and switching equipment for installation in its Long Island City power house, which supplies power to the Pennsylvania tunnel and terminal electrification at New York. This is the fourth unit of this capacity that the Pennsylvania has purchased from the Westinghouse Company for this power house.

The Erie is installing a motor-driven air compressor at Susquehanna, Pa. Purchased electric power will replace the need for added boiler capacity. At present a steam-driven compressor with a capacity of 2,650 ft. per min. is supplying the requirements of the shop. This will be replaced by a synchronous motor-driven compressor with a capacity of 3,600 cu. ft. The steam unit will be sent to Hornell, N. Y., and a smaller steam-driven unit now in service at Hornell will be installed at Susquehanna as an emergency unit. A 13-panel switchboard is also being installed and underground cables laid between the switchboard and the power lines which bring power to the shops. The switchboard provides for the control of the motor-driven compressor, two motor generator sets, one of which is to be installed, and the various distribution feeders for shop power, light and electric welders. Growing shop requirements have made improved power facilities necessary and 220-volt alternating current, 220-volt direct current and 110-volt direct current is furnished to the shop. The work should be completed by the latter part of July.

Shops and Terminals

Ann Arbor.—This company will construct a new roundhouse and machine shop at Owosso, Mich.

New York Central.—This company will construct an additional car repair shop building at Adrian, Mich.

Chesapeake & Ohio.—This company will add a 100-ft. turntable, a water station and a cinder conveyor to its equipment at Taplin, W. Va.

Chicago, Burlington & Quincy.—This company has awarded a contract to G. A. Johnson & Sons, Chicago, for the construction of a machine shop at Beardstown, Ill.

Illinois Central.—This company has awarded a contract to the Ellington Miller Company, Chicago, for alterations to a turntable at Memphis, Tenn., which will cost $15,000.

St. Louis-San Francisco.—This company has awarded a contract to the Howlett Construction Company, Moline, Ill., for the erection of a 300-ton, reinforced concrete coaling station at East Thomas, Ala.

St. Louis-San Francisco.—This company will construct a 15-stall roundhouse and additional shop buildings at Monett, Mo., to cost approximately $500,000 to replace facilities recently destroyed by fire.

The Southern Pacific.—This company is constructing with its company forces a 16-stall roundhouse, machine shop, power house, car repair shed, mill building, oil house and an employees' building at Lafayette, La.

Atchison, Topeka & Santa Fe.—This company has authorized the construction of a 1,000-ton reinforced concrete coaling station at Argentine, Kan., and a 600-ton reinforced concrete coaling station at La Junta, Col.

Galveston, Harrisburg & San Antonio.—This company will construct an eight-stall addition to the roundhouse at El Paso, Tex., and will also erect an addition to the blacksmith shop, a washroom and a fuel oil station.

Washington Terminal.—This company has awarded a contract to the Ogle Construction Company, Chicago, for the construction of a 1,200-ton, five track, reinforced concrete coaling station with sanding facilities at Washington, D. C.

Illinois Central.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of an enginehouse at Central City, Ky.

The company has also authorized the construction of a 300-ton coaling station at Council Bluffs, Iowa, and a coal hoist with sanding facilities at East St. Louis, Ill., and water treating plants at Parkersburg, Iowa, Iowa Falls, Webster City and Marcus, and at Haldane, Ill., Dixon and Panola.

Pere Marquette.—This company, jointly with the Pennsylvania, has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 500-ton reinforced concrete, four-track, automatic electric coaling station at the new engine terminal at Twenty-first street, Detroit, Mich., reported in the March issue of the *Railway Mechanical Engineer* which will be used by both roads.

Chicago & North Western.—This company has awarded a contract to G. A. Johnson & Sons, Chicago, for the construction of a roundhouse at Casper, Wyo.

The company also has awarded a contract to the Ogle Construction Company, Chicago, for the construction of a 250-ton, reinforced concrete coaling station at Evansville, Wis., and two 600-ton, reinforced concrete coaling stations at the Chicago shops, Chicago, and has awarded a contract to the C. W. Gimbel Company for the construction of a 30-stall roundhouse, a machine and repair shop, a car foreman's shop and an ice house at Madison, Wis.

Missouri Pacific.—This company has authorized the construction of a new machine shop at Wichita, Kan., to cost $78,000, and the construction of a viaduct at Fourteenth street, St. Louis, Mo., which will cost $130,000. This company has also authorized the construction of necessary facilities for handling fuel oil for locomotives, including storage at large terminals and outlying supply stations, on the Arkansas, Louisiana and Memphis divisions, which will cost $350,000.

PERSONAL MENTION

General

S. B. Andrews has been appointed mechanical engineer of the Chesapeake & Ohio, succeeding J. J. Ewing, assigned to other duties.

J. A. Carmody has been appointed superintendent of electric equipment of the New York Central, succeeding C. H. Quereau, resigned. A. J. Clarkson has been appointed general inspector succeeding Mr. Carmody.

W. J. Tollerton, general mechanical superintendent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been given the title of general superintendent of motive power.

J. F. Long, master mechanic of the Baltimore & Ohio, with headquarters at Connellsville, Pa., has been appointed superintendent of motive power and machinery of the Los Angeles & Salt Lake with headquarters at Los Angeles, Cal., succeeding C. M. Hoffman, who has resigned.

C. F. Needham

Charles F. Needham, whose appointment as assistant to the general manager of the Canadian National with headquarters at Toronto, was announced in the April issue of the *Railway Mechanical Engineer* was born at London, Ont., on December 9, 1877. He entered railway service in July, 1898, with the Grand Trunk and held the positions of stenographer, head timekeeper, accountant, chief clerk, special assistant to the vice-president in charge of the motive power and car departments, assistant to the general superintendent of the motive power and car departments and as acting assistant to the operating manager. His early experience was in the maintenance of way department. He served for seven years in a divisional motive power department office and fourteen years in the system motive power department office. He then served for a brief period in the operating department and returned again to the motive power department. At the time of his appointment as assistant to the general manager of the Canadian National, Mr. Needham was serving as assistant to the general superintendent of the motive power and car departments of the Grand Trunk.

G. Durham, superintendent of motive power and cars of the Wheeling & Lake Erie, with headquarters at Cleveland, Ohio, has been appointed acting general manager, with the same headquarters, relieving S. Ennes, president and general manager, and who has given up the duties of general manager on account of ill health.

H. W. Ridgway, superintendent of motive power of the Colorado & Southern, with headquarters at Denver, Col., has been appointed assistant to the superintendent of motive power, Lines West, of the Chicago, Burlington & Quincy, with the same headquarters, with jurisdiction over the Denver shops.

F. W. Hankins, assistant chief of motive power of the Pennsylvania, with headquarters at Philadelphia, Pa., has been appointed general superintendent of motive power of the Central region, with headquarters at Pittsburgh, Pa., succeeding H. H. Maxfield, who has been appointed superintendent of motive power of the Southern division, with headquarters at Wilmington, Del.

G. B. Frahel, superintendent of motive power of the Central Ohio division of the Pennsylvania with headquarters at Columbus, Ohio, has been given jurisdiction over the Indiana division and will retain present headquarters, the offices of superintendent of motive power of the two divisions having been consolidated. J. E. Mechling, superintendent of motive power of the Indiana division, has been appointed special inspector in the office of the general superintendent of motive power with headquarters at St. Louis, Mo.

Amos C. Davis has been appointed assistant chief of motive power of the Pennsylvania with headquarters at Philadelphia, Pa. Mr. Davis was born on March 20, 1876, at Altoona, Pa. He was educated in public and private schools in Indiana County, Pa. His entire railroad service, dating from April 3, 1893, has been with the Pennsylvania, his first position being that of machinist apprentice at the Altoona shops. At the end of his apprenticeship he was employed as a machinist for about two years and was then made gang leader in the erecting shop. After several minor promotions he was appointed acting assistant master mechanic at Altoona on March 8, 1909, and on April 1, 1910, foreman of the miscellaneous shop. For five years, from July, 1912, to July, 1917, he was general foreman of the locomotive erecting shop at Altoona. On the latter date he was made general foreman at East Altoona, and in October of that year general foreman of the Altoona machine shop. On October 21, 1918, Mr. Davis was appointed master mechanic of the Maryland division, with headquarters at Wilmington, Del. Two years later he was appointed superintendent of motive power of the Southern division, which he held at the time of his recent promotion to the position of assistant chief of motive power.

A. C. Davis

C. K. Woods, whose promotion to assistant superintendent of motive power of the Pere Marquette, with headquarters at Detroit, Mich., was reported in the May issue of the *Railway Mechanical Engineer*, was born on January 14, 1868, at Uxbridge, Canada. He entered railway service in 1885, in the mechanical department of the Erie & Huron, a Canadian line. Mr. Woods was employed as a machinist in the shops of the Toledo Central & Western at Frankfort, Ind., in 1892, and was subsequently promoted to general foreman at the same place. He was appointed master mechanic of the Pere Marquette, with headquarters at Saginaw, Mich., in 1900, and served in this capacity for 18 years. In 1918, at the beginning of federal control, he was appointed supervisor of equipment, but upon the termination of federal operation in 1920, returned to his position as master mechanic at Saginaw. He was serving in this capacity at the time of his recent promotion to assistant superintendent of motive power, with headquarters at Detroit. The position which he now holds is one recently created.

C. K. Woods

S. J. Hungerford, vice-president of the Canadian National, has been appointed vice-president in charge of operation and maintenance of the entire system, into which the Grand Trunk has recently been consolidated. Mr. Hungerford was born on July 16, 1872, near Bedford, Que., and received a high school education. He entered railway service in 1886 as a machinist apprentice on the Canadian Pacific at Farnham, Que. From 1891 to 1897 he served as a machinist at various points in Quebec, Ontario and Vermont. From 1897 to 1900 he was assistant foreman at Farnham, Que. During the latter year he was promoted to locomotive foreman at Megantic, Que. From 1901 to 1903 he served in a similar capacity at Cranbrook, B. C. In 1903 he was appointed master mechanic at Calgary, Alta. In 1907 he was appointed superintendent of locomotive shops at Winnipeg. Seven years later he became superintendent of Western Lines of the Canadian Northern at Winnipeg. A month later he was appointed superintendent of rolling stock of the entire system with headquarters at Toronto. In 1917 he was advanced to general manager of the Eastern Lines with headquarters at Toronto. In 1918 he was appointed assistant vice-president of the Canadian National. In 1920 he was appointed vice-president in charge of operation, which position he now continues with the enlarged Canadian National system.

Master Mechanics and Road Foremen

F. R. Butts, general foreman on the Chicago, Burlington & Quincy, with headquarters at Kansas City, Mo., has been promoted to assistant master mechanic of the Beardstown division, with headquarters at Centralia, Ill.

R. H. Flynn, master mechanic of the Pennsylvania, with headquarters at Indianapolis, Ind., has been transferred to Columbus, Ohio, succeeding T. B. Farrington. W. R. Davis, assistant master mechanic, with headquarters at Wilmington, Del., has been promoted to master mechanic, with headquarters at Indianapolis, Ind., succeeding Mr. Flynn.

O. E. Ward, assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, with headquarters at Galesburg, Ill., has been promoted to master mechanic of the Alliance division, with headquarters at Alliance, Neb. H. H. Urbach, general foreman, with headquarters at Denver, Colo., has been promoted to assistant master mechanic of the Galesburg division, with headquarters at Galesburg, Ill., succeeding Mr. Ward.

Shop and Enginehouse

T. B. Farrington, master mechanic of the Pennsylvania, with headquarters at Columbus, Ohio, has been appointed assistant works manager of the Altoona shops at Altoona, Pa.

W. J. Hill has been appointed supervisor of work equipment of the Atchison, Topeka & Santa Fe, Eastern lines, with headquarters at Topeka, Kan., succeeding C. A. Braillier, who has been assigned to other duties.

Car Department

George Edward Smart, whose appointment as chief of car equipment of the Canadian National with headquarters at Montreal was announced in the April issue of the *Railway Mechanical Engineer*, was born in Edinburgh, Scotland, and entered railway service in August, 1892, in the car department of the Grand Trunk. He held various positions in this department and in 1904 was appointed general inspector of heating and lighting on the Canadian Pacific. In 1906 he was promoted to general car inspector and three years later to divisional car foreman of the Eastern lines of the Canadian Pacific Railway. In October, 1913, he was appointed master car builder of the Canadian Government Railways and five years later he was appointed superintendent of the car department. In 1919 he was appointed general master car builder of the Canadian National and in 1920 to mechanical assistant to the vice-president, which latter position he held until the time of his recent promotion.

Purchasing and Stores

A. V. B. Gilbert has been appointed purchasing agent of the Atlanta, Birmingham & Atlantic with headquarters at Atlanta, Ga., succeeding A. D. Daniel, promoted.

C. N. Davids, who served for 35 years as purchasing agent of the Colorado Midland and later as purchasing agent of the Denver & Salt Lake, died on May 3 at Alamosa, Col.

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Erecting Shop Competition Award

THE results of the erecting shop competition were highly satisfactory and proved beyond a shadow of doubt that the importance of this department of railroad shop work is fully appreciated. It was also demonstrated that erecting shop men and those interested in this department are amply capable of expressing themselves regarding its needs and possibilities when the occasion demands. In all, ten contributions of merit were received. The first prize of $50 was awarded to M. H. Westbrook, shop superintendent, Grand Trunk, Battle Creek, Mich., and the second prize of $35 to H. C. Venter, general foreman locomotive shop, Southern Pacific, Sacramento, Cal. Practically all of the contributions contained constructive suggestions but particular mention should be made of two articles in view of the evident time and care taken in their preparation. These two were submitted by Charles Raitt, Atchison, Topeka & Santa Fe, Prescott, Ariz., and S. P. Kennedy, Pittsburgh, Pa. It is proposed to publish Mr. Westbrook's article in the August *Railway Mechanical Engineer.* Mr. Venter's article and the others will be published in later issues so that interest in this subject will not be allowed to lag. Erecting shop men are to be congratulated upon the way in which they have taken hold of this competition and submitted information regarding many labor-saving methods, jigs and devices which will unquestionably speed up the work of this department.

Shop Management Competition

BECAUSE of the time limitations few members were able to take part in the discussion on "Shop Management Problems of Today" at the Mechanical Division meeting, but those who did, spoke right to the point. Many of those who followed the three-days' proceedings critically felt that in some respects it marked the high spot of the conference. Mr. Demarest's remarks were particularly appreciated: he paid little attention to the physical factors involved, but placed special emphasis upon the importance of the human element. It is good to see the Mechanical Division taking up and emphasizing the importance of management problems. It has not given *too much* attention to standards and such details, but rather entirely *too little* to those things which concern the management of men. This new development in the efforts of the association should appeal with special force to the readers of the *Railway Mechanical Engineer,* for it and its predecessors have consistently tried to develop and emphasize the question of human relationships on the railroads and particularly in the mechanical department. How can an officer or foreman get the best results in dealing with or directing those under him? The principles of successful management have been emphasized time and time again in these days of intense production and industrial activity—emphasized so much that they have perhaps become more or less trite and commonplace. But have they been applied as they should be?

The *Railway Mechanical Engineer* is deeply interested in this entire question because it believes that the best interests of the public, the men, the management and the investors can only be secured when the men and the management co-operate heartily and enthusiastically to give the public the best and the most efficient service. Moreover, it does not believe that the interests of the men and the management are so diverse that they cannot thus co-operate and that they must struggle continually one with the other—incidentally, to the loss of all of the factors involved, because friction spells inefficiency and waste, and one element in the combination cannot long profit at the expense of the others.

We want to know practical ways in which the principles of successful management can be applied. What has been your experience? How in your opinion can a shop or gang be best managed—operated to secure the most complete and hearty co-operation from the men and with the least loss in friction or waste? What have you done to build up the morale of your gang or shop? How can you get the best results in dealing with the men under you? For the most practical and constructive articles on any phase of this question of making management more effective and efficient, received before September 15, 1923, we will give a first prize of $75 and a second prize of $50. There are no limitations as to the number of words; generally speaking we would suggest not more than 1,200, but the length of the article is unimportant as compared to the value of the practical suggestions contained in it. Moreover, while we appreciate the use of good English, that is a secondary consideration; we shall be glad to edit the articles for publication if the material is really worth while. Articles, other than those awarded prizes and which may be used, will be paid for at space rates.

Combatting Corrosion of Steel Cars

IN its report on the standard car, the Committee on Car Construction has taken important action on the question of corrosion which, however, was scarcely mentioned in the discussion. The specifications state that "all steel plates 1/4 in. or less in thickness, pressed parts made therefrom and channel side sills shall include a content of copper of not less than 0.20 per cent." This would require the use of copper bearing steel in practically all of the members of the car body except the underframe. Copper steel has been under test for some time and has shown much higher resistance to corrosion than ordinary steel wherever it has been tried. The American Society for Testing Materials has had various types of iron and steel exposed in Pittsburgh, Annapolis and Ft. Sheridan and has carefully studied the rate of corrosion in different materials. In this test copper steel has shown the best results. Several instances of long life obtained from steel with a small percentage of copper were given in an article entitled "Reducing Corrosion in Steel Cars," by J. J. Tatum.

The use of a small content of copper to retard corrosion has the advantage that it adds little to the cost of the equipment. It seems the most promising material available for reducing the enormous losses now suffered because of rapid rusting in steel cars. The increase in the life of equipment that will be obtained by using copper steel can only be determined after it has been in service for several years. However, the fact that the Car Construction Committee, which is representative of the most important railroads of the country, has specified this material indicates that the mechanical department officers regard the experience already obtained as sufficiently convincing to justify the use of copper steel on a large scale.

Locomotive Shop Schedule

ONE of the interesting features of this issue is the first installment of an article describing a new locomotive shop scheduling system now being installed at the Silvis shops of the Chicago, Rock Island & Pacific. This system differs from most schedule systems in railroad shops in that it is intended to provide not only centralized control of production and a well-balanced shop organization but accurate data for cost control as well. Both of these factors are essential to efficient shop operation and it seems logical to combine them in a single system. The new shop schedule at Silvis is similar in many respects to the combined schedule and cost systems used in many manufacturing plants and marks the most pretentious effort yet made along these lines in railroad shops. Its installation and the results accomplished by it will be described in future issues of the *Railway Mechanical Engineer.*

The Apprentice Question

ONE of the high spots in the Mechanical Division meeting at Chicago was the individual paper by John Purcell of the Santa Fe, on training mechanical department apprentices, and the discussion which followed its presentation. Is it not true that there has been entirely too much "buck passing" on this matter in the past? There has been no question, for instance, about the necessity for highly skilled mechanics on the railroads and in the industries. Apprenticeship, however, in some industries and on some railroads is more or less of a joke. Apprentice systems have been maintained but have been directed in a haphazard sort of way; in only a comparatively few cases have comprehensive training systems been developed, carefully planned to meet the existing conditions and taking advantage of the best methods and practices which have been developed. Too many railroads have said, "Why should we go to a lot of extra expense and effort to develop skilled workers for other railroads and other industries?" In other words, they did not want to go into the proposition unless everybody else did the same thing. This, of course, is an extremely selfish point of view and is largely responsible for the great shortage of skilled labor in industry today.

Fortunately, the shoe has begun to pinch so hard that there seems to be a more or less general movement toward the adoption of modern apprenticeship plans, such as advocated by the Santa Fe and a number of other progressive roads. The indications are that during the coming year we may expect a great advance in the application of the best modern apprenticeship methods on many roads. Mr. Purcell's summing up of the results which have been obtained on the Santa Fe is well worth careful consideration and study on the part of all who are interested in this matter.

The perennial question of special apprentices is once again coming to the forefront. Several roads are now taking on a considerable number of college graduates with the hope of giving them a practical training and welding them into the organization. A good share of the discussion of Mr. Purcell's paper related to the use of college men by the railroads. Regardless of the pros and cons of the discussion on this subject, it must not be forgotten that some of the strongest leaders in the development of the mechanical departments of the railroads of this country have been technically trained men; moreover, as the scope and responsibilities of the department have widened, the demand for such men has been growing stronger and stronger.

It may be profitable to find just what reactions the apprentices themselves have toward the different methods of training which are used. After all, unless they themselves appreciate the efforts that are being made to train them and take a real interest in their work, little in the way of fruitful results can be expected. Is it not true, also, that frequently we assume that the boys are looking at things in a certain way, when as an actual fact their ideas are radically different from what may have been anticipated? Is it not logical to suppose that a study of their frank reactions will be very helpful in suggesting ways and means of making the apprentice training methods more effective? It was for these reasons that the *Railway Mechanical Engineer* last month announced two competitions, to close September 1, 1923. First and second prizes of $35 and $25 were offered for the best articles received from regular apprentices now in service, these prizes to be awarded on the basis of the practical value of the observations or suggestions in their contributions. Another competition with first and second prizes of the same amounts was offered to college men who are now serving either as regular or special apprentices, for their comments on the opportunities which are being offered to them by the railroads and how the railroads can make the best use of their services; these papers to be judged on the practical value of the suggestions and criticisms. While no limit is placed on the length of the contributions in these competitions it is suggested that they contain not more than one thousand words.

Enginehouse Crane Facilities

ONE of the important features of enginehouse design referred to by the committee on that subject is the provision of cranes for handling increasingly heavy locomotive parts. If 21 out of 42 roads, as reported, use no mechanical hoisting devices at all in enginehouses and only five of the total number use power trucks, the general need of greater facilities for handling heavy driving wheels, rods, air compressors, etc., can be readily appreciated. Owing to relatively high first cost, overheard traveling cranes are more or less limited to large terminals handling heavy repairs and in these installations the recent tendency has been to segregate heavy repair work at a few stalls or pits served by the traveling crane rather than have the crane extend over all the pits. Jib cranes and mono-rail hoists have their respective fields of usefulness. In the case of the latter, the rails should be laid out so that "spotting" a locomotive in order that the hoist may reach the required parts will be unnecessary. Experience bears out the statement of the committee that "unwheeling hoists will prove economical where all drivers are to be dropped and work done on them." Tractors are mentioned in the report, but the committee seems to have omitted reference to one of the most important time and labor-saving devices recently adapted to enginehouse use—the power crane truck. Storage battery trucks with power-operated radial lift arms have been installed for a sufficient period in many enginehouses throughout the country to demonstrate their great value in saving time and labor. They are used not only in removing and applying heavy locomotive parts but in transporting these parts about the enginehouse, machine shop and storehouse with a minimum of manual labor. Air compressors, for example, can be applied with ease using the radial lift arm as compared to chain falls and brute strength. These trucks are now furnished with sufficient capacity to lift parts weighing 3,000 lb. or less 12 ft. above the floor, and the operating speed under full load is about 400 ft. per min. In connection with power crane trucks an important adjunct is a smooth, hard floor in the enginehouse and passageways to the machine shop and storehouse. The trucks are powerful enough to negotiate rough floors, but results are much more satisfactory with smooth flooring.

Mechanical Officers Have Most to Gain

In their addresses before the Mechanical Division convention at Chicago, June 20 to 22, both W. B. Storey, president of the Atchison, Topeka & Santa Fe, and C. H. Markham, president of the Illinois Central, laid particular emphasis on the need that every officer take an active part in the efforts of the railroads to bring about a better public understanding of the railroad problem. Mr. Markham, furthermore, referred specifically to the fact that the extent to which capital will probably be available for needed facilities, is likely to depend on the extent to which such an understanding is effected. In this respect the officers of no departments have a greater interest in effecting a satisfactory solution of the railroad problem, whereby the return on the capital invested in the railroads will be sufficient to restore their credit for liberal supplies of new capital, than those of the mechanical department. Speaking of the railroads as a whole, probably no department is so generally under-supplied with facilities or has its much-needed appropriations stricken from the budget as frequently as does the mechanical department. And, contrary to the opinion quite frequently held by mechanical department sufferers, this is not entirely due to a failure to appreciate the opportunities for the productive use of capital in this department, but is the result of necessity when the amount of capital obtainable will do no more than supply the equipment needed for direct use in satisfying the demands of the public. The officers of no department, therefore, have a more direct interest in obtaining fair treatment for the railroads from the public, as it is only through such treatment that the mechanical departments are likely to be in a position to secure the appropriations much needed for reducing the cost of its operations.

The Mechanical Division Meeting

The mechanical officers of the railroads have reason to be proud of the meeting which the Mechanical Division of the American Railway Association held last month in Chicago. The three-day session was crowded with reports and papers of exceptional interest and value and a record of accomplishments was made which compares favorably with any previous convention. In this issue of the *Railway Mechanical Engineer* will be found a very complete report of the proceedings. It deserves careful study because every man in the mechanical department will find in it many ideas that he can profitably apply in his daily work. It would be futile to try to list the high spots of the meeting. Mechanical work is so many-sided that each man must find them for himself. However, there are some rather unusual features of the meeting which deserve special emphasis.

The Executive's Viewpoint

Modern railroads are enormous organizations spread over a wide area and extremely complicated in operation. Some employ more than 100,000 men and have monthly revenues in excess of fifty million dollars. The mind can scarcely grasp the ramifications of such a system. Under the circumstances it is natural that there should be a tendency for railroad employees to acquire a local or departmental point of view. The addresses of Mr. Aishton, Mr. Atterbury, Mr. Markham and Mr. Storey strike a note that has seldom been sounded at previous conventions. They give a well-rounded presentation of the way in which the mechanical department officer can best function as a part of the great North American transportation system.

It is interesting to notice the reiteration of the part railroad men can take in molding an enlightened public opinion on the railroad question. Manufacturers and storekeepers have many points of contact with the people in their communities. Through Chambers of Commerce and another business organization, they make their influence felt. Railroad men may well follow their example. No railroad officer should adopt the attitude that his company's relations with the public can be handled entirely by the traffic department. There is a real message for the mechanical officer in the appeal of the executive for help in bringing about a better understanding of the railroad question.

Getting Results from What You Have

The Mechanical Division of the American Railway Association has sometimes been regarded primarily as a standardizing organization. This is, of course, an important branch of its work but the primary function of the mechanical department officer is to operate the existing facilities with a maximum efficiency and economy. Probably more attention was given to questions of this nature than at any previous convention. The discussion on increasing the mileage of locomotives and on the management of shops and repair tracks are examples of the good work which the Division can do in disseminating information regarding approved methods.

More Important Than Mechanical Appliances

The experience of the past few years has directed attention very forcefully on the relations between the management and the employees, as was thoroughly indicated by the numerous references to the human element. The paper by Mr. Purcell and the discussion which followed its presentation show how effective apprentice training courses, consistently carried on, can be in solving some of the most troublesome personnel problems that the railroads are facing. Other phases of employee relations were discussed by General Atterbury, Mr. Demarest and Mr. Goodnow. One of the points that was emphasized particularly was the importance of the foreman and the necessity for training men in such positions. It would seem that the Mechanical Division might well carry on the good work which it has done this year on the personnel question by discussing next year the problem of selecting and training foremen.

The Car Construction Report

The action of the Mechanical Division in voting to submit the report of the Car Construction Committee, embodying designs of standard box cars, to letter ballot no doubt marks one of the final steps toward the adoption of standard box cars. This movement was started before this country entered the war and the final design is the outcome of many years of careful study. The standard designs overcome many of the objections that have been offered in the past. They provide a flexible construction which retains interchangeability of parts but permits the use of any satisfactory alternates and allows considerable latitude in detail design. In its present form the standard car will probably prove satisfactory to the great majority of roads. The complete designs prepared by the committee are intended to give the best practical combination of maximum strength with minimum weight. Many of the details are new and it is probable that some changes will be found desirable when the cars are in actual service. On the whole, it would seem that the committee has succeeded very well in developing a car that will give the minimum over-all operating cost and has avoided the disadvantages of standardization, though obtaining all its practical benefits.

What Our Readers Think

Influence of Copper on Corrosion of Steel

Calcutta, India.

To the Editor:

The writer was interested to notice in a recent issue of the *Railway Mechanical Engineer* that American engineers were now frequently specifying that copper-bearing steel shall be used for roofs of rolling stock, and also for such parts of freight cars as come into contact with the lading. The publication of the results obtained from this policy would be of the greatest interest to railway engineers all over the world.

The usual practice in the case of steel construction in India is to use steel paneling as follows:—16 S.W.G. (0.065 in. thick) for coaching or passenger stock and 12 S.W.G. (0.109 in. thick) for freight or goods stock. Roof plates for goods stock are of steel 10 ft. 10⅞ in. by 4 ft. 5¾ in. by 2½ lb. The plates are rolled from steel made by either the acid or basic open-hearth process.

It is found that such paneling and sides to passenger vehicles may become completely corroded through in from three to ten years, the corrosion occurring in the region of the bottom sills and also to a lesser extent along the moldings. The corrosion invariably occurs from the inside outwards and up to the present no means have been devised to stop this.

It should be remembered in this connection that passenger stock in India is provided with lifting or dropping window sashes and shutters, while in some cases lifting wire gauze screens are also provided. These special arrangements are of course the outcome of local conditions and climate. Unfortunately their provision allows an easy ingress of water and damp to the inner sides of the paneling. Even in the dry seasons the trouble still exists through the ingress of water used for washing down the cars. With the fixed windows usual in most other countries, this trouble does not exist and the life of paneling is correspondingly increased.

The existing tendency is to panel the sides with small size match-boarding, a practice found to be both convenient for repairs and economical in the saw mills. The main disadvantage is that under the trying climatic conditions of this country, it is difficult to maintain the paintwork in first class condition owing to the multiplicity of joints in the match-boarding.

With regard to freight cars in India, the whole of the modern stock is completely of steel construction. Very little trouble is experienced with the roofs, but corrosion takes place along the bottoms of the vertical panels, reducing their life to about ten years.

In view of the immense importance of this subject of corrosion, the following points, which have been taken from a recent paper read by Sir Robert Hadfield before the Institution of Civil Engineers, London, may be of interest.

The subject of the paper was the preparation and description of various ferrous metals used in an elaborate research into the deterioration of structures exposed to sea action, including some general considerations on the subject of corrosion. The paper is profusely illustrated with microphotographs and contains information of great general interest to engineers. The results of the research are being awaited with great interest by engineers in England.

Sir Robert Hadfield points out the probable importance of proper heat treatment of all ferrous alloys, even in the case of the wrought irons and low carbon steels, and the data supplied in this connection alone is of considerable value.

In the second portion of his paper, the author refers briefly to the current theories on corrosion, and then goes on to review the position regarding the influence of copper on steel.

Briefly, the position is that, although several investigations have been made on the subject, the fact that copper has some beneficial effect upon iron has not yet been fully substantiated. D. M. Buck of Pittsburgh has come to the conclusion from a long series of careful experiments that 0.25 per cent of copper improves the resistant properties of steel to corrosion in air. Dr. S. L. Hoyt of Minneapolis has come to the conclusion that the best material for sheeting should contain 0.20-0.25 per cent of copper. Dr. Cushman of Washington as a result of special study on the subject considers that copper in small quantities has a tendency to reduce corrosion in an acid atmosphere. On the other hand, he finds that under certain conditions, such as immersion in waters, either acidic or alkaline, the presence of copper appears to be either of no value or positively detrimental.

Inspired very largely by these American investigations, the Germans carried out a similar research, extending even during the war period. Owing to the fact that the German ores contain small proportions of copper which occur in the manufactured steels, they had a special incentive for arriving at some conclusion in this connection. However, it was found that the effect of copper depended largely upon the conditions of exposure while in most cases its influence was uncertain. In certain other respects they found themselves unable to confirm the results arrived at by other experimenters.

In his summing up, Sir Robert Hadfield says " . . . it is considered from the investigation that the addition of copper to steel for the purpose of preventing or mitigating corrosion would not generally be advisable."

The position is undoubtedly obscure, but under certain conditions of atmospheric exposure, there would appear to be a general tendency towards crediting small admixtures of copper with some beneficial effect. For the enterprise of the American engineers who have done and are doing so much to unravel this difficult problem, English and other engineers will feel indebted and it is sincerely hoped that these efforts may be rewarded by a success commensurate with the time and money expended.

R. C. Case,
Indian State Railways.

New Books

Steam Power. *By C. F. Hirshfield and T. C. Ulbricht, 474 pages, 5¼ in. by 7½ in., 252 illustrations, bound in cloth. Published by John Wiley & Sons, New York.*

The first edition of this book was printed in 1916. The second edition, now issued, has been revised carefully and considerable new matter included. It was written primarily as a text book for students in technical schools and being of an elementary character, will be found to be of particular value to operators of power plants and others who do not wish to go fully into details of theory or thermodynamics. No mathematics higher than elementary geometry are used in the text and only a sufficient amount of physics to make the subject clear. Descriptions are given of condensing and non-condensing reciprocating engines of various types, including simple, compound and una-flow. There are chapters on valve gear, regulation, indicator and entropy diagrams. Other subjects covered are turbines, condensers and auxiliary equipment. Steam boiler fuels and combustion are also taken up. A few steam tables and a well-prepared index complete this short, but well-written book.

The Booster-Equipped Locomotive and the D. & H. Dynamometer Car

Tender Booster Increases Tonnage 31 Per Cent

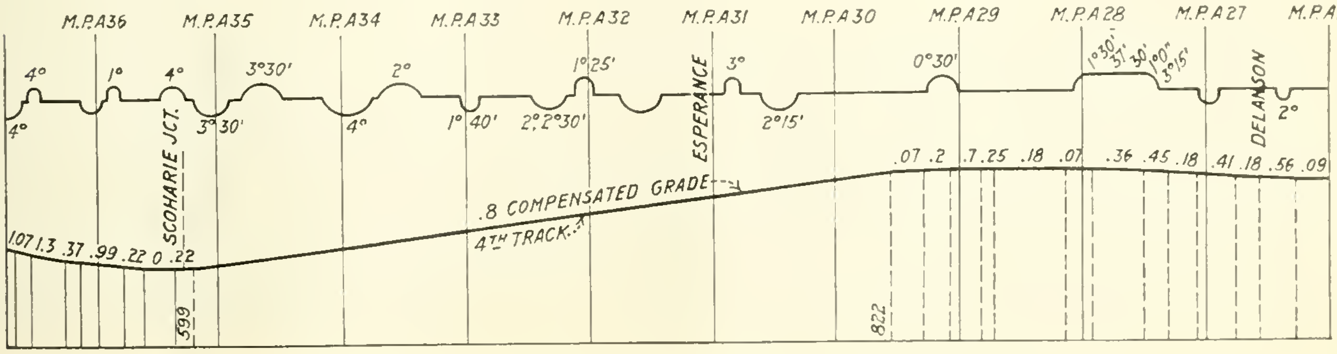
Delaware & Hudson Demonstrates Hauling Capacity of Consolidation Locomotive Equipped with This Device

A REMARKABLE demonstration of the ability of the M & L tender booster to increase the tonnage which a locomotive can haul was given on the Delaware & Hudson on June 5. On that day a Consolidation locomotive equipped with the booster took a train 31 per cent in excess of the standard rating up a 0.8 per cent grade nearly six miles long. This heavy train was stopped on the grade and could not be started by the locomotive alone. When the booster was thrown in, the train began to move at once and was accelerated quickly to a speed of seven miles an hour. The booster used in the test is similar in general to the first design, which was described and illustrated in the *Railway Age* of July 22, 1922, page 145.

The demonstration was conducted between Scoharie Junction and Delason and was watched by about 60 representatives of railroads and supply companies. The profile of the track on which the test train ran is shown in one of the drawings. It has a long grade of 0.8 per cent, compensated, from JX tower, about mile post 35.1, to mile post 29.5. The train consisted of a superheated Consolidation locomotive, No. 901, equipped with the M & L type B tender booster, the Delaware & Hudson dynamometer car and 35 loaded freight cars. The total weight of the train, including the dynamometer car, was 2,260 actual tons, or 2,476 adjusted tons. The weights and dimensions of the locomotive are given in Table I.

The demonstration run was made with the test train on the fourth track, which has a very uniform grade. To give the spectators an opportunity to watch the performance of the locomotive and the booster a special train with flat cars equipped for observation purposes was run on a parallel track alongside the locomotive. The test train started at JX tower and with the booster thrown in moved steadily up the grade

The Test Train Pulling Up the Grade with the Train for Observers Beside It



Profile of Track on Which the Test Run of the Tender Booster Was Made at a speed of about 7½ miles an hour. At about mile post 33 the booster was thrown out and in three times while the locomotive was moving at about 8 miles an hour, to demonstrate the operation of the booster control mechanism. The train was stopped at mile post 30.26 at 11:01. Practically the entire train was standing on a 2 deg. 15 min. curve, the locomotive having just passed onto the tangent. With the booster cut out several attempts were made to start the train, but although the steam pressure was at the maximum, the main engines alone could not overcome the resistance at this point. When the booster was thrown in, the train immediately started and accelerated to 7 miles per hour in about 660 ft., this speed being maintained with little variation to the top of the grade.

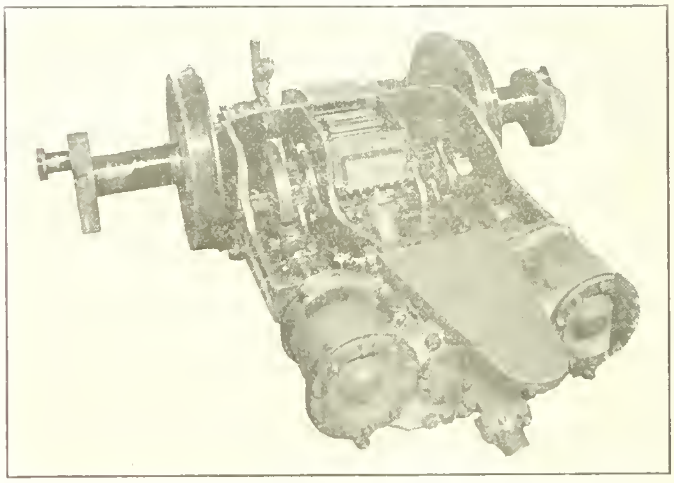
TABLE I

Weights, Dimensions and Factors of Locomotive No. 901

Type of locomotive	Consolidation
Cylinders, diameter and stroke	21½ in. by 30 in.
Valve gear, type	Stephenson
Weights in working order:	
On drivers	183,150 lb.
On front truck	24,000 lb.
Total engine	207,150
Tender loaded	157,067
Tender empty	88,400
Wheels, diameter outside tires:	
Driving	57 in.
Front truck	30 in.
Tender	36 in.
Boiler:	
Type	Wooten
Steam pressure	215 lb.
Diameter, first ring, inside	73 in.
Firebox, length and width	120¼ in. by 108¼ in.
Tubes, number and diameter	210—2 in.
Flues, number and diameter	30—5⅜ in.
Length over tube sheets	14 ft. 0 in.
Grate area	90.1 sq. ft.
Heating surface:	
Firebox	227 sq. ft.
Tubes and flues	3,116 sq. ft.
Total evaporative	3,343 sq. ft.
Superheating	471 sq. ft.
Comb. evaporative and superheating	3,814 sq. ft.
Tender:	
Style	Rectangular
Water capacity	9,000 gal.
Fuel capacity	14 tons
Rated tractive force, 85 per cent	42,100
Cylinder horsepower (Cole)	1,628
Boiler horsepower (Cole) (est.)	1,655
Weight on drivers ÷ tractive force	4.35
Boiler horsepower ÷ cylinder horsepower, per cent	102

One of the illustrations is a reproduction of the dynamometer chart at this section of the run. It will be noted that the combined tractive force of the locomotive and the tender booster was over 50,000 lb. The locomotive was fired with a mixture of anthracite and bituminous coal and throughout the run the steam pressure remained quite uniform at about 210 lb. A gage was connected to the steam chest of the booster engine and from a comparison with the gage on the locomotive boiler, no drop in pressure was perceptible. The steam temperature was about 650 deg. on the locomotive and 610 deg. on the booster.

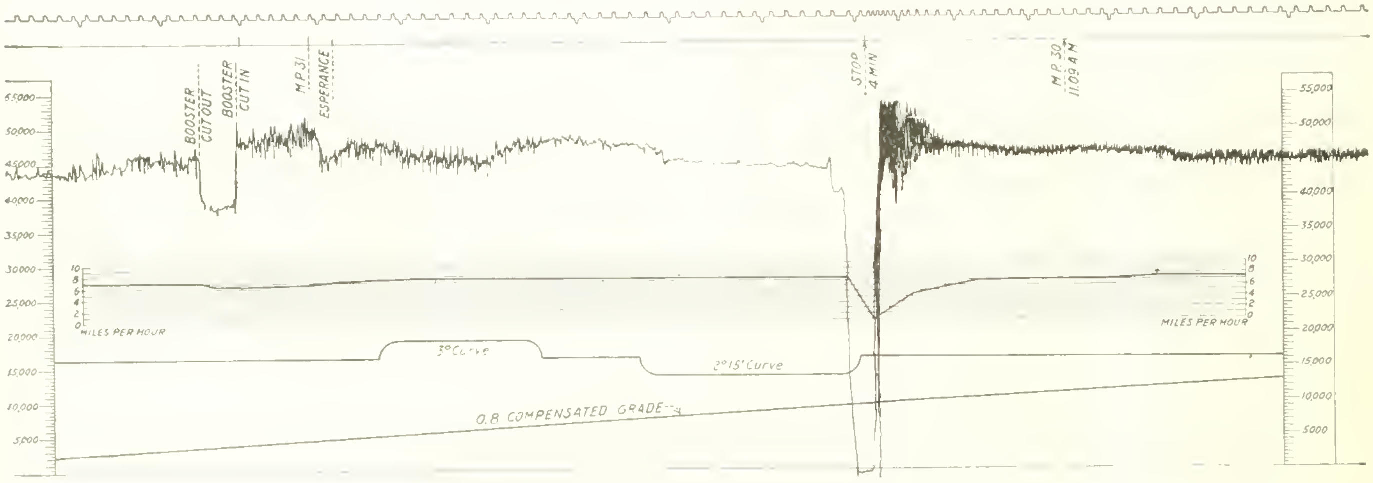
Near the left end of the dynamometer record will be noted one point where the booster was cut out and again thrown in. The sharp falling off of the tractive force and the immediate decrease in speed are convincing evidence of the work done by the booster. The chart shows the tractive force of the booster at a speed of about 7 miles an hour is about 10,000 lb.



The Booster Engine with Crank Case and Gear Covers Removed

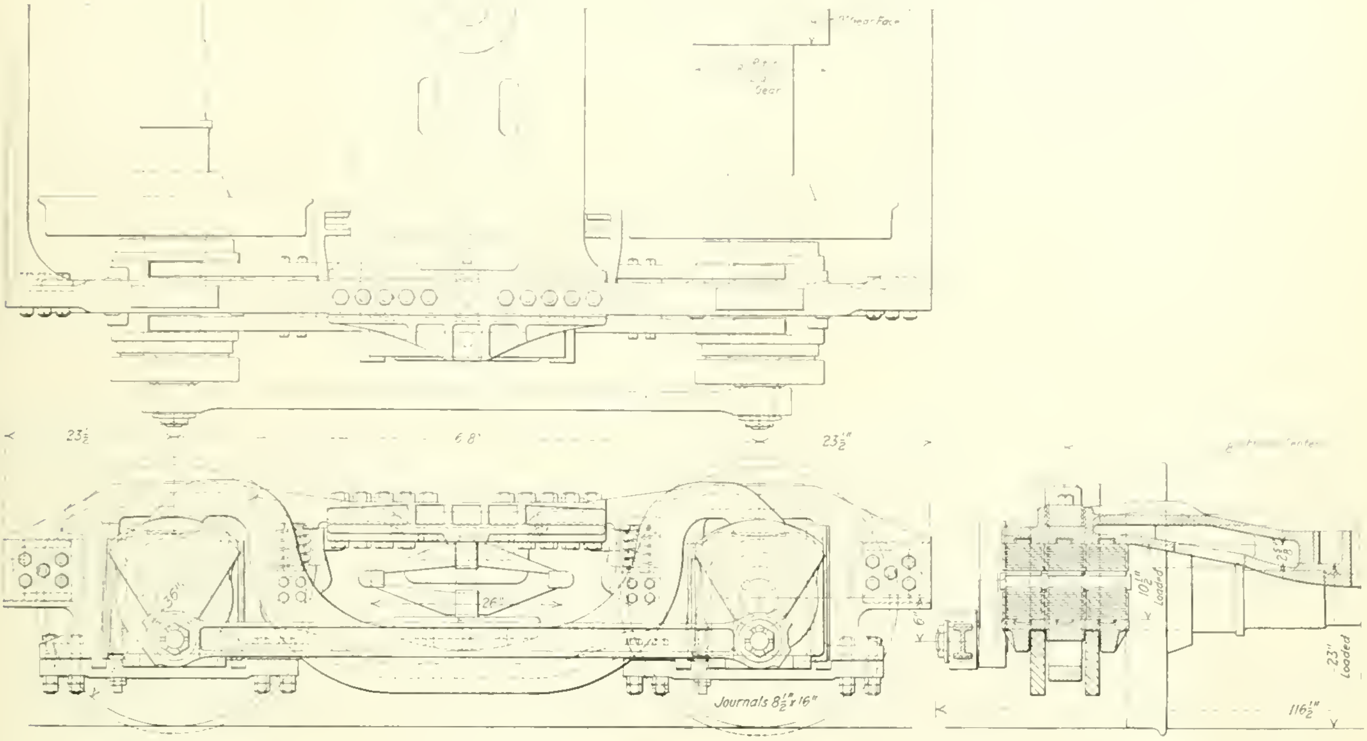
The construction of the booster differs little from the earlier design described in the previous article in the *Railway Age*. The principal modification is in the size of the cylinders which are now 12 in. diameter by 10 in. stroke. The rated tractive force for the Type B design with 12 in. by 10 in. cylinders, 70 per cent cut-off and 36-in. wheels, is as follows: 185 lb. steam pressure, 13,300 lb.; 200 lb. steam pressure, 14,400 lb.; 210 lb. steam pressure, 15,100 lb. The weight of the booster with its truck is 28,000 lb.

The engine with its control and transmission is hung from a three-point suspension on the axles and is geared to the rear axle with a ratio of 2.25 to 1. The idler gear is carried in a cast-steel frame rotating about the engine shaft and is thrown into engagement with the gear on the axle by a small steam cylinder. The gear on the main shaft and the idler gear are both 8 in. in diameter with 10 in. face while the driving gear on the axle is 18 in. in diameter, 10 in. face.



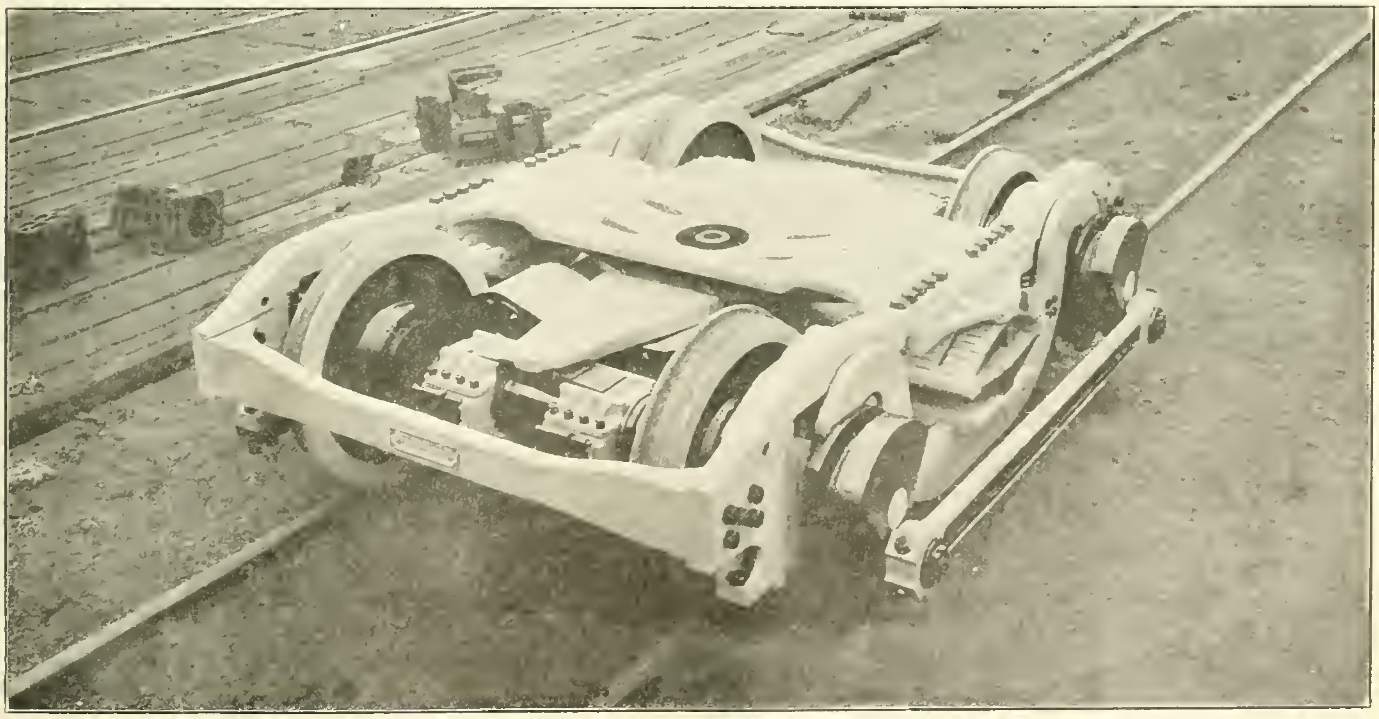
A Section of the Dynamometer Chart of the Test Run

The gears are enclosed in a separate compartment and run in soft grease. The clutch cylinder is separated from the main frame except at the point where it is supported, to prevent the steam from heating the oil which lubricates the booster mechanism. The connecting rods, crossheads and bearings are lubricated by a splash system. A scoop is attached to the counterweight inside the crank case and as the engine revolves, this throws oil into a pan from which it runs through pipes to the main bearings and the eccentric. There is also a scoop on the bottom of the connecting rods which lubricates the crank bearings.



Assembly Drawing of Truck Used with the M. & L. Booster

No change has been made in the steam supply, which is taken from the main locomotive steam pipes and is controlled by an air-operated valve which is opened or closed by an air valve in the cab. To obtain the necessary flexibility in the steam connections between the engine and tender and also between the tender frame and the booster, Barco joints are used. The steam line from the locomotive to the booster is 3-in. pipe



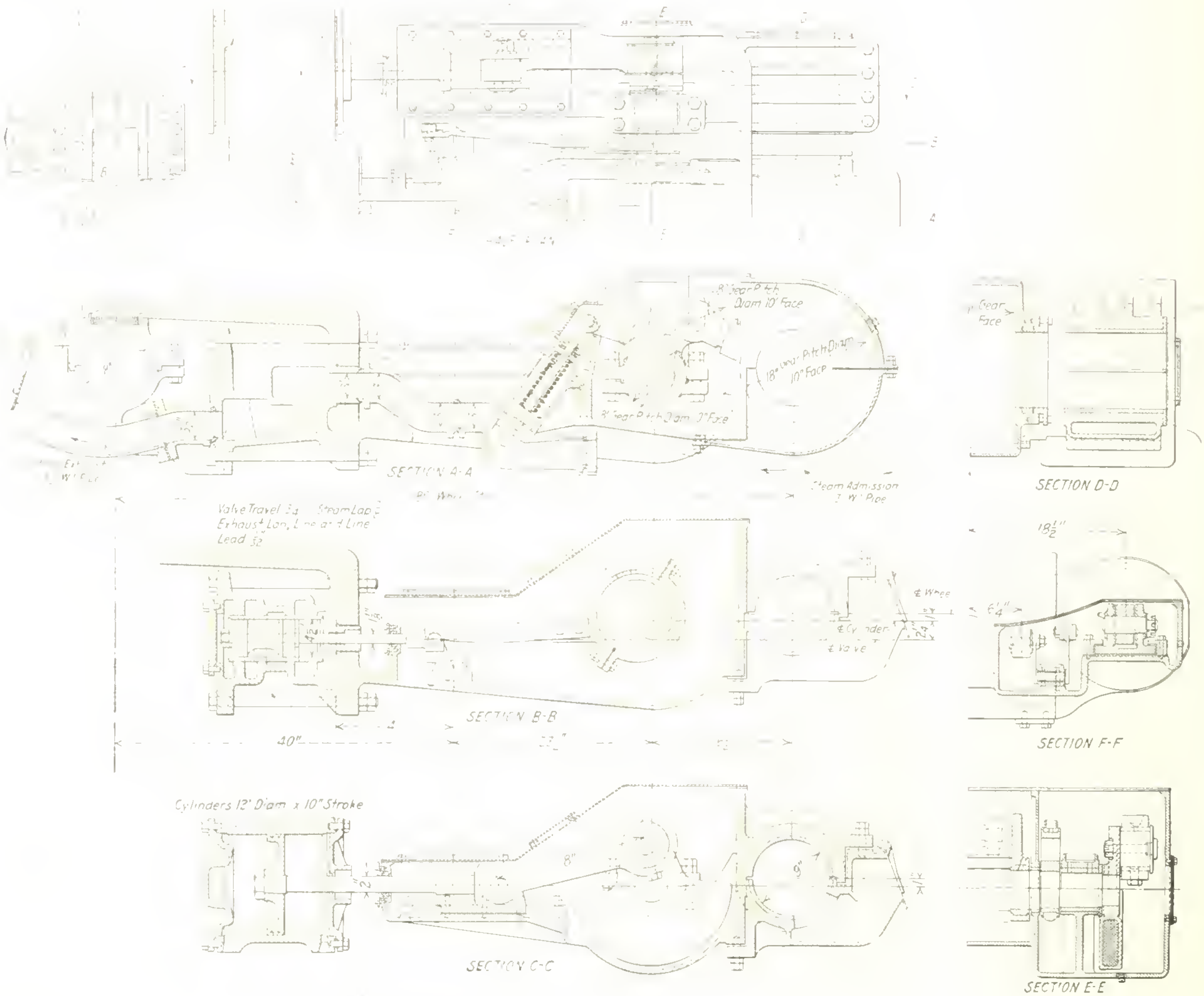
The M. & L. Type B Tender Booster

with a steam trap just ahead of the booster engine. For the exhaust, 3½-in. pipe is used which is curved upward and exhausts into a vertical pipe through the tender tank. Plans are now being made to apply a feedwater heater to utilize the exhaust steam.

One of the principal features of the M & L booster is the simple and positive control mechanism. As will be noted from the drawing, the steam from the locomotive passes to the clutch cylinder before it reaches the booster engine. The steam passages are so arranged that the gears must be in mesh before any considerable amount of steam can reach the booster cylinders. Since the clutch piston controls both the meshing of the gears and the admission of steam to the booster cylinders, the successive operations in throwing the booster into action must necessarily take place in a definite sequence and for that reason the device can be engaged at any reasonable speed without danger of damaging the mechanism. When the steam supply to the booster is shut off, a spring on the upper side of the clutch piston throws the gears out of mesh.

The truck to which the booster is applied is of the pedestal type with a cast steel frame with such modifications as were found desirable to facilitate the booster application. The wheels are 36 in. in diameter with centers 80 in. apart. Power is transmitted from the rear to the front axle by side rods mounted on cranks placed at a radius of 6 in. from the center. The stresses in the side rods are low even at relatively high speed. The forces acting at the crank pin and the centrifugal force at 12 miles per hour cause a combined stress of 5,132 lb. per sq. in. At 60 miles an hour the maximum stress due to centrifugal force alone is 9,100 lb. As the locomotive builder's specifications for side rods call for material with a tensile strength of 90,000 lb. per sq. in. the factor of safety is ample.

The M & L tender booster is intended for use in freight service and is especially valuable on divisions with short ruling grades. It makes it possible to increase the tonnage of freight trains without the expense of reducing grades or strengthening rails and bridges and also eliminates the need for helper engines. Incidental benefits resulting from the use of the tender booster are reduced stresses on draft gear and equipment and more rapid acceleration. It also largely eliminates slipping and consequently reduces rail wear and tire wear. The Delaware & Hudson is planning to apply the tender booster to a considerable number of locomotives. The first to be equipped are Consolidation locomotives with 31,000 lb. tractive force, known in the railroad company's designation as Class E2. These locomotives are used in branch line service and by applying boosters the railroad will be able to increase tonnage on these lines and avoid a large expenditure for stronger bridges which would otherwise be necessary to accomplish the same object.



Plan and Sectional Elevations of Booster Engine and Control Mechanism

Reducing the Corrosion in Steel Cars

Steel Containing a Small Percentage of Copper Adopted to Prevent Rapid Deterioration

By J. J. Tatum
Superintendent Car Department, Baltimore & Ohio

DURING the period of government control of the railroads, the writer, as manager of the Car Repair Section of the Railroad Administration, had an unusual opportunity for studying the condition of car equipment on the various railroads of this country. The observations made at that time proved conclusively that steel freight equipment built in recent years has been deteriorating very rapidly due to corrosion. On the other hand, it is noticeable that occasionally iron and steel sheets are found well preserved after long periods of service. To determine the reason for the difference in the life of such material, some of the structures which had shown high resistance to corrosion were carefully analyzed.

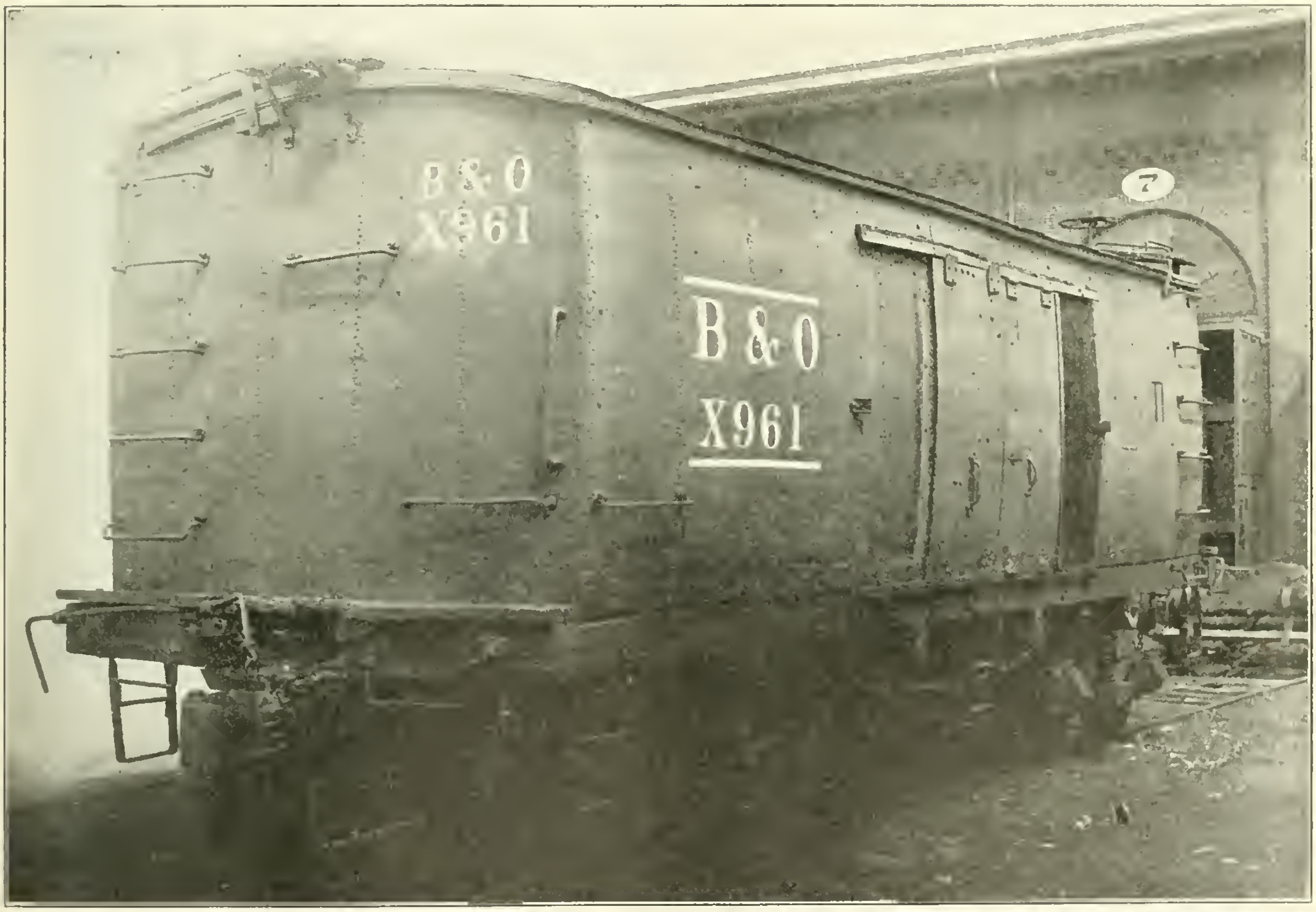


Fig. 1—Box Car with Iron Superstructure, Built During the Civil War. The Metal, Although Unprotected, Shows Very Little Deterioration

In 1862 the Mount Clare shops of the Baltimore & Ohio built a considerable number of box cars with iron bodies and wood underframes. Some of these cars are still in existence and the original sheets in the bodies are well preserved as shown by the car illustrated in Fig. 1, which is still in service as shop car at the Mount Clare shops. Because the metal in the superstructure of this car was in such good condition—notwithstanding it did not receive the usual protection of frequent painting, as has more modern equipment—in 1917 a piece of it was taken from the car and sent to the laboratory for analysis. The chemical composition of the sheet was found to be as follows: Carbon, very low; sulphur, .020 per cent; phosphorus, .034 per cent; manganese, none; copper, .54 per cent.

The analysis of low carbon steel now generally used for car work is approximately as follows: Carbon, .18 per cent; sulphur, .045 per cent; phosphorus, .015-.035 per cent; manganese, .50 per cent; copper, none. It is interesting to compare these two analyses with the composition of the copper-bearing steel which the Baltimore & Ohio is now using in passenger and freight cars. This shows an analysis as follows: Carbon, low; sulphur, .040 per cent; phosphorus, .008 per cent; manganese, .38 per cent; copper, .25 per cent.

Another instance of metal resisting corrosion during a long period of exposure was found at Cumberland, Md. The Baltimore & Ohio built a rolling mill at this point in 1870, which is still standing. Recently a material reclaiming plant was established in this mill. The supports from the furnaces installed when the mill was originally placed in operation were intact and several of the furnace stacks still remained. One of the stacks was removed because of the necessity of locating a furnace in the space it occupied. It was thought at the time it would be necessary to build a new stack for the furnace being installed. When the old stack was removed, to our surprise it was found that the metal showed very little deterioration notwithstanding it had been erected, as nearly as could be established, about 50 years ago.

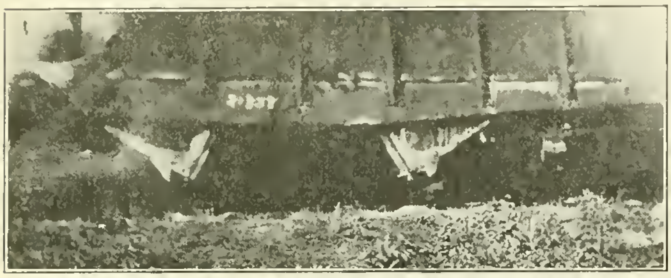


Fig. 2—Corrosion Due to Rain Washing Through Coal Indicated by White Deposits on Side of Car and Under Hoppers

There is a great deal of smoke from locomotives at Cumberland and it would naturally be expected that the corrosive gases would affect the metal in the stack. In order to find the composition of this material which remained in such good condition, a piece was cut from the stack and sent to the laboratory. The chemical composition was found to be as follows: carbon, .012 per cent; sulphur, .030 per cent; phosphorus, .177 per cent; manganese, .05 per cent; copper, .44 per cent. This stack was wrought iron; it was not as good a grade as the iron found in the old box car already mentioned, being higher in sulphur and very much higher in phosphorus; but even so, with .44 per cent copper, it gave far better service than stacks made from ordinary steel as now manufactured.

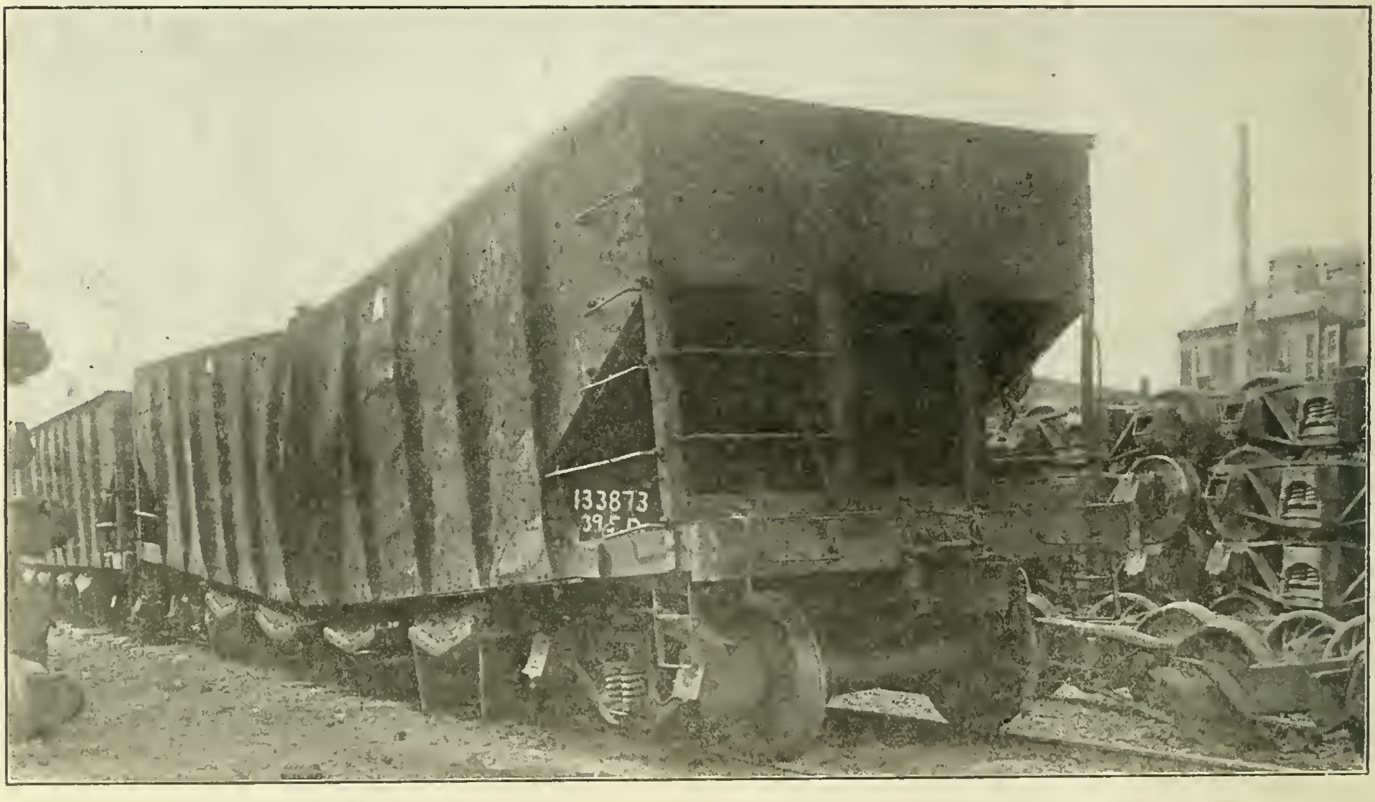


Fig. 3—All-Steel Car after 12 Years' Service, Weakened by Corrosion so That It Buckled at the Center

A large portion of the side walls of the Cumberland rolling mill were covered with galvanized, corrugated sheets. This metal was also in good condition, showing practically no deterioration. A piece was cut from one of the sheets and sent to the laboratory; it showed carbon, very low; sulphur, .022 per cent; phosphorus, .092 per cent; manganese, none; copper, .35 per cent.

Following the investigation further with a view to finding a metal most suitable for car construction which would give longer life and would not deteriorate from corrosion so rapidly as the metal which the Baltimore & Ohio had been using, the action of the acids in coal was studied. A steel hopper car loaded with bituminous coal which had been standing for some time is shown in Fig. 2. It will be noted that a white coating has collected on the sides of the hopper sheets and there are white deposits on the track and ties left from the rain water after washing through the coal. These salt deposits were collected and sent to the chemical laboratory for analysis. The investigation showed the deposits to be sulphate of iron. Part of it was light green in color and crystallized; another pile was whitish, finer and had lost the water of crystallization. The deposits were found to contain free acid which would be very corrosive to steel sheets.

A piece of copper steel plate and a piece of ordinary steel plate were immersed in a saturated solution of this salt. The result of this test was as follows:

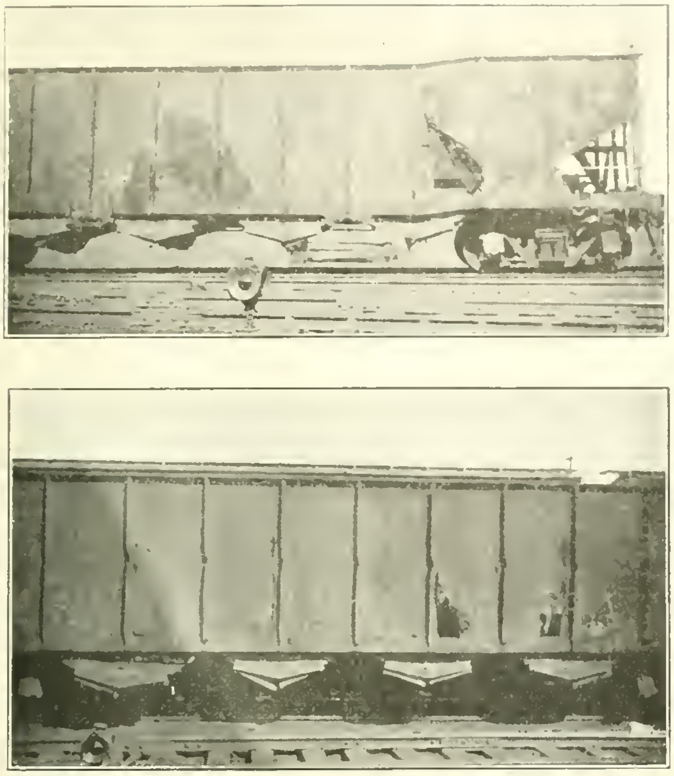
COPPER STEEL

Weight of piece	Surface exposed	Amount dissolved	Amount per sq. in.
18.383 gms.	6.094 sq. in.	.017 gms.	.0028 gms.

PLAIN STEEL

Weight of piece	Surface exposed	Amount dissolved	Amount per sq. in.
26.928 gms.	6.750 sq. in.	.0480 gms.	.0071 gms.

Further investigation of both freight and passenger equipment showed that plates and structural shapes used in the construction of cars which were exposed to lading or atmosphere were deteriorating very rapidly, requiring replacement in from 10 to 12 years. Figs. 3, 4 and 5 show all-steel coal and coke cars which were built in 1911. The steel in the sides and floors of these cars had deteriorated to such an extent that they would not hold the lading and did not have sufficient strength to withstand the stresses imposed in service, making it necessary to rebuild the cars entirely. The only parts which could be reclaimed were the center sills, bolsters, inclined floor supports and, in some instances, the end sills and short draft sills from the bolsters to the end sill in addition to the draft gear, air brakes and trucks. The serviceable parts of the cars which could be used in rebuilding are shown in Fig. 6. The center sills were reinforced and the superstructure re-erected, the finished car being shown in Fig. 7.


Figs. 4 and 5—Steel Cars with Sides so Weakened by Corrosion That They Will Not Hold Lading

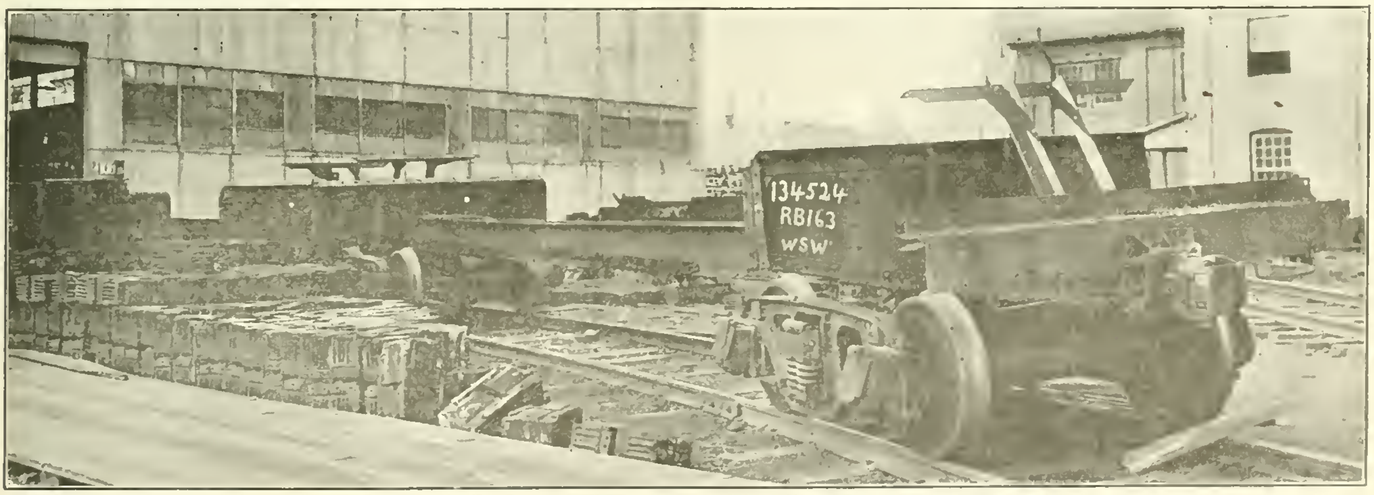


Fig. 6—All That was Worth Saving from a Hopper Car, Built in 1911

Copper-bearing steel was used in rebuilding these cars and it is expected that this material will give much longer service than was obtained from the ordinary steel which was originally used. Exhibit A shows the chemical and physical properties of copper-steel sheets required by the Baltimore & Ohio specifications. It is felt that the investigation outlined above is conclusive and convincing evidence that steel with a small content of copper will give much longer life in car equipment.

Exhibit A

Specifications for Copper-Bearing Miscellaneous Sheets and Structural Steel

1. Scope—This specification takes effect from date, superseding all specifications for this material, and covers material used in coal car construction, passenger car roofs, and other purposes for which its use has been approved by the general superintendent of motive power.

Manufacture

2. Process—The steel shall be made by the openhearth process.

Chemical Properties and Tests

3. Chemical Composition—(a) The steel shall conform to the following requirements as to chemical composition:

Phosphorus, not over	0.05 per cent
Sulphur, not over	0.05 per cent
Copper, not less than	0.20 per cent

Ladle Analysis (b) Analysis made from the test ingot made by the manufacturer shall conform to the requirements in Section 3-A.

Check Analysis (c) Analysis made by the purchaser from drillings shall conform to the requirements in Section 3-A.

Physical Properties and Tests

4. Tensile Tests—(a) The material shall conform to the following requirements:

Tensile strength, lb. per sq. in.	50,000-65,000
Yield point, min., lb. per sq. in.	0.5 tens. str.
Elongation in 8 in. min. per cent	1,500,000 ÷ tens. str.

(b) The yield point shall be determined by the drop of the beam of the testing machine.

5. Modifications—(a) For material over ¾ in. in thickness, a deduction of 1 from the percentage of elongation specified in 4-A shall be made for each increase of ⅛ in. thickness above ¾ in. to a minimum of 18 per cent.

(b) For material under 5/16 in. in thickness, a deduction of 2.5 from the percentage of elongation in 8 in. specified in Section 4-A shall be made for each 1/16 in. decrease in thickness below 5/16 in.

6. Bend Test—(a) The test specimen shall be bent cold 180 deg. without cracking on the outside of the bent portion as follows: For material ¾ in. or under in thickness, flat on itself; for material over ¾ in. to and including 1¼ in. thickness around a pin the diameter of which is equal to the thickness of the specimen; and for material over 1¼ in. in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

7. Test Specimens.—(a) Tension and bend test specimens shall be taken from the finished rolled material.

(b) Tension and bend test specimens shall be of the full thickness of material as rolled and may be machined to the form and dimensions shown in Fig. 8, or with both edges parallel.

TABLE NO. 1

Ordered thickness inches	Permissible excess in average weights per square foot of plates, for widths given, expressed in percentages of nominal weights									Ordered thickness inches
	Under 48 in.	48 to 60 in. exclusive	60 to 72 in. exclusive	72 to 84 in. exclusive	84 to 96 in. exclusive	96 to 108 in. exclusive	108 to 120 in. exclusive	120 to 132 in. exclusive	132 in. or over	
Under 1/8	9	10	12	14	..	..	..	..	..	Under 1/8.
1/8 to 3/16, exclusive	8	9	10	12	..	..	..	..	..	1/8 to 3/16, exclusive.
3/16 to 1/4, exclusive	7	8	9	10	12	..	..	..	..	3/16 to 1/4, exclusive.
1/4 to 5/16, exclusive	6	7	8	9	10	12	14	16	19	1/4 to 5/16, exclusive
5/16 to 3/8, exclusive	5	6	7	8	9	10	12	14	17	5/16 to 3/8, exclusive.
3/8 to 7/16, exclusive	4.5	5	6	7	8	9	10	12	15	3/8 to 7/16, exclusive.
7/16 to 1/2, exclusive	4	4.5	5	6	7	8	9	10	13	7/16 to 1/2, exclusive.
1/2 to 5/8, exclusive	3.5	4	4.5	5	6	7	8	9	11	1/2 to 5/8, exclusive.
5/8 to 3/4, exclusive	3	3.5	4	4.5	5	6	7	8	9	5/8 to 3/4, exclusive.
3/4 to 1, exclusive	2.5	3	3.5	4	4.5	5	6	7	8	3/4 to 1, exclusive.
1 or over	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over.

8. Number of Tests—(a) A tension and one bend test shall be made from each melt for each thickness of plate material and from one of the largest and one of the smallest sections of structural material rolled. If one test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(b) If the percentage of elongation of any tension test specimen is less than that specified in Secton 4-A and the fracture is outside the middle third of the gage length, as indicated by the scribe scratches marked on the specimen before testing, a re-test shall be allowed.

Permissible Variations in Weight and Thickness

9. (a) The thickness of each plate shall not vary more than .01 in. under that ordered. The overweight of each lot in each shipment shall not exceed the amount shown in the following:

(b) The cross-section or weight of each piece of steel shall not vary more than 2.5 per cent from that specified, except in the case of sheared plates, which shall be covered by the following permissible variations. One cubic inch of rolled steel is assumed to weigh 0.2833 lb.

(c) When ordered to weight per square foot. The weight of each lot in each shipment shall not vary from the weight ordered more than the amount given in Table 1.

(d) When ordered in thickness. The thickness of each plate shall not vary more than 0.01 in. under that ordered.

Workmanship and Finish

10. (a) All material must be straight and smooth and those which are buckled and have irregular surfaces will be rejected.

(b) The finished material shall be free from injurious defects and shall have a workmanlike finish.

The Galveston Causeway Construction Company, Galveston, Tex., formerly Larkin & Sangster, Inc., and its surety, the United States Fidelity & Guarantee Company, must pay the Galveston, Harrisburg & San Antonio, and other railroads, $652,626 for excess cost of the causeway connecting Galveston with the mainland of Texas. This is in accordance with the decision of the District court and of the Court of Appeals which the United States Supreme Court sustained on April 30; a writ of certiorari was denied. The contractor having become insolvent and unable to proceed with the work, it was taken over and completed by the railroads. Their claim was for the damage sustained by the contractor's breach, being the difference between the contract price and the amount they had been compelled to pay to complete the contract.

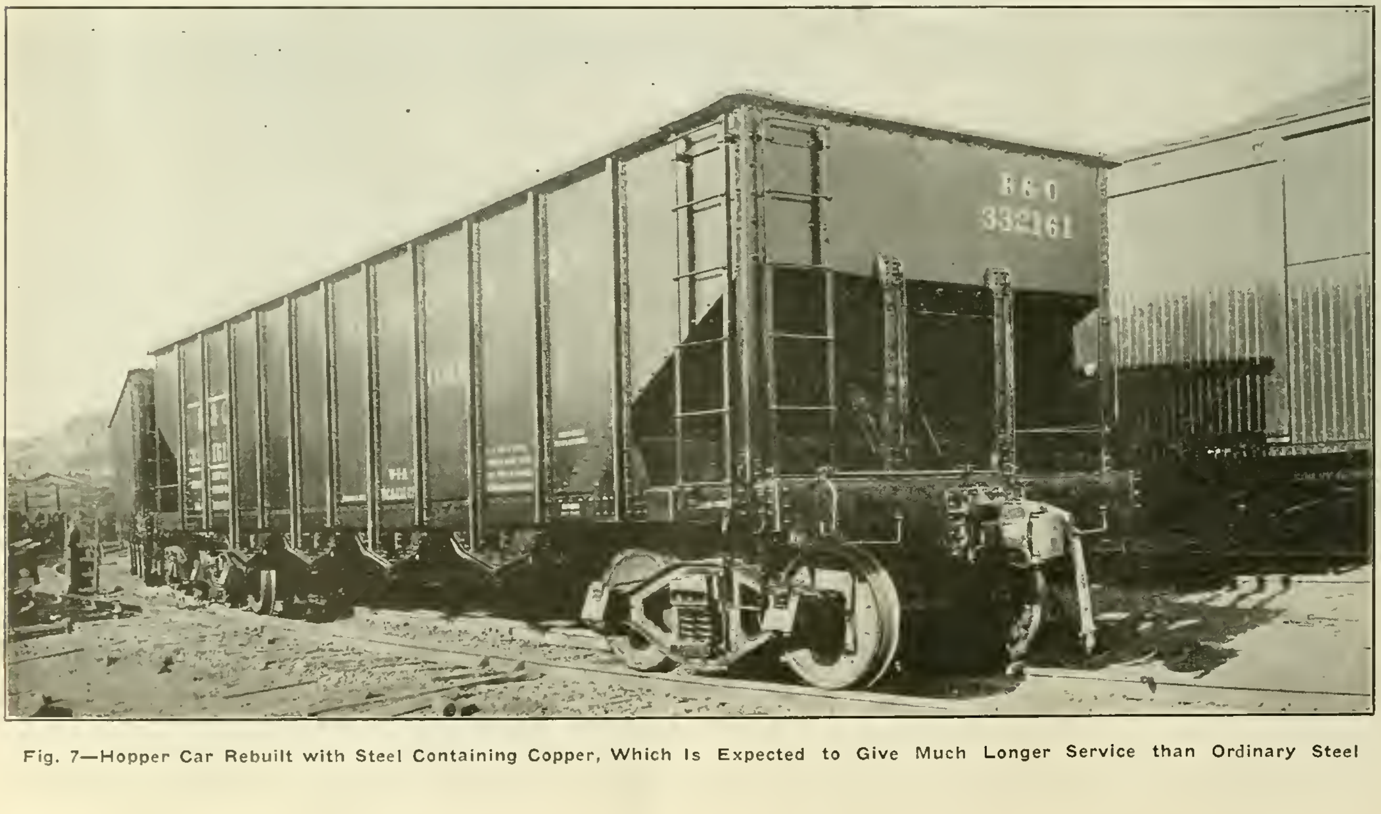


Fig. 7—Hopper Car Rebuilt with Steel Containing Copper, Which Is Expected to Give Much Longer Service than Ordinary Steel

Locomotive Scheduling at the Silvis Shops

New Schedule System Is Designed to Provide Centralized Control of Production and Accurate Cost Data

By L. C. Bowes*, H. K. Robinson† and G. F. Sandstrom‡

UNUSUAL interest attaches to the new locomotive scheduling system now being installed at the Silvis shops of the Chicago, Rock Island & Pacific because of the complete centralized control which it is designed to give of all shop activities. Accurate cost data will also be made readily available. The most vital part of the system is the master schedule board, made in two sections, each of which relates to half of the operations involved in repairing a locomotive. Referring to Fig. 1 which shows the first section of the master schedule board, it will be noticed that this is a three-dimension board. Under the caption "Operations" down the center of the board are listed unit operations on locomotives passing through the shops for general overhauling and repairs. Horizontally to the left and vertically under the scheduled locomotive number a signal ticket is placed signifying that the respective locomotives are to receive work. Horizontally to the right from this signal ticket and under the proper scheduled date, tickets are placed signifying the start and finish of each operation.

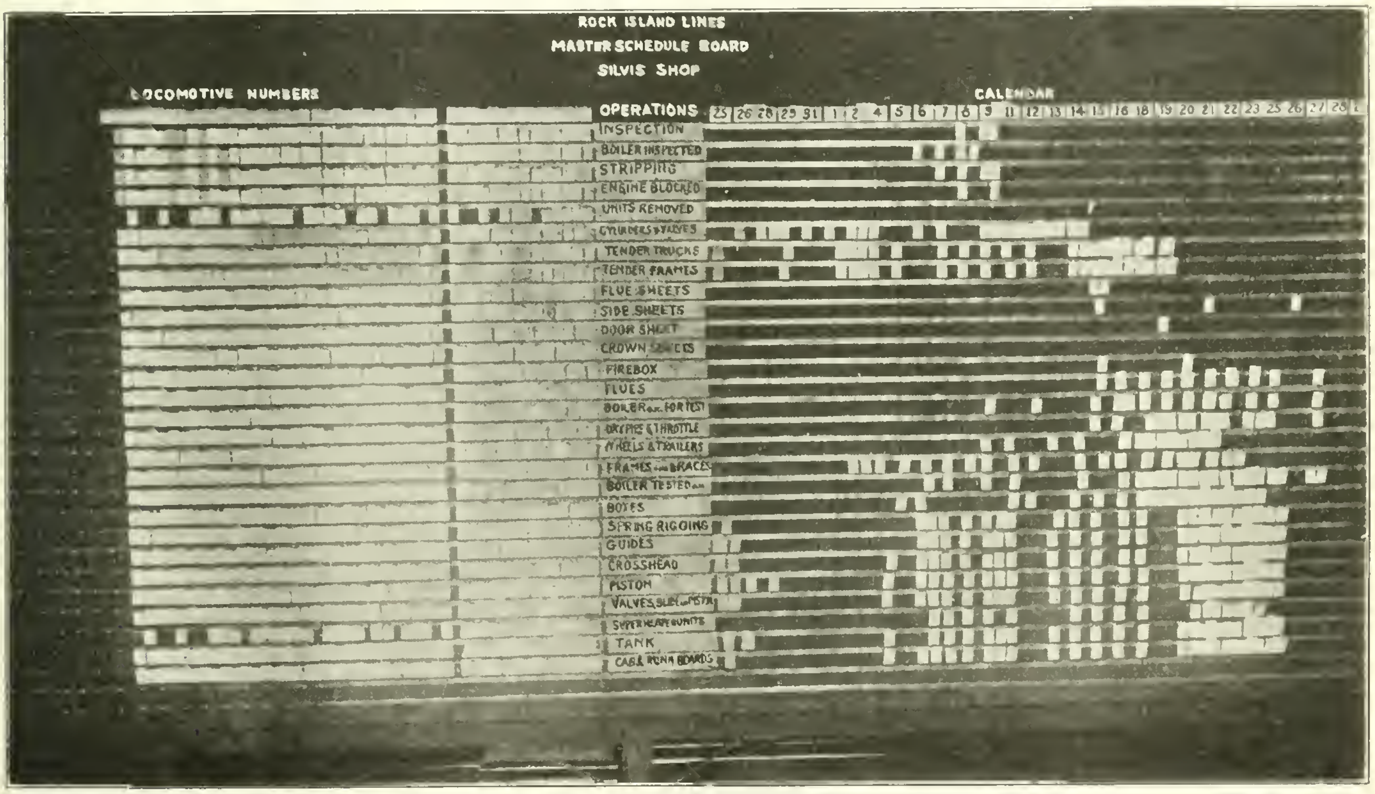


Fig. 1—First Section of Master Schedule Board Which Visualizes Forcefully the Progress of Work Through the Shop

To further visualize the work, a color scheme has been used. When a locomotive is first placed on the schedule board, a buff signal ticket is inserted. As the respective unit operations are completed, the buff ticket is replaced by a green ticket indicating that these operations have been performed. In the event there is danger of not meeting the scheduled dates, the buff ticket is replaced by a red ticket which signal can be seen by all concerned, calling for immediate action.

Thus it can be seen by reading the left-hand section of the board actual progress and the extent of same is indicated by the length of the green ticketed line under the respective locomotives, and the danger points are glaringly shown by the contrasting splashes of red. Another important feature of this method of visualizing activities is the possibility of readily and accurately performing the daily loading of the shop by reading vertically under the calendar dates on the right-hand section of the board.

The outstanding advantage of the mechanical construction of these boards is the allowance for complete flexibility which, as is well known, is a very desirable feature. The unit operations are shown on printed tickets which can be readily regrouped as analysis may warrant. Also the calendar dates are on printed tickets which provide for a continuous rotation from one month to the next of all scheduled operations. Further, locomotive numbers, signals and indications for scheduled work are printed on removable tickets which provide for the quick change of signals against operations, and the moving forward and backward of the tickets against scheduled work in the calendar section. This provides for perpetual and easy-going schedule endeavor in that as soon as locomotive work reports are received and analyzed, the necessary operations are placed on the schedule board and this locomotive automatically takes its place in the program. As soon as the locomotive is O. K. to despatch, the schedule board is cleared of all tickets pertaining to that locomotive.

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*Production Engineer, C. R. I. & P.

†Special Accountant, C. R. I. & P.

‡Industrial Engineer, Roberts-Pettijohn-Wood Corporation

A complete list of the operations listed on the first section of the master schedule board, which is shown in Fig. 1, is as follows: Inspection, boiler inspected, stripping, engine blocked, units removed, cylinders and valves, tender trucks, tender frames, flue sheets, side sheets, door sheets, crown sheets, firebox, flues, boiler O. K. for test, dry pipe and throttle, wheels and trailers, frames and braces, boiler tested O. K., boxes, spring rigging, guides, crosshead, piston, valves (slide or piston), superheater units, tank, cab and running boards. The second section (not shown) of the master schedule board is exactly the same in design as the first section, but contains an entirely different list of operations to complete the work on a locomotive. These operations are indicated as follows: Engine trucks, engine wheels, motion work, air pumps, lagging, steam and crosshead pipes, gages and cab fittings, lubricators, injectors, safety valves, shoes and wedges, rods, grates, smokebox, ash pans, valve setting, air brakes, jacket and pipe, brake rigging, breaking in, final inspection and O. K. to despatch.

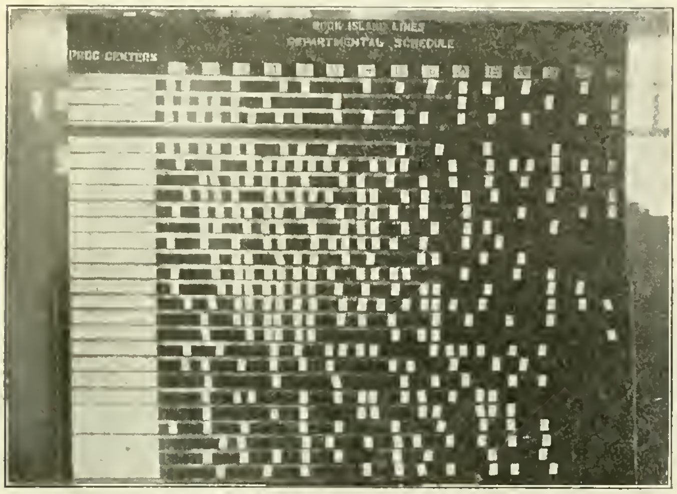

Fig. 2—Sectional or Departmental Schedule Board

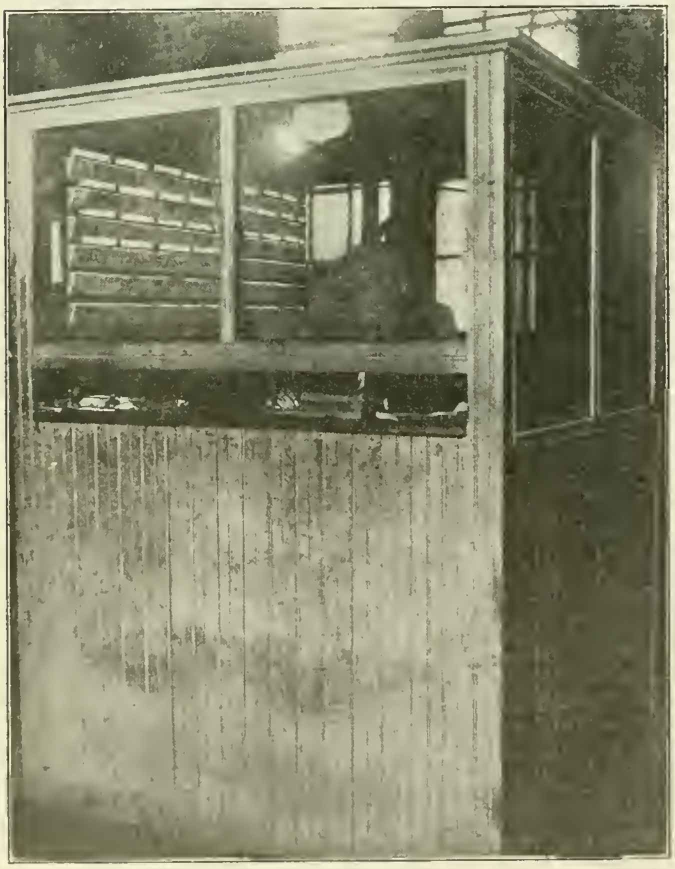

Fig. 3—Booths Containing Despatch Boards Are Located at Strategic Points

Sectional Schedule Boards

Supporting the main schedule board are a number of sectional or departmental boards, one of which is shown in Fig. 2. These boards are so arranged as to visualize the loading of the production-of-work centers against the calendar. A production center is any group of machines, bench, floor space or pit which is logically or practically assigned and confined to certain particular and specified activities. The mechanical construction and flexibility of these boards are the same as the master board and they provide for perpetual scheduling and are limited to an actual 15-day loading.

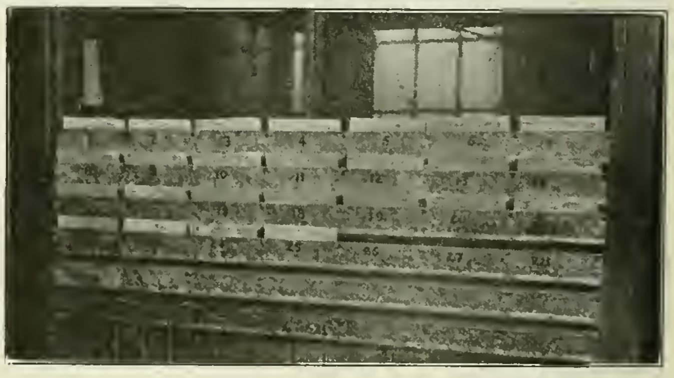

Fig. 4—Close-Up View of Despatch Board in Booth

Supporting the sectional schedule boards are a number of booths (Fig. 3) in which are placed the despatch boards, shown in more detail in Fig. 4. These despatch boards are a series of pockets in which are placed the production or work cards. Each pocket is numbered to correspond to the production center on the sectional schedule board and the production cards therein are written against the schedule work as reflected on the sectional schedule board. This production card is the last connecting link between the workmen and schedule inasmuch as it is necessary for each workman to present himself to his assigned booth, call his center number and receive the production cards which constitute his instructions for doing work. Each booth is in charge of a despatcher who is in constant attendance in the booth.

(Forthcoming articles will explain in detail the function and routine of operations which are designed to maintain control of production and provide accurate data for cost control.—Editor.)

For Several Years efforts have been made to draw up a code for the welding of unfired pressure vessels. Opinions of the best welding experts were not in agreement on many essential points. Fundamental scientific knowledge, based on test data, was not available. The American Bureau of Welding (Research Department of the American Welding Society), has completed a series of tests on some fifty tanks. The program involved an expenditure of over $15,000. The test data, analysis of same, conclusions and recommendations to the Boiler Code Committee of the A. S. M. E. have been compiled in a report, copies of which may be obtained from the American Welding Society, 33 West Thirty-ninth street, New York, at $1.50 to members and $5 to non-members.

PROCEEDINGS OF DIVISION V-MECHANICAL

AMERICAN RAILWAY ASSOCIATION

CHICAGO
JUNE 20-22, 1923

Mechanical Division Meeting at First Session on Wednesday Morning

Proceedings of Mechanical Division Meeting

Large and Enthusiastic Conference with Constructive Program Designed to Help Meet Increasing Traffic Demands

The 1923 Annual Meeting of the Mechanical Division, American Railway Association, was held at Orchestra Hall, Chicago, Wednesday, Thursday and Friday, June 20, 21 and 22, 1923.

The meetings were opened and called to order at 10:00 A. M. on the first day and 9:30 A. M. on the other two days. The three afternoon sessions convened at 2:00 P. M. The first floor of the Orchestra Hall was reserved exclusively for railroad representatives and members of the Division, visitors being permitted to occupy the balcony. Registration was in the lobby by special registration clerks.

Chairman Coleman's Opening Remarks

We are all very sorry that the railway conditions, after the experience we have had during the past year, did not justify a regular convention this year, but I sincerely hope that next year will offer a greater opportunity for a real convention. The Railway Supply Manufacturers' Association is very much disappointed at the postponement of your convention but is earnestly looking forward to offering you an exhibit next year showing many improvements in machinery and devices.

J. Coleman

The program for this business meeting is somewhat different from former programs of the meetings of the Mechanical Division. We have here representatives of the executives of the American Railway Association who will address you; also two gentlemen who represent two of the largest manufacturers of railway equipment—both of these gentlemen are outstanding figures in their respective lines and the papers they will offer you will be of great benefit to this association.

I want to congratulate you on this splendid attendance representing the mechanical genius of the railways all over this continent—men interested in the building, maintaining and operation of railway equipment. It shows the hearty co-operation among you men who are responsible in your particular line for the maintenance of railway equipment. It also is a compliment to the executives of the various railways of this country who encourage this co-operation and your attending meetings—your visits to railway shops and exchanging ideas with men holding similar positions, from the foremen, master car builders and general superintendents of motive power. These are the men who are responsible for the expenditure of a large percentage of the earnings of each railway in the maintenance, operation, design and building of railway equipment. These men are spenders of money, and in a way not earners because the earnings come from traffic solicited through channels of the traffic department; but you are responsible for the condition of the equipment for the movement of all transportation on the railways and the earnings depend entirely on the condition of your equipment.

There has been some reflection and some criticism on the operation of the railways through various channels—in legislatures and other organizations which are not familiar with the inside workings of railways, especially in the mechanical department.

The papers that will be presented and the reports of the various committees will be most interesting, and I sincerely hope that every man from all parts of this broad country—both United States and Canada—will give an expression to the chairmen of the various committees of their experiences in operation and maintenance of equipment. Some railways have to operate under most extreme climatic conditions during the winter months; others have an opportunity of operating under most favorable conditions, and the experience of all is necessary for the guidance of the chairmen of the various committees to prepare reports that will be educational and of benefit for the standardizing and operation of equipment all over this country.

Economy and Efficiency

The slogan of this organization is "Economy and efficiency." What you have been striving to do, and what has been done since the close of the great war, in trying to rehabilitate the railways after the experience you have had, clearly demonstrates I think in the minds of all, and in the minds of your executives, that the policy of this organization has been and always will be a progressive and constructive one.

Appreciation for the Mechanical Department*

Remarkable Record Has Been Made in Spite of Most Serious Difficulties and Handicaps

By W. W. Atterbury

Vice-President, Pennsylvania Railroad System

Let me say at the outset that the Mechanical Division—the men responsible for the condition of cars and locomotives with which to move the country's freight—cannot be given too much credit for what they have accomplished in recent years in the face of almost insurmountable difficulties.

Frankly, I do not think that railroad men in general, much less the public, have an adequate conception of the handicaps which the motive power men have overcome. I cannot begin to summarize in a letter what the past eight or ten years have meant in difficulties, disappointments, hard work, and determination in the mechanical departments of the railroads. I know of no finer tribute to their zeal and energetic devotion to the public service than the reports which are now coming from the Car Service Division in Washington. Only a few days ago a batch of newspaper clippings were placed on my desk, with headlines something like this: "Rail Motive Power in Record Condition—Greatest Number of Serviceable Locomotives Available in History of Transportation."

W. W. Atterbury

Labor Problem Greatest Difficulty

These, of course, do not begin to tell the story as we know it. We who do know it, however, can read between the lines not only congratulations to the mechanical men, but also a guarantee that no matter how much more remains to be done, these men will get it done.

What happened to the mechanical forces during and since the war is familiar to those directly in charge. The labor problem was, beyond question, and in some respects it is today, the greatest difficulty. Even prior to the war most of us did not have sufficient funds with which to make necessary improvements. Most of us have not had sufficient funds since then. That condition, however, was aggravated by much more serious developments in the relationship between managements and employees on all railroads in the country.

Anti-Railroad Propaganda

The scale of rates of wages built up through years of practical experience was shattered, piece-work was abolished, classification of mechanical work in the shops was rearranged on an unsound basis, featherbed jobs were forced upon us, and overtime and pay for time not worked at all added to already mounting costs of production. On top of that came outside dictation as to methods and practices and pay and every conceivable thing to make the work in the motive power department an exceedingly thankless and an altogether unsatisfactory job.

Much Accomplished Under Difficulties

I mention these things merely to emphasize my own realization of what the Mechanical Division men have encountered, in contrast to what they have, nevertheless, accomplished. In expressing the appreciation that I believe is their due, I might also refer to another handicap which is still upon us. In the past five or six years the railroads have been subject to a constant attack of anti-railroad propaganda, fostered in large part by representatives of railroad employees—of employees especially in the mechanical department. The result has been two-fold: It has not only affected the morale of the men themselves, but also has resulted in a flood of restrictive measures which have seriously affected the output of the shops.

Transportation Program of the A. R. A.

When you consider all these difficulties on the one hand, and on the other the remarkable progress that has been made since the war, in spite of extraordinarily heavy business and the coal and railroad strikes, I am frank to say that every mechanical man should now be a confirmed optimist. The program of adequate transportation which the American Railway Association has laid out should give them no pause. Of course, to carry it out requires practically one hundred per cent performance on their part, but if they put as much energy into it—under the better present conditions than they have had for many years—as they put into their jobs during and since the war, it ought to be for them a comparatively simple task. Therefore, I do not hesitate to add that the carrying out of that program depends more upon them than any other branch of the service.

Employee Representation

As to the general situation, you, of course, know my attitude as to the proper relation between railroad management and railroad employees. The policy of dealing directly with our employees through their own employee representatives is no longer an experiment with us. It is a working success. In the past few days that policy has been extended even to the adjustment of piece-work prices by conferences equally representative of management and employees, with two-thirds vote deciding any issue. I believe that if the railroads can get their relations with their employees on the basis of facts, fair play, and faith in each other, a great deal of our troubles will end.

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*Vice-President Atterbury was unable to attend the convention, but sent this message through President Aishton, of the American Railway Association.

The Work of the Mechanical Department

Committee Work Reviewed—Mechanical Department an Essential Cog in the Transportation Machine

By W. B. Storey
President, Atchison, Topeka & Santa Fe, and Member Board of Directors of the A. R. A.

When the president of the American Railway Association asked me to make some remarks here today he said: "You must remember, Storey, the Mechanical Division is your baby." Rather a good-sized baby, and possibly some of you may wish to know why it is my baby.

When the reorganization was effected by which the various associations connected with railroads were brought under one control—that is, the American Railway Association—it was decided that a member of the board of directors of the American Railway Association should be assigned to each division. For instance, one of the directors is assigned to keep in touch with the work of the Claims Division; another one, the Engineering Division; I was assigned to the Mechanical Division.

W. B. Storey

As a consequence I have attended practically all of the meetings of the General Committee and have familiarized myself with the work that has been done by the Mechanical Division during the time I have been assigned to that work and therefrom I have drawn certain conclusions, and I am going to submit them to you today.

For many years you comprised two organizations—the Master Car Builders' and the Master Mechanics'. Most of the motive power officials were members of both associations. When the reorganization took place, by which the Mechanical Division was formed, many of you felt that the passing of the old organizations meant the end of the work in which you had all become so interested, and you accepted the new order of things with some question as to whether it would really fill the place so long held by the original bodies—and with some it has been hard to feel as much interested in the present plan as in the old. One of the tasks before you, therefore, is to restore the morale which actuated you so strongly in the old days.

Valuable Work Accomplished by Some Committees

There is, of course, no question as to the work that is being accomplished by some committees, but there are many directions in which nothing is being done. Let us, therefore, take a quick review of your various committees. Those that are on the list of what I might call active committees are the Arbitration, Prices for Labor and Materials, Car Construction, Couplers and Draft Gear, Brakes and Brake Equipment, Train Brake and Signal Equipment, Wheels, Loading Rules, Safety Appliances, Locomotive and Car Lighting, and finally the special committee on Tank Cars. All these committees are very much alive and doing very valuable work—I might say, that this is work which is absolutely essential to the every day handling of interchange.

Then there are the inactive committees, if I may so style them, viz., Autogenous and Electric Welding, Feed Water Heaters for Locomotives, Mechanical Stokers, and Electric Rolling Stock. While the work of these committees may be classed as not of first importance so far as interchange of cars is concerned, it is highly important from an economic point of view and much could be accomplished if this work was actively pushed. The cost of the committee work should not be heavy and much can be accomplished for the common good.

Common Experimental Laboratory Needed

There is one committee that can hardly do much until the railroads as a whole are willing to support a physical laboratory; viz., Locomotive Design and Construction. There is no question as to the importance of these subjects to the different railroads, but each individual railroad has thus far worked out its own problems and has been compelled to do its own experimenting. There is, of course, not the need for standardization as in the case of cars, because locomotives do not pass from one road to another; but if an experimental plant could be supported by the railroads as a whole, I feel that great good could be accomplished by this committee.

There is another committee that may be of some value, but it has a subject that is hard to standardize. I speak of Scheduling of Equipment Through Repair Shops. Such studies must be made by each road and must hinge on the design and capacity of each shop.

Follow-up Work Essential

It is my feeling that to place the Mechanical Division where it belongs, live energetic work must be done by practically all our committees. We have been going through a transition period and, with the many problems facing us when the roads came back to us, with our shopmen's strike, with our heavy business one year and our famine the next, we have all been so busy taking care of the immediate problems confronting us and we have been so circumscribed by the orders for economy, which means on many roads the cessation of expenditures, that we have not been able to take that larger view necessary to a proper understanding of where the real economics can be found. I say to you, gentlemen, that the real economies are in the results of your committee work, but this work must be systematically planned and advanced. It does not answer simply to appoint a committee and say, "Now that question is settled." The plan must be systematically followed up, and you must have an organization that will so manage that chairmen of committees that do not produce will be replaced by those who will get results; and members of committees who do not take any interest in their subject will be replaced by those who will work. In this way only will you prevent dry rot creeping into the Mechanical Division.

Mechanical Officers Carry Heavy Responsibilities

I think you all recognize the tremendously important part you play in the general plan of railroad transportation, but I sometimes doubt if our executives, as a class, realize it. On the Santa Fe Railroad last year practically 30 per cent of our entire expenditure for the year went to maintenance of equipment—or nearly one-third of the entire expenditures of the road. The proportions on one road are representative of the country as a whole, and you can thus see what a tremendous responsibility rests on you. It is because of this large interest that lies in the mechanical end of our work that the Santa Fe for one is ready to back any program that makes for economy. I therefore ask you to take yourselves seriously and to strive to make the Mechanical Division the live force that it should be.

Mechanical Department Should Work Smoothly with Other Cogs in the Transportation Machine

Next, I wish to say a few words to the younger men here today—the older officers know of what I am about to speak, but the younger officers may not have had the subject brought to their attention. I refer to the relation between the mechanical department of your road and the balance of the working forces. Too often we have the feeling that the mechanical department is so far removed from the public that we have no interest in the relations with that great and powerful force, public opinion. First, however, we must realize that we are an essential part of the transportation machine; that while we may be only a cog in that machine, we are such an important cog that the machine would be worthless without us—and, as a cog works with other cogs, so must we of the mechanical departments work with the operating and maintenance-of-way departments. We must take an interest in the work of others—in other words, we must have team work—so that all departments will work together for the good of the whole. You of course have most intimate relations with the transportation department, because it lays at your doors all delays to trains due to failure of equipment, and you are compelled to spend much time in telling why. The transportation department is another cog, and it has its troubles as well as the mechanical department—and I think you have sympathy for each other. But what about the maintenance of way and structures department? You do not come in as close contact with them and they seem to be a world apart. They, however, are a cog and deserve your very close attention. In this connection, I wish to call attention to the report, just out, of the committee on wheels. In this report is given the record of a joint meeting at which there was a full discussion of the tread design of wheels and its relation to the canting of rails. All such discussions are good for the service.

Then comes the engineering department with its endeavor to limit the weights on drivers and its inability to get turntables long enough or roundhouse doors wide enough to handle properly your engines.

I suppose many of you hardly can see any intimate relationship between the accounting department and the mechanical department. You know, of course, that such a department exists, but its connection with you and your work has, as a rule, been a bothersome one only. I want to say right here that the mechanical department needs the accounting department, and the more you cultivate it and study it the more good you can get out of it. If you men in charge of work could take a short course in auditing and accounting, it would help you immensely. You cannot learn how to save unless you learn to think in terms of cost, and the business of the accounting department is to determine costs. And so it is with all departments—you must work with them; therefore, help them all you can and learn from them all you can.

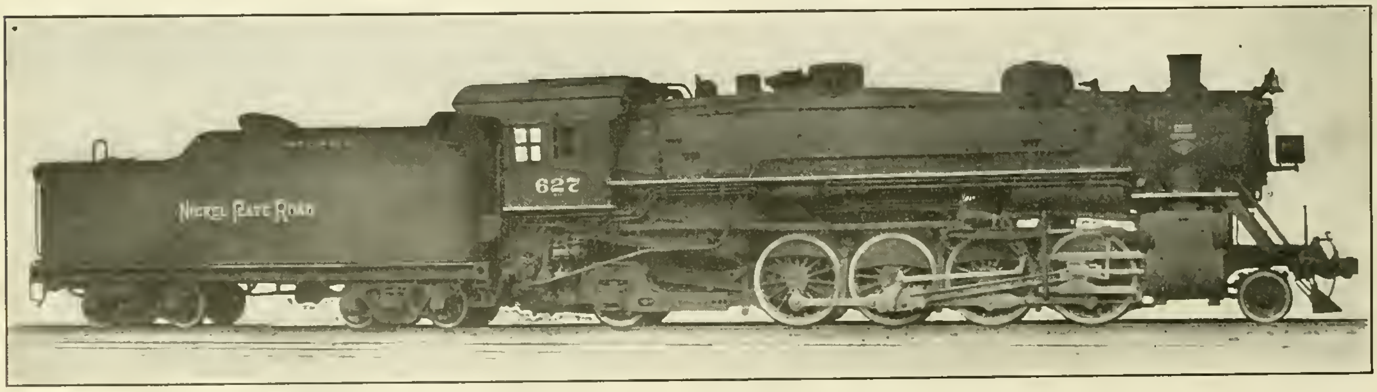
Relation of Mechanical Men to the Public

Finally, I wish to speak of the relation of the mechanical man to the public. Much of the trouble that has come to the railroads in times past has been because the public did not understand the railroad question. The way to make them see it is to understand it yourselves and to have your foremen and the men under the foremen understand it; and if they understand it, they will have a very strong influence in getting the public to understand it. We want your help in spreading the gospel. Tell your neighbors that what we want is a moratorium—we want to be let alone for a time to see if we can work our way out of the many difficulties that beset us. Tell this to your neighbors. You come in contact with part of the public and you can help to that extent, and in this helping you are enhancing the value of the mechanical department.

A Mechanical Division Booster

In closing I want to say that I am heartily in sympathy with this idea of meeting in Chicago. Before I became attached to the Mechanical Division I had some doubts about our meetings in Atlantic City, but since I have attended these meetings I have become a convert to the exhibitions and to the work that has been done and I believe that Chicago is the more central point and that we can concentrate our work more here and I believe that better results will be had here than meeting in Atlantic City. I simply wish to give you that as my private opinion that I have formed after an observation of the work of the Mechanical Division during the time that I have been attached to it.

* * *



Mikado Locomotive for Nickel Plate, Built by Lima Locomotive Works

Report of the Committee on Car Construction

Standard Box Car Designs Including Single-Sheathed and Double-Sheathed Types Submitted

This committee carefully considered the various subjects assigned to it, especially that relating to the design of box cars and their trucks. The following is an abstract of the committee's report:

Car Door Fasteners

A recommendation was made to the effect that steps should be taken to bring about an improvement in the present car door fasteners, as those commonly used are inadequate and do not afford shipments proper protection.

Attention was called to various mechanical locking devices, now being worked out by various railroad car departments.

The committee investigated designs made by the Delaware, Lackawanna & Western, Union Pacific, and Atchison, Topeka & Santa Fe. After a thorough consideration of these designs, it was concluded that the A. R. A. standard box car details already include a burglar-proof guide for use in connection with a bottom Z-bar, and if properly applied with a Z-bar track at the top, with the clearances prescribed by sheet 26 of the A. R. A. Standards, it is doubtful if the door could be lifted over the rear guide.

Probably a great deal of the existing complaint in regard to box car door fastenings is caused by the large number of doors running with bottom guides that have only a short lap over the door, or where the bottom of the door is not sufficiently protected, and decays, so that it may be readily lifted over the rear guide. It is believed that if the standard drawings and door specifications of the A. R. A. Mechanical Division are followed, the doors will be sufficiently burglar-proof for all ordinary service. (See also report in the 1920 Proceedings.)

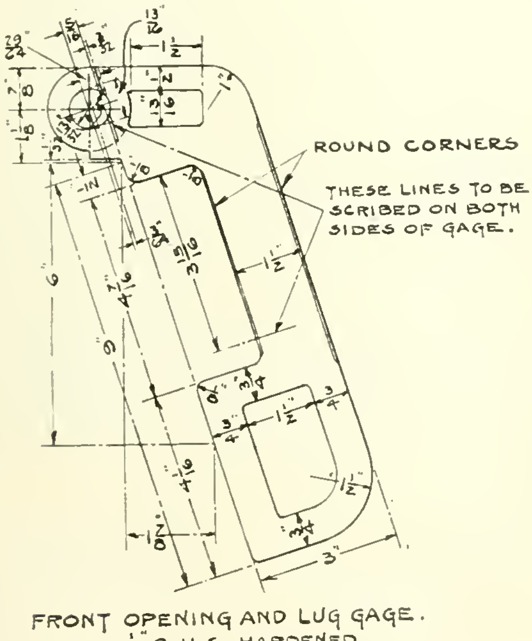

ROUND CORNERS
THESE LINES TO BE SCRIBED ON BOTH SIDES OF GAGE.
FRONT OPENING AND LUG GAGE.
1/8" O. H. S. HARDENED.

Fig. 1.—Journal Box Gage for Lug and Front Opening

However, there may be cars assigned to regular territory, or regularly engaged in hauling costly commodities, where it appears desirable to provide fastenings of more than ordinary security, and it is recommended that such cases be handled by individual railroads, to suit their particular requirements.

Permanently Fastening End Doors on Box Cars

The following recommendation was received from the Pacific Coast Claim Conference, Los Angeles, Calif., dated June 9, 1922:

"At the meeting of the Pacific Coast Claim Conference, Portland, Oregon, May 16-18, a committee was appointed for the purpose of handling the question of permanently fastening end doors on box cars, this subject being under consideration on account of its relation to the question of claim prevention. The committee made the following recommendation:

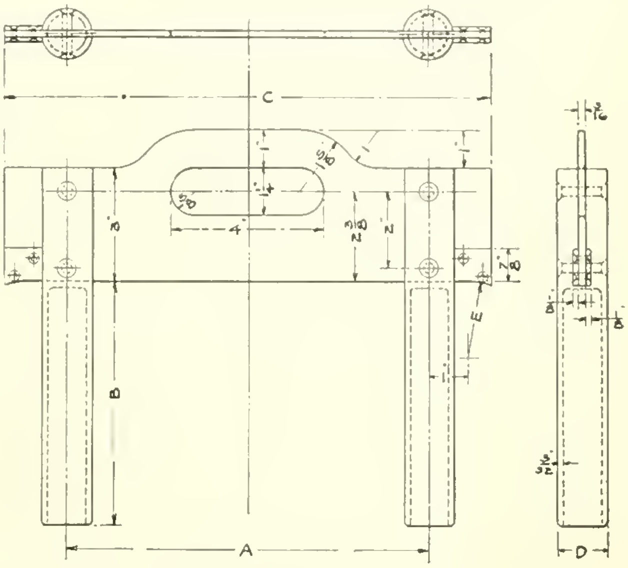


Fig. 2.—Journal Box Gage for Bolt Holes

"We recommend the entire abolition of end doors, as rapidly as traffic conditions will permit. As long as the end doors are used they shall be maintained in as substantial a manner as side doors."

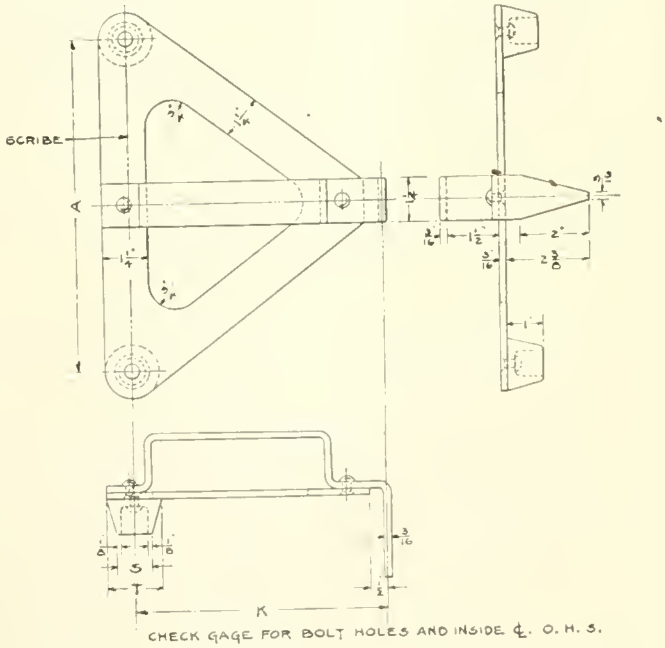
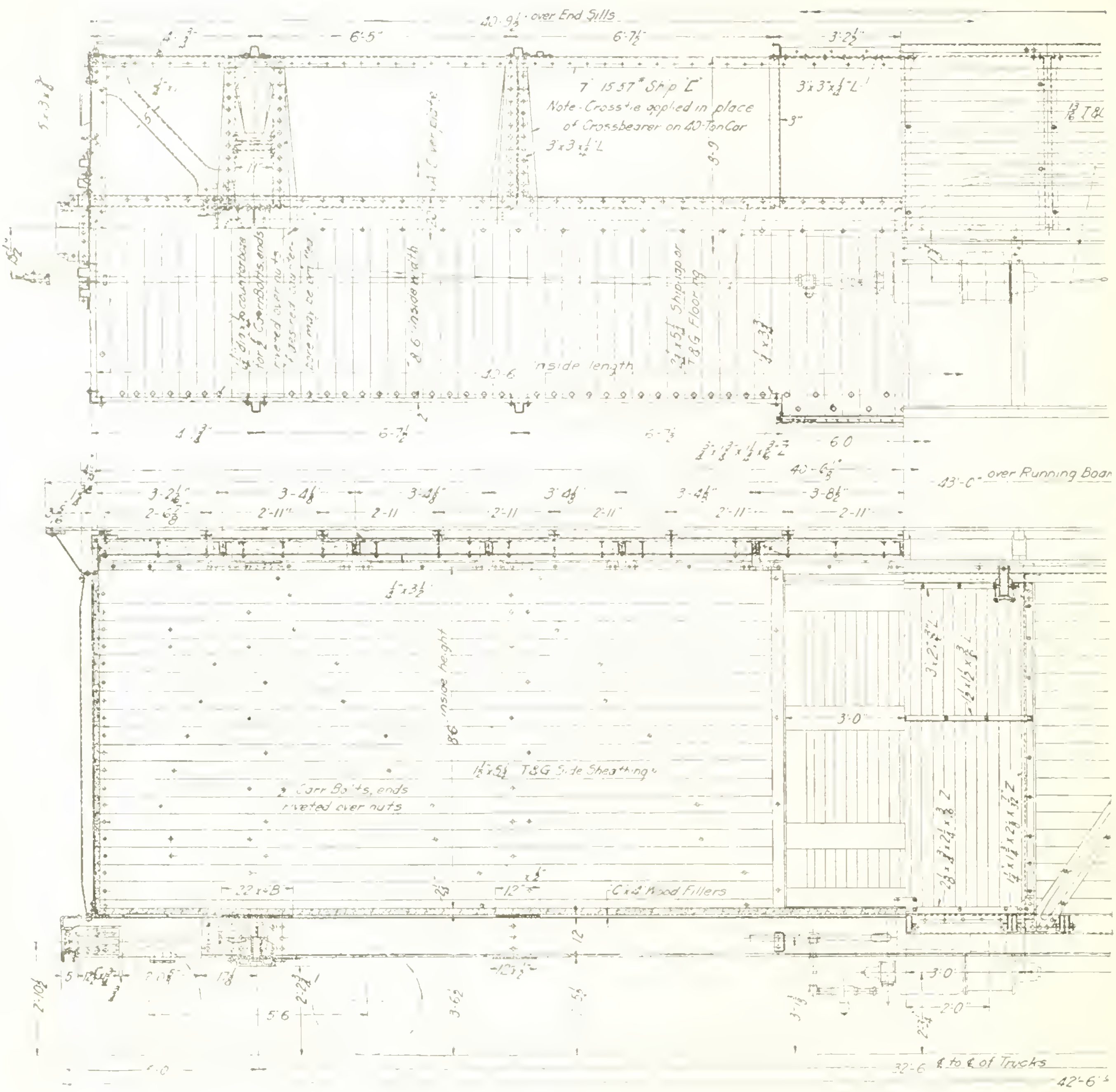


Fig. 3.—Journal Box Gage for Center Line and Bolt Holes

We concur in these recommendations, and, therefore, suggest that Fig. 9, Section "C," page 60, in the Manual and the reading in the middle of page 47, relating thereto, be eliminated; but that



General Arrangement of Single-Sheathed

the reading relating to the sealing of end doors, at bottom of page 47, should remain as at present.

Defective Equipment—Needed Improvement in Condition of Side Doors

The following recommendation was received from the Pacific Coast Claim Conference, dated June 9, 1922:

"Due to heavy claim expenditures resulting from pilferage and shortage of freight, which it often is difficult to guard against when doors and fastenings are defective, the Pacific Coast Claim Conference earnestly recommends that steps be taken by the A. R. A., Section Five, to make the recommended practice of that Section, as to the application of doors and door fixtures, the standard practice, allowing the use of either flush or non-flush doors, and to prevent the interchange of cars built after some selected date, unless equipped in the manner prescribed. Also that the doors on old cars be so equipped after a reasonable length of time."

The committee concurs in this recommendation, believing that it resolves itself into a question of interchange rules, and recommends to the association to determine whether the loss due to the imperfect condition of doors on existing cars would justify the necessary expenditure to equip the doors in accordance with the recommended practice of the Mechanical Division, which the committee feels would entirely overcome the difficulty.

The committee further believes that such investigation will lead to formulation of interchange rules which will make it obligatory that cars be maintained in accord with A. R. A. standards.

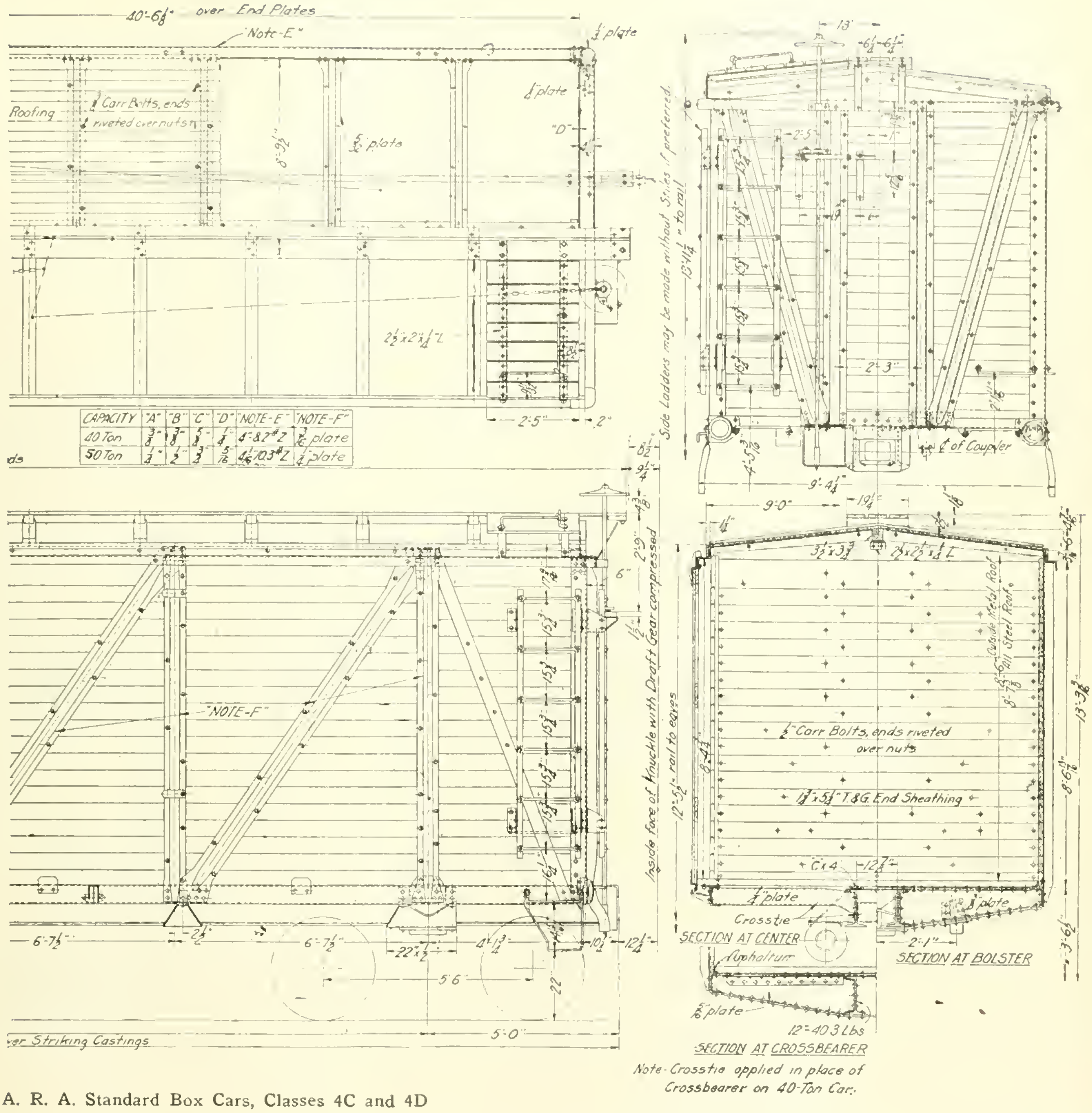
Journal Box Gages for Bolt Hole, Dust Guard Opening, Lid Lug and Wedge Seats

The gages shown in the Manual are not up-to-date, since minor modifications have been made in the boxes from time to time. It was, therefore, necessary to correct the existing gages, and to indicate gages for boxes not now covered.

The committee therefore, submits the design of gages shown in Figs. 1-5 inclusive, for adoption as standard, in connection with the present existing designs of journal boxes, class C, D, E, and F.

Fundamentals—Center Sill Area

For box type cars, the roof structure reinforces the top chords


40'-6½" over End Plates
Note-E
¼" plate
⅜" Carr Bolts, ends riveted over nuts
Roofing
8'-9½"
5/16" plate
"D"
2½"x2½"x¼" L
2'-5"
2"
CAPACITY "A" "B" "C" "D" NOTE-E NOTE-F
40 Ton ⅜" ⅜" ⅝" ¼" 4"-8.2#Z 3/16" plate
50 Ton ½" ½" ¾" 5/16" 4 1/16" 10.3#Z ¼" plate
Side Ladders may be made without Stiles if preferred.
13'-1¼" to rail
Inside face of Knuckle with Draft Gear compressed
12'-5½" rail to eaves
NOTE-F
6'-7½"
22"x2"
5'-6"
5'-0"
over Striking Castings
9'-4¼"
℄ of Coupler
9'-0"
3½"x3½"
2½"x2½"x¼" L
Outside Metal Roof
All Steel Roof
13'-3⅞"
⅝" Carr Bolts, ends riveted over nuts
1⅛"x5¼" T&G End Sheathing
¼" plate
Crosstie
SECTION AT CENTER
Asphaltum
⅜" plate
12"-40.3 Lbs
SECTION AT CROSSBEARER
SECTION AT BOLSTER
Note - Crosstie applied in place of Crossbearer on 40-Ton Car.

A. R. A. Standard Box Cars, Classes 4C and 4D

of the sides, thereby preserving the alinement, and furnishes a measure of strength permitting a reduction of center sill area. Hence the center sill area may be reduced by 2 sq. in., making the minimum center sill area for such cars 28 sq. in.

It is hereby recommended that this be adopted as standard, and that item 12, page D/3, of the Manual, be amplified, as follows:

12. Area of center sills between rear followers (minimum).
    For cars not equipped with roofs, 30 sq. in.
    For cars equipped with roofs, 28 sq. in.

Limiting Outline for Freight Cars

A thorough investigation of available information relating to clearances of all railroads was made, to determine the outline to which A. R. A. cars should be designed. As a matter of record, we present Fig. 6, which was selected. The designs made by the committee will be held within this outline. (For cut see page 438).

The capacity of one "F" axle is 60,000 lb. The estimated average weight of four axles and eight wheels is 11,000 lb. From this, the maximum weight on rails of a loaded car, equipped with four "F" axles, will be 251,000 lb.

It is recommended that this weight be adopted as the standard and incorporated in the Rules of Interchange.

Standard Cars

In compliance with instructions to prepare box car designs, the committee made a thorough investigation of the state of the art, including the present day requirements, and selected a basis contemplated to result in a car of adequate strength and minimum weight, with minimum cost of maintenance. Fundamentals covering present day requirements and adequate strength have been submitted to the division heretofore, and have been adopted as standard.

The committee is now pleased to submit the design covered by cuts herewith, of single and double sheathed cars of both 4/C and 4/D types.

These designs represent a redesign of a first design, which had been thoroughly criticised by the members of the committee, and by the committee of the Railway Car Manufacturers' Association, to whom it was submitted for suggestions that would facilitate production.

It will be noted that the center sill construction is the same for all of the designs, differing only in so far as adjustment must be made for difference in capacity, difference in foundation brake, and difference in draft attachments.

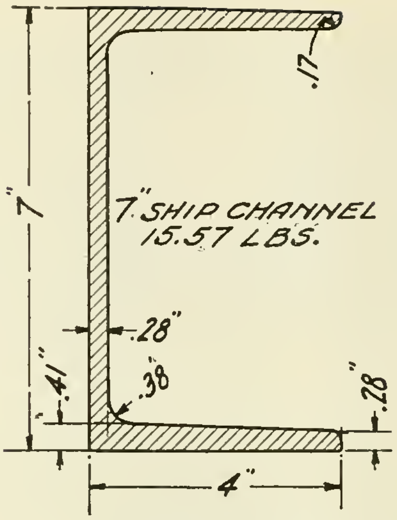
In the 4/C cars the cover plate is ⅜ in. thick, and cross ties are substituted for cross beams, at a material saving in weight, compared with the 4/D cars, which have crossbearers and a ¼ in. center sill cover plate.

The center sill section recently adopted, on account of being the most economical section that can be used, has been incorporated.

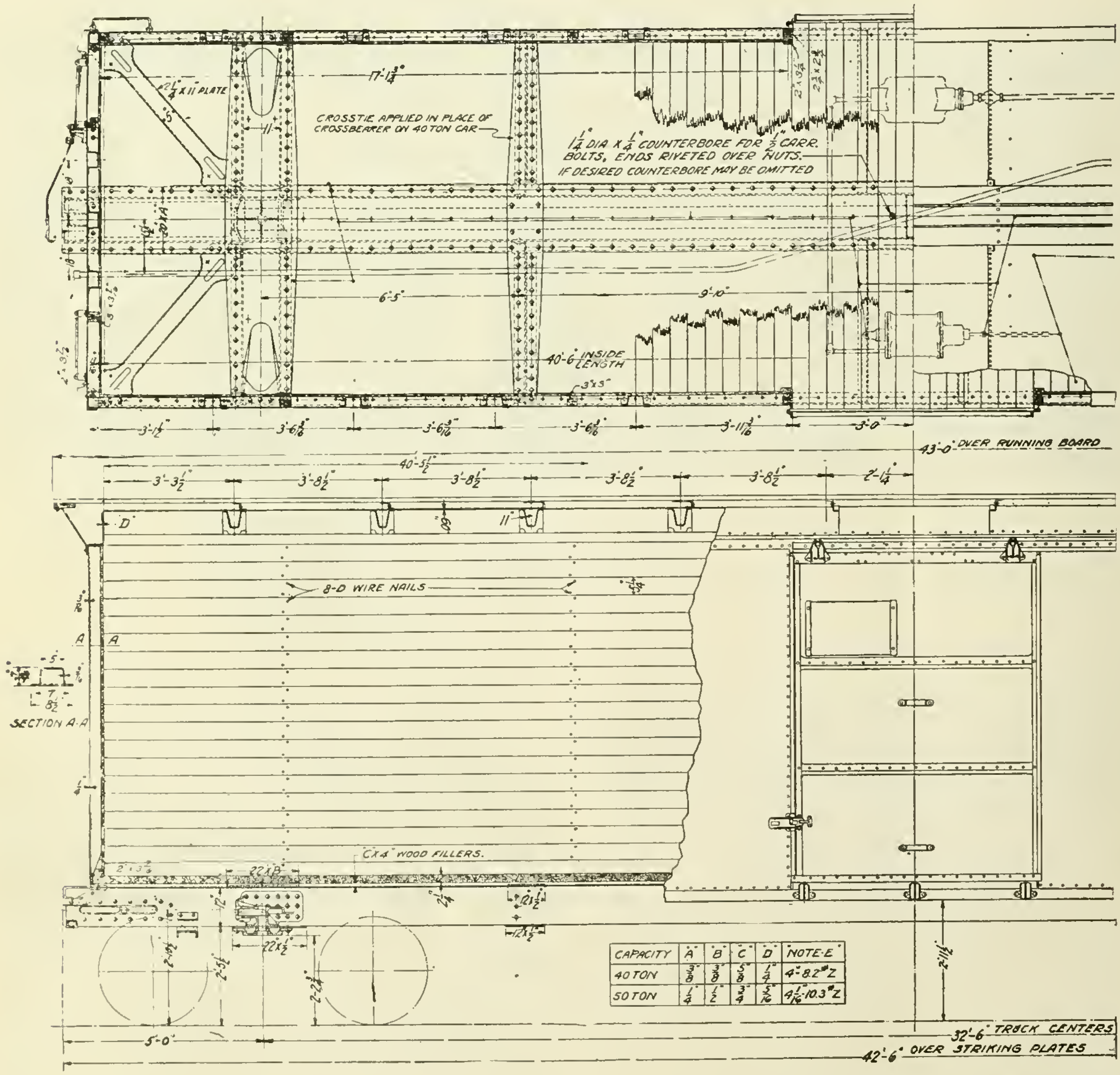
The side sills are of a new channel section, 7 in. deep with 4 in. flanges, which has many advantages over the standard channels. The committee has specified that they should be made of copper bearing open hearth steel. The distance over side sill channels must, necessarily, be less for the single sheathed car than for the double sheathed car, which is also reflected in the length of bolsters, crossbearers, and cross ties.

Adjustment in the inside width of the car was made to provide the same dimensions over the flanges of the Z-bar top plates, thereby making all roofs interchangeable. For this reason, the double sheathed car is about 3 in. wider inside than the single sheathed car.

We show two designs of roof, which are, as far as we know, the best of their respective types; one is a metal covered wooden roof, and the other an all-steel riveted roof. Either roof may be



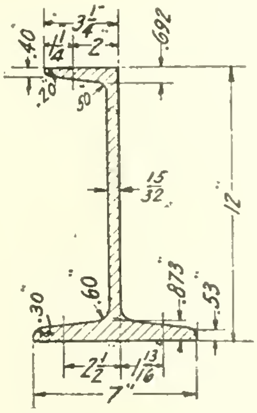
Cross Section of Special Side Sill Channel for Standard Box Cars



CAPACITY	A	B	C	D	NOTE·E
40 TON	⅜"	⅜"	⅝"	¼"	4"-8.2#Z
50 TON	¼"	½"	¾"	5/16"	4 1/16"-10.3#Z

General Arrangement of A. R. A. Standard used on any of the four designs, and other roofs preferred by individual railroads should be equal in strength and serviceability, and interchangeable with those shown.

The ends of the center sills are arranged for the use of a vertical draft gear yoke on the single sheathed car, and for a horizontal draft gear yoke on the double sheathed car. Since the center sills are interchangeable, new cars of any of the four designs can be arranged for either vertical or horizontal yoke draft attachment, and for either type of body brake arrangement.



Cross Section of Center Sill Members for Standard Box Cars

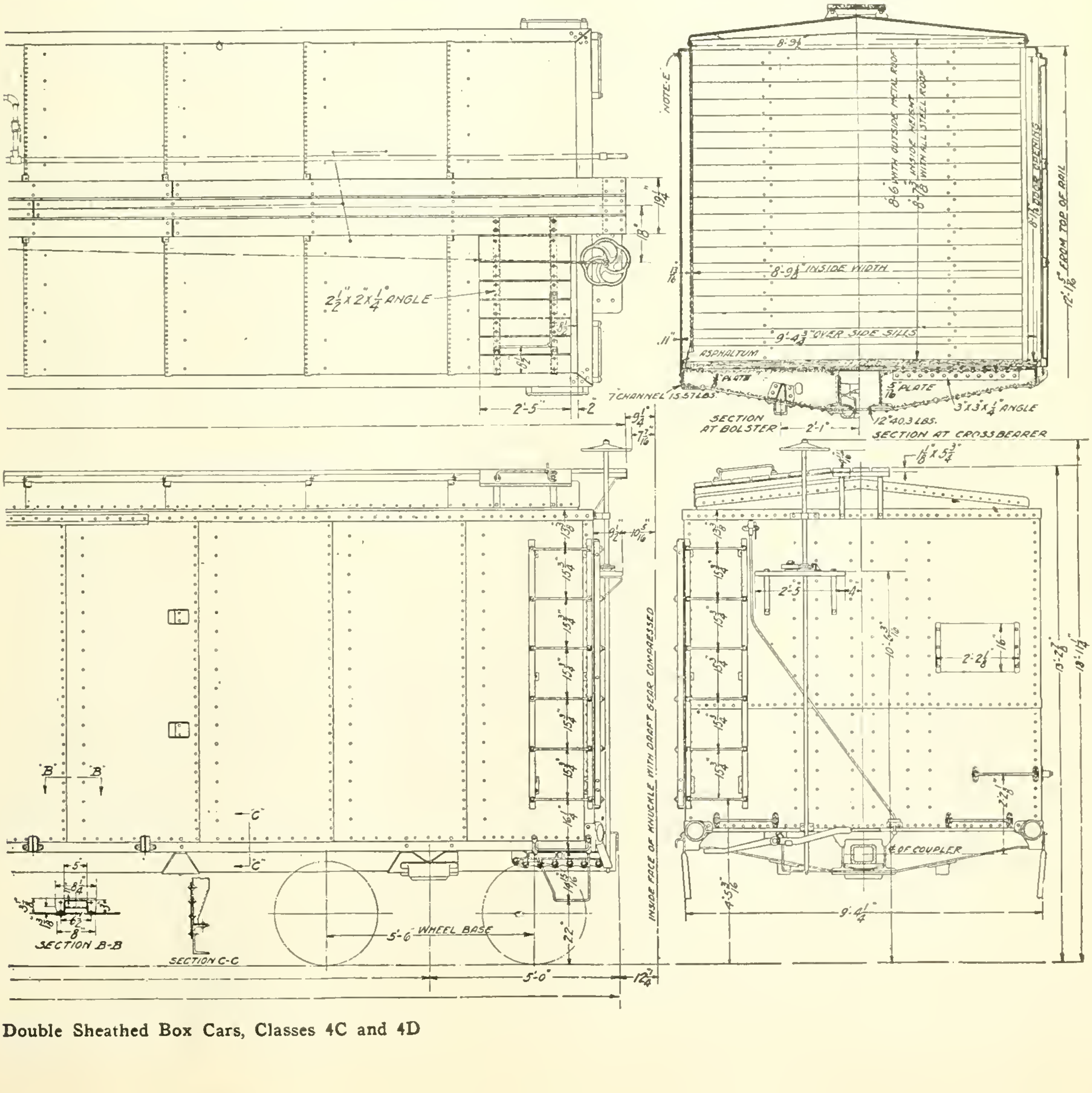
The combined bolster filler and backstop casting shown in the design is recommended for use, provided the owner or owners of patents on the combined bolster filler and backstop casting permit the free use of the combined bolster filler and backstop casting, without restriction or any obligation whatsoever, by any railroad or car owner whose cars are used under the jurisdiction of the A. R. A. or its successors.

Other alternate detail designs have been incorporated, which may be used on any of the four car designs, as preferred.

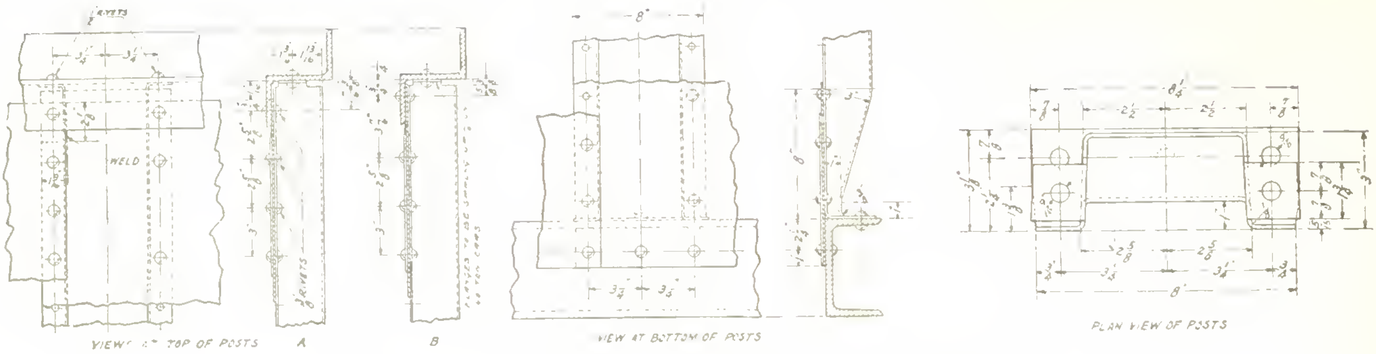
The foundation brake arrangements are of the two types now in general use; one with the cylinder and reservoir bolted together, and one with the cylinder and reservoir separate, and located on opposite sides of the car.

The hand brake power, based on 1,500 lb. pull on chain, has been made approximately equal to the air brake power, based on 50 lb. cylinder pressure.

Since the most vital part of a car is embodied in coupler, draft gear and draft attachments, a great amount of attention was directed to this part of the design. The type D coupler, which is



Double Sheathed Box Cars, Classes 4C and 4D

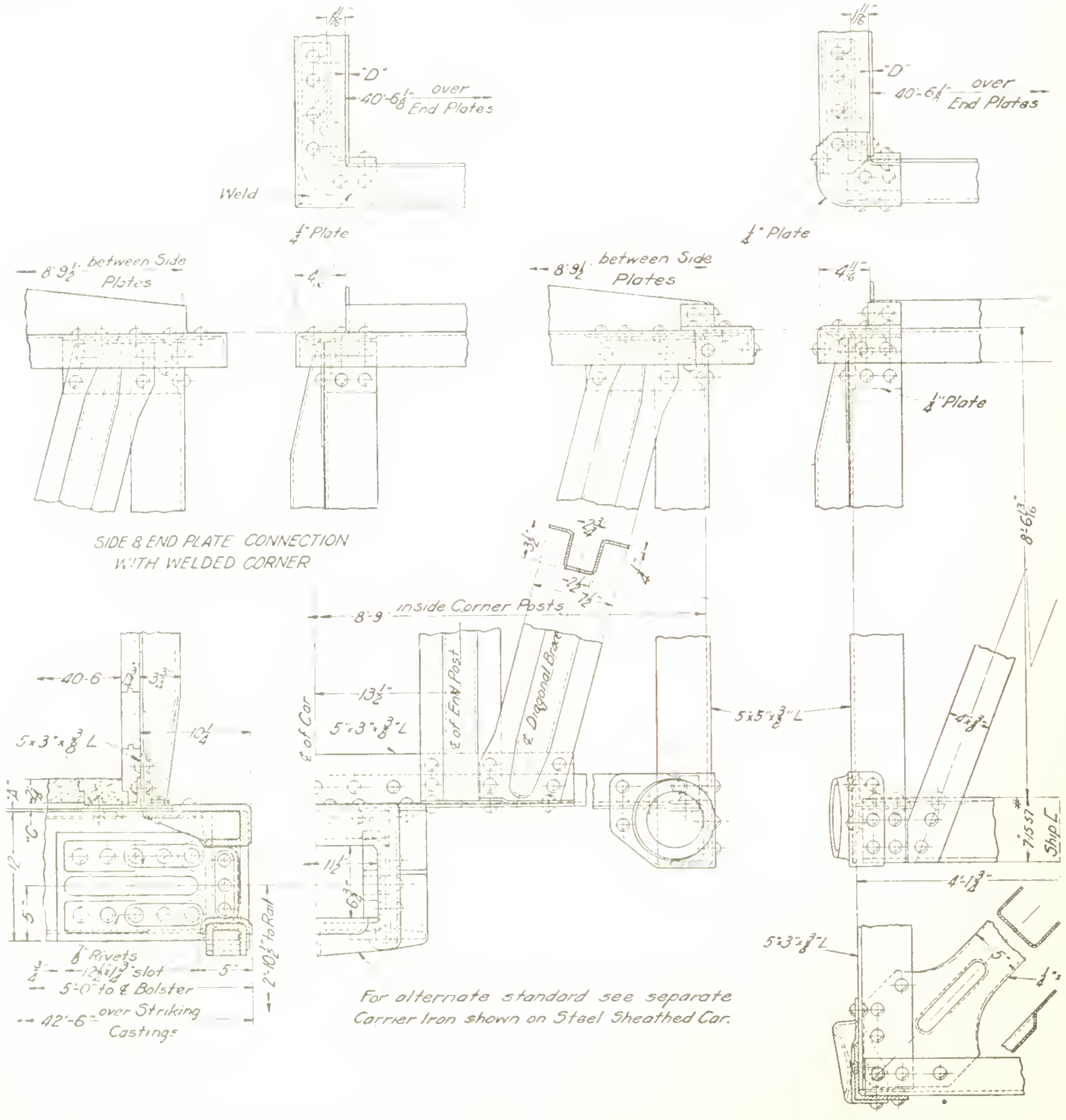


Details of Parts and Methods of Fastening, Double Sheathed Cars

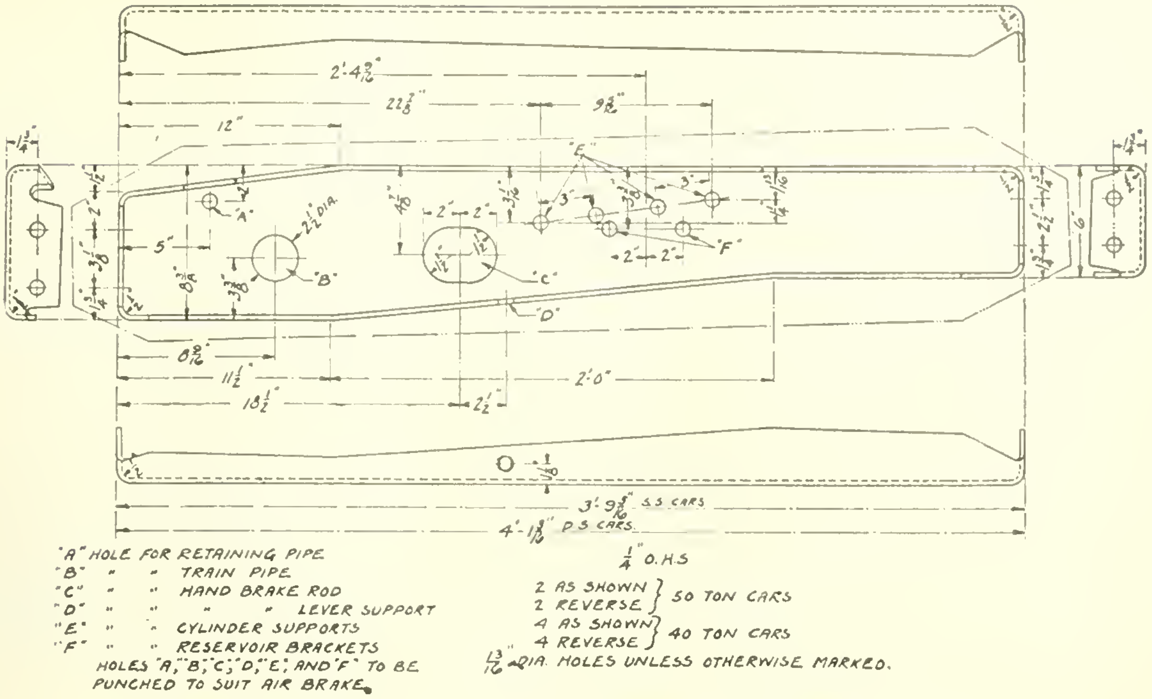
now standard, may be considered equivalent to 15 sq. in. of solid class A cast steel, that is, it will begin to take a permanent set at closely the same compression force as that which would begin to produce a permanent set in a bar of class A cast steel having an area of 15 sq. in.

The committee suggest that the draft gear used should be equivalent to 20 sq. in. of class A cast steel.

The draft gear backstop should be attached to the webs of the center sills with not less than thirty-six ⅞ in. rivets, driven to solidly fill 15/16 in. holes. These do not include the additional



Arrangement of Framing of Single


2'-4 7/16"
22 7/8"
9 3/16"
12"
"E"
"A"
2 1/2" DIA.
"B"
"C"
"D"
"F"
5"
8 9/16"
11 1/2"
18 1/2"
2'-0"
2 1/2"
3'-9 5/16" S.S CARS
4'-1 13/16" D.S CARS
"A" HOLE FOR RETAINING PIPE
"B" " " TRAIN PIPE
"C" " " HAND BRAKE ROD
"D" " " " " LEVER SUPPORT
"E" " " CYLINDER SUPPORTS
"F" " " RESERVOIR BRACKETS
HOLES "A," "B," "C," "D," "E," AND "F" TO BE PUNCHED TO SUIT AIR BRAKE.
1/4" O.H.S
2 AS SHOWN, 2 REVERSE } 50 TON CARS
4 AS SHOWN, 4 REVERSE } 40 TON CARS
13/16" DIA. HOLES UNLESS OTHERWISE MARKED.

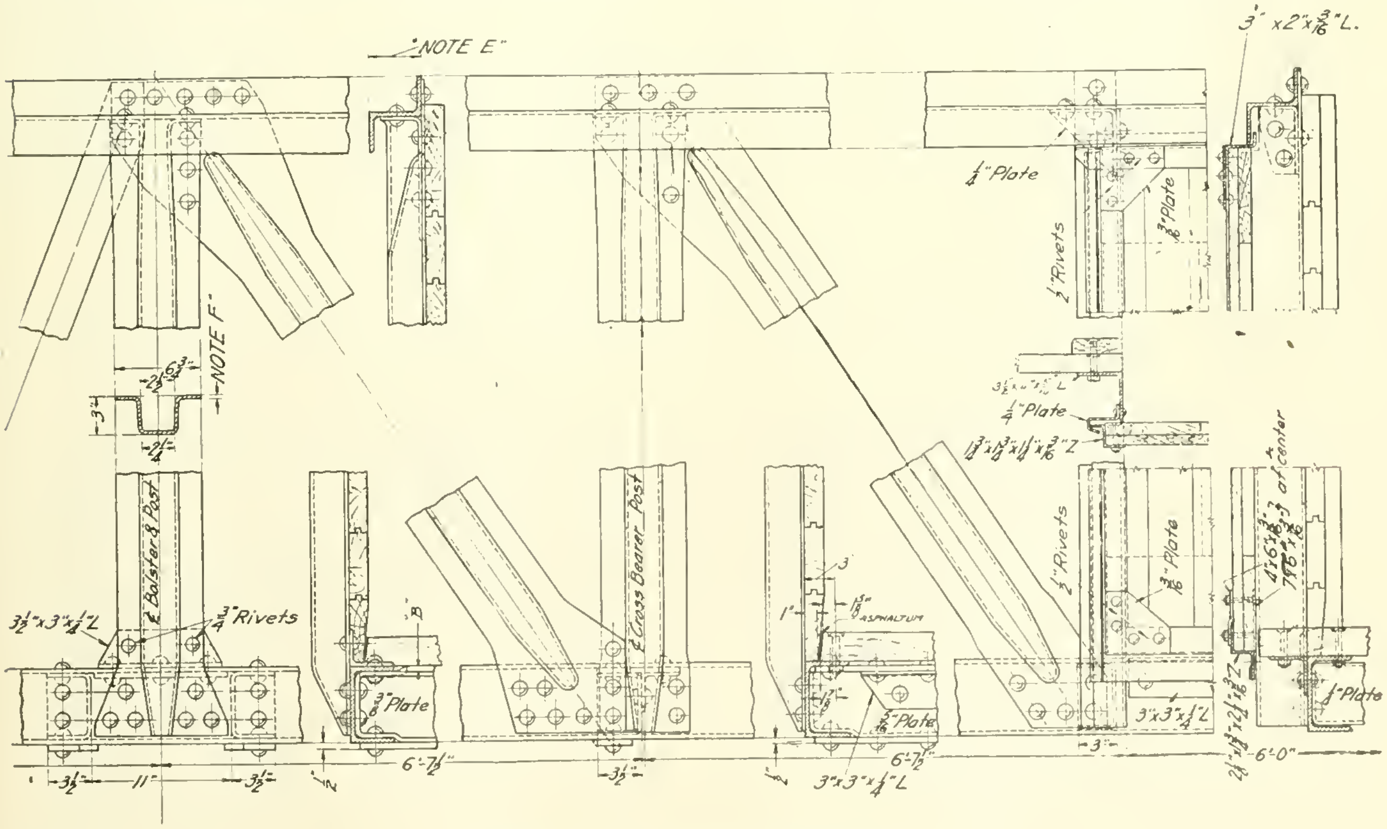
Detail of Cross Tie, Single and Double Sheathed Cars, Classes 4C and 4D

rivets which may be required through the bottom flanges or top and bottom cover plates.

The space for draft gear and followers is 24⅝ in. in length, and 12⅞ in. (distance between center sills) in width.

For draft gears embodying transverse springs, holes may be cut into the webs of the center sills, as required.

To provide for facilitating interchangeability of roofs, the dimensions over outside of flanges of side plates are 8 ft. 10⅛ in., and of end plates are 40 ft. 6⅛ in. for all cars. Likewise the height of doors has been made 8 ft. 5¾ in., and the width 6 ft. 3 in., for all cars. The car ends could not be made interchangeable without detriment to the car designs.

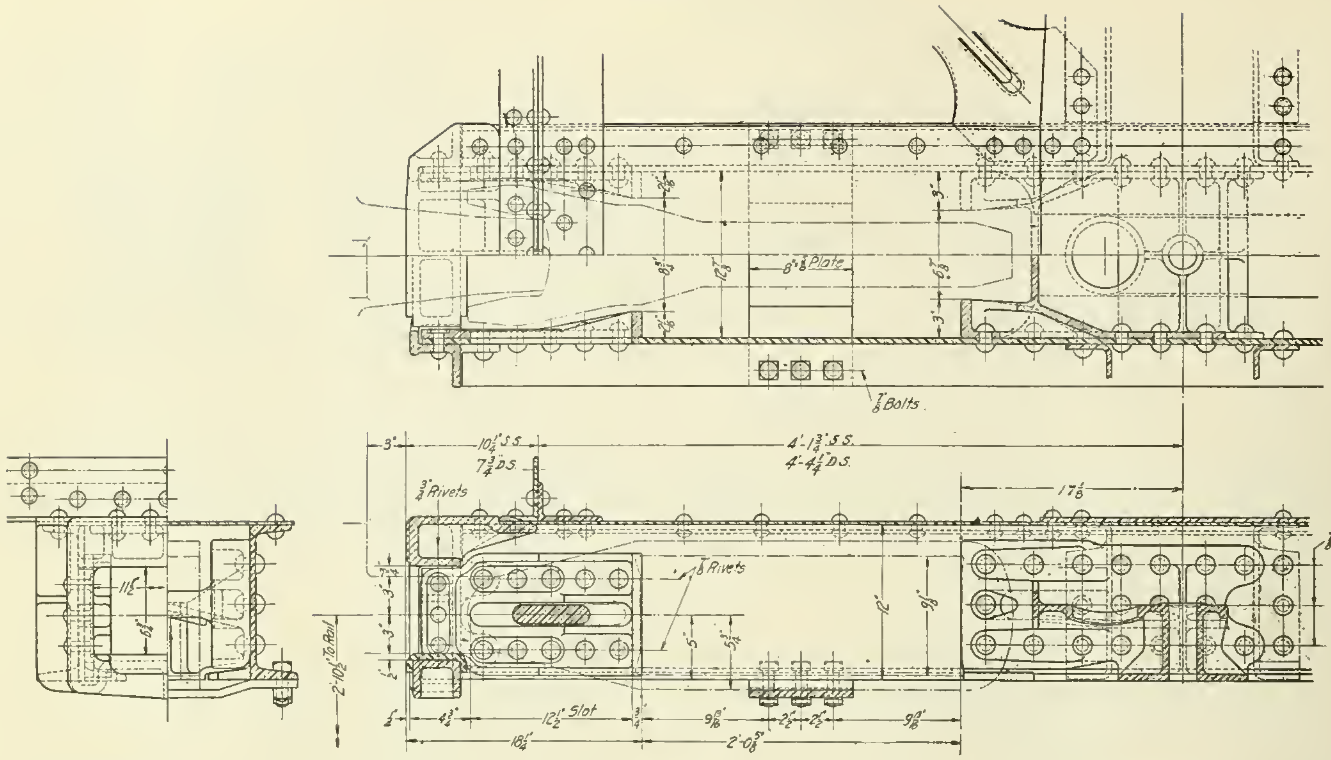


CAPACITY	"A"	"B"	"C"	"D"	"NOTE-E"	"NOTE-F"
40-Ton	3/8"	3/8"	5/8"	1/4"	4"-8.2# Z	3/16" plate
50-Ton	1/4"	1/2"	3/4"	5/16"	4 1/16"-10.3# Z	1/4" plate

NOTE:- ALL RIVETS 3/4" DIA. UNLESS OTHERWISE NOTED.

Note:- Crosstie applied in place of Crossbearer on 40-Ton Car.

Sheathed Cars, Classes 4C and 4D



Arrangement at Draft Gear, Single and Double Sheathed Cars with Vertical Yoke Draft Gear Classes, 4C and 4D

General specifications for these cars have been prepared, and are appended hereto.

The estimated weight of each car, based on using fir lumber, is 40,000 lb. for the single sheathed 4/C car, 43,000 lb. for the single sheathed 4/D car and, correspondingly, about 500 lb. more for the doubled sheathed cars, each based on detail design as shown.

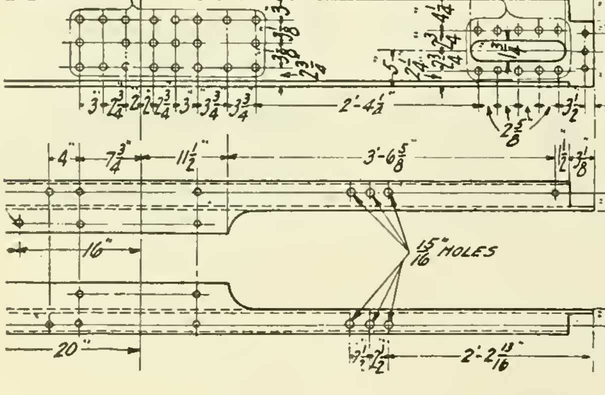
Probably more time and study are embodied in these designs than in any previous design, but it is expected that when the first cars are built slight modifications will be found advisable, to better facilitate shop operations. The committee will incorporate such modifications in the design, and will add details as required.

To complete the design of these box cars it was necessary to also include designs of trucks.

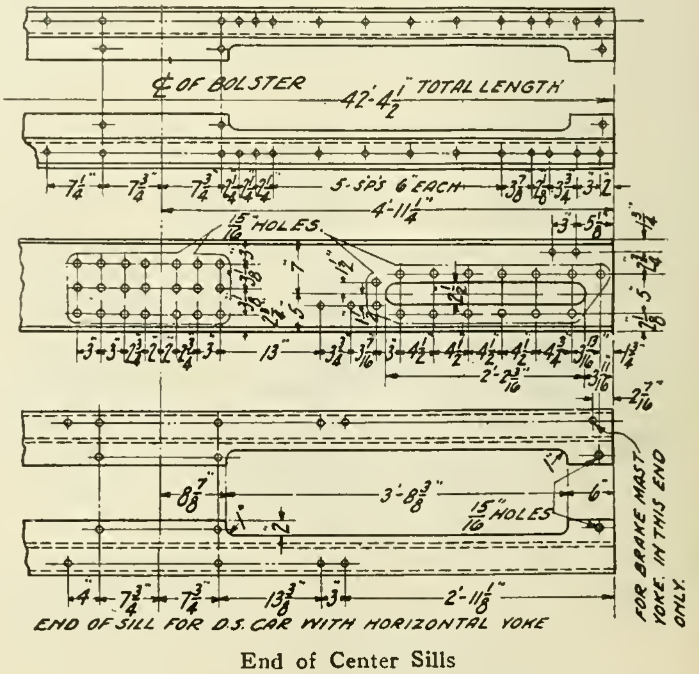
Whatever truck design is now adopted will, naturally, have to also fit any other types of cars that may be used in the future. It was, therefore, deemed desirable to design trucks of the 2/C, 2/D and 2/E classes, on the basis of minimum weight and adequate strength, to meet loaded car weights equal to the axle capacities.

The committee submits, for approval, as standard trucks, the 2/C, 2/D and 2/E types shown on the general plan, with alternates covering side frames having either integral or separable boxes.

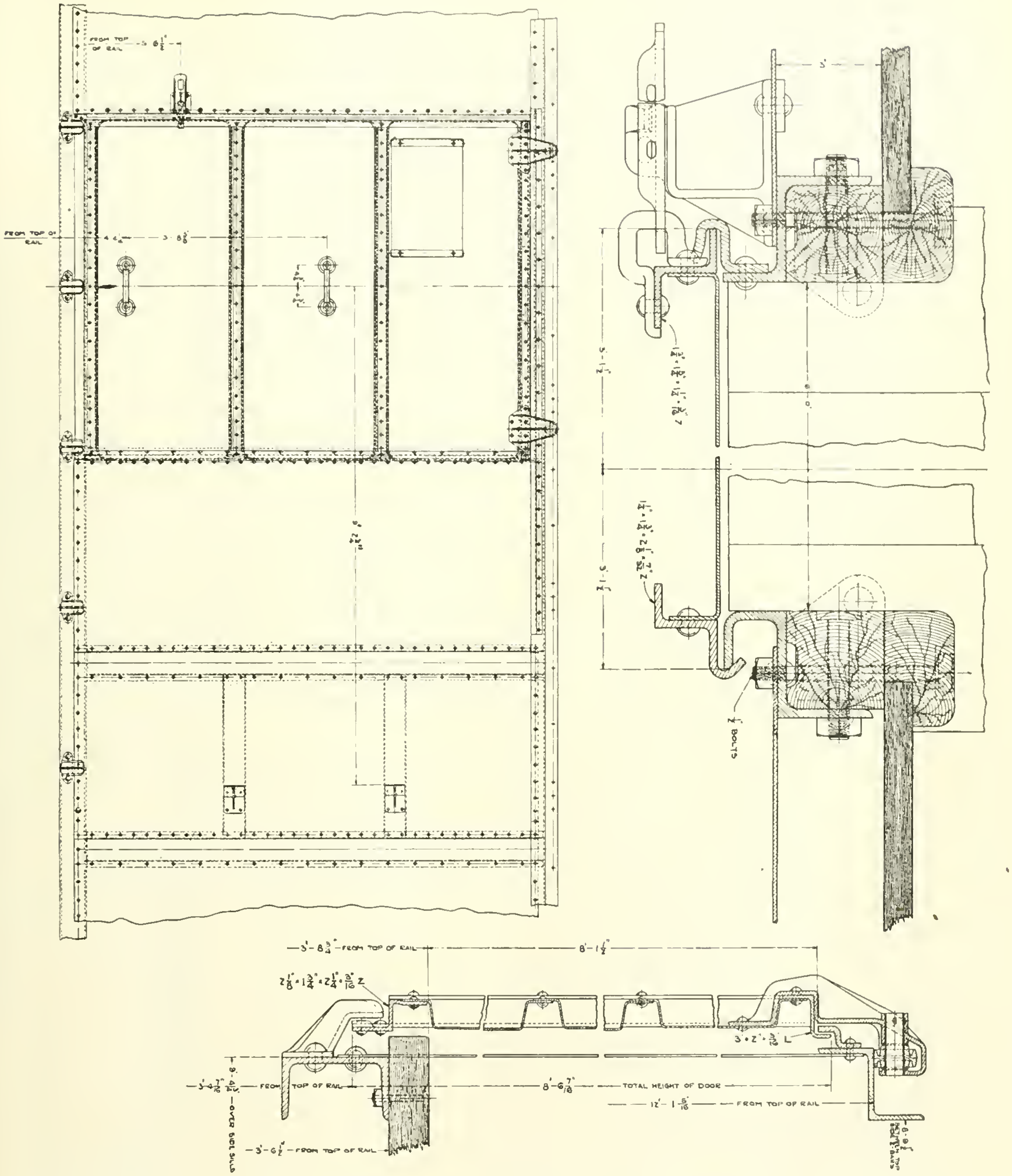
Bolster designs cover cast steel bolsters with integral and separable center plates, also pressed steel bolsters. The general drawing shows the recommendations for all the general fixed limitations. A special effort was made to maintain as large a distance between the top of the rail and the bottom of the side frame as possible. The committee believes that this distance, under any conditions of service, should not be less than 4½ in.



End of Center Sills
Single Sheathed Cars with Vertical Yoke



End of Center Sills
Double Sheathed Cars with Horizontal Yoke


FROM TOP OF RAIL
FROM TOP OF RAIL
3'-8$\frac{3}{4}$" FROM TOP OF RAIL
8'-1$\frac{1}{2}$"
2$\frac{1}{8}$"×1$\frac{3}{4}$"×2$\frac{1}{4}$"×$\frac{3}{16}$" Z
3"×2"×$\frac{3}{16}$" L
8'-6$\frac{7}{16}$" TOTAL HEIGHT OF DOOR
12'-1$\frac{5}{16}$" FROM TOP OF RAIL
3'-6$\frac{1}{2}$" FROM TOP OF RAIL
OVER SIDE SILLS
$\frac{3}{4}$" BOLTS

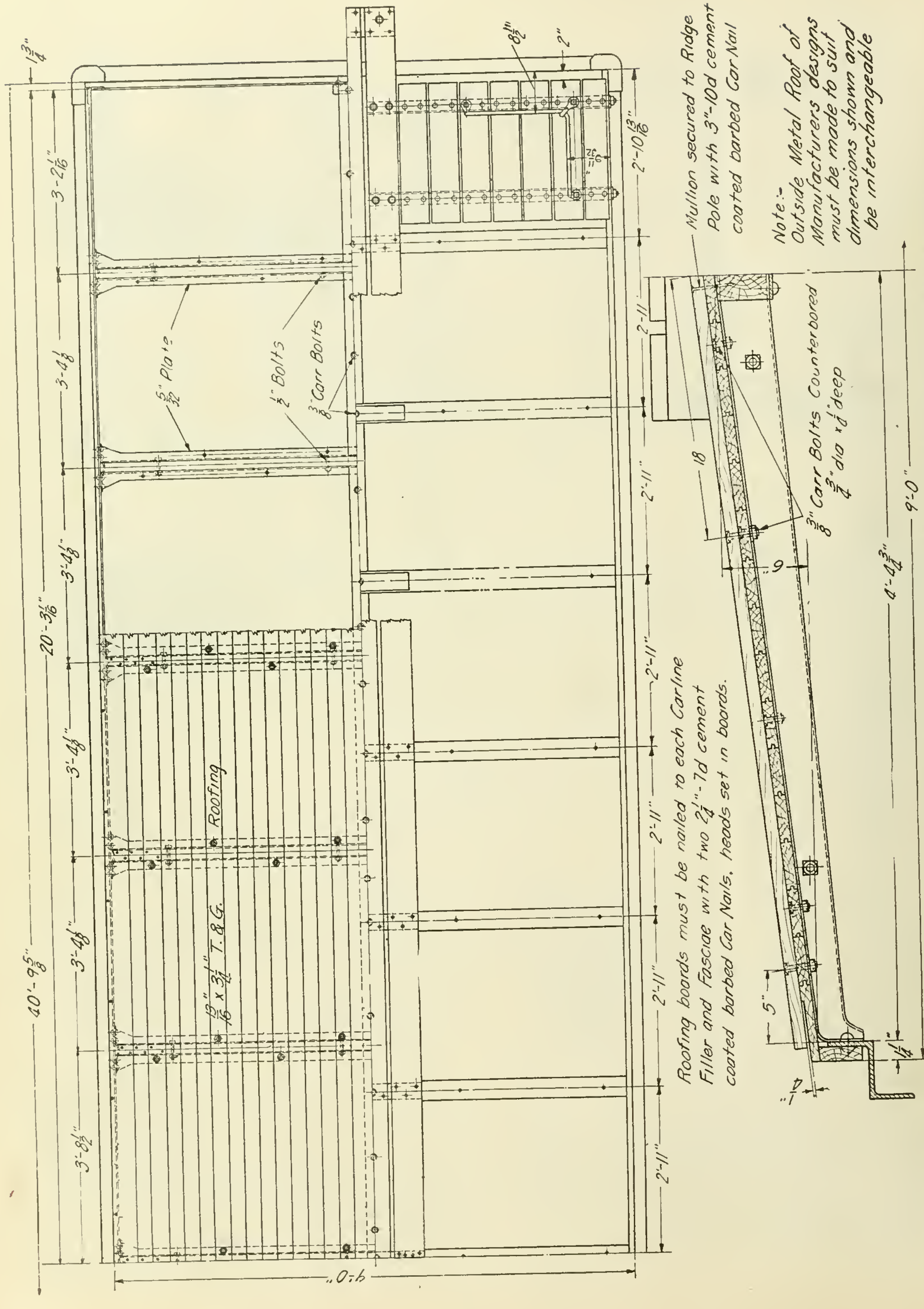
Steel Door Arrangement Shown Applied to D. S. Car, Single and Double Sheathed Cars, Classes 4C and 4D

A. R. A. standard fundamentals have been observed throughout. The stresses in side frames, bolsters, and other parts, have been very carefully calculated on generally accepted methods of calculation. It is the intent of the committee, at some time in the future, to submit to the association methods on which side frames and bolsters should be calculated and tested, similar to the data formerly submitted for axles.

It will be noted that two types of journal boxes, lettered W and Y are shown. Box W shows a development of the desire to provide a separable box side frame as light as possible, which does away with some of the trouble experienced with the ordinary box bolt. Box Y shows the side frame and box cast integral.

The arrangement as shown with boxes W and Y give, by far, the lightest side frames of any satisfactory design considered, and are recommended for adoption as alternate standards.

The opening for the bolster in the side frames provides for sufficient clearance over the top of the bolster to provide for lining up under the springs to compensate for 1½ in. reduction in radius

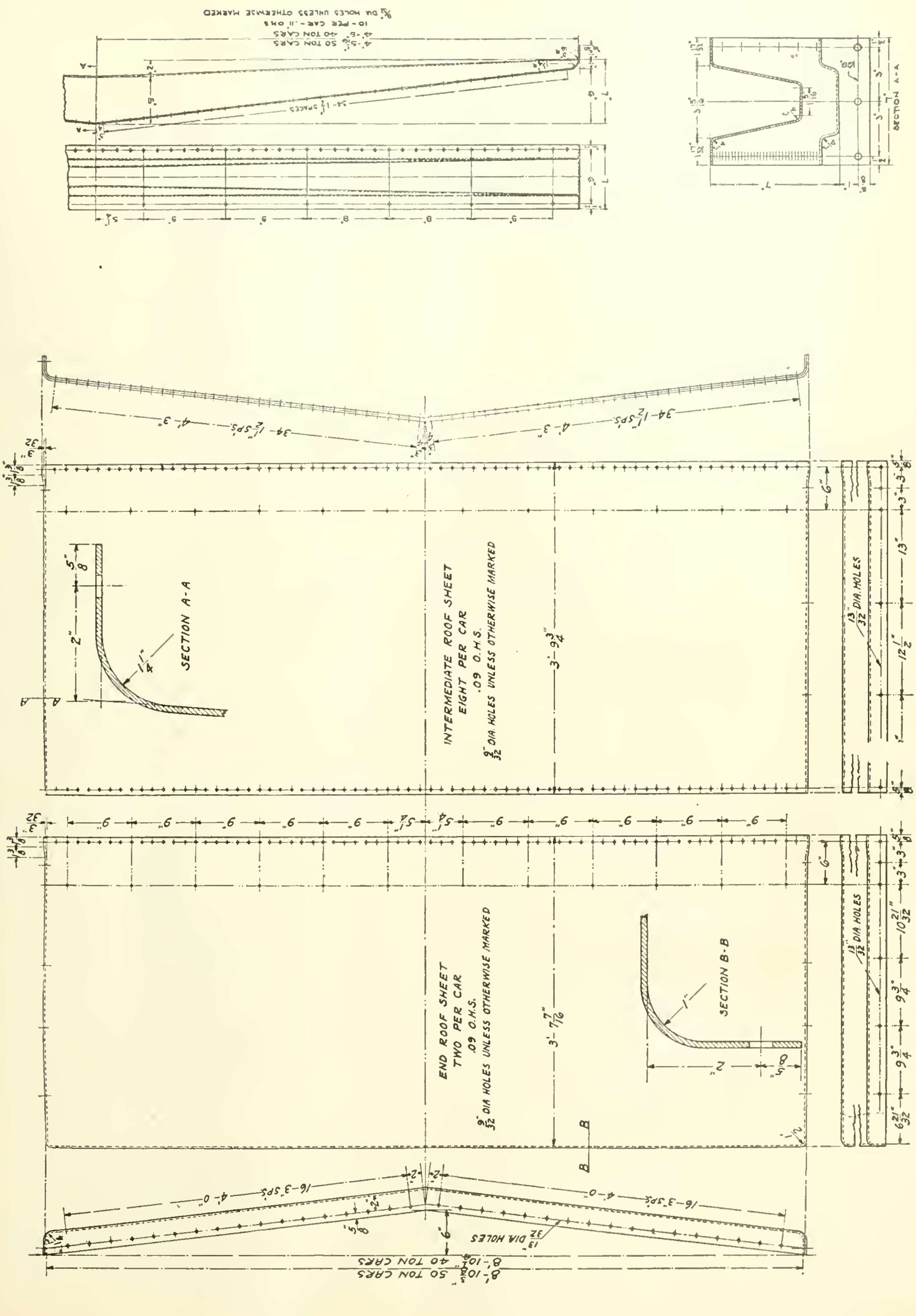


Roofing boards must be nailed to each Carline Filler and Fasciae with two 2 1/4"-7d cement coated barbed Car Nails, heads set in boards.

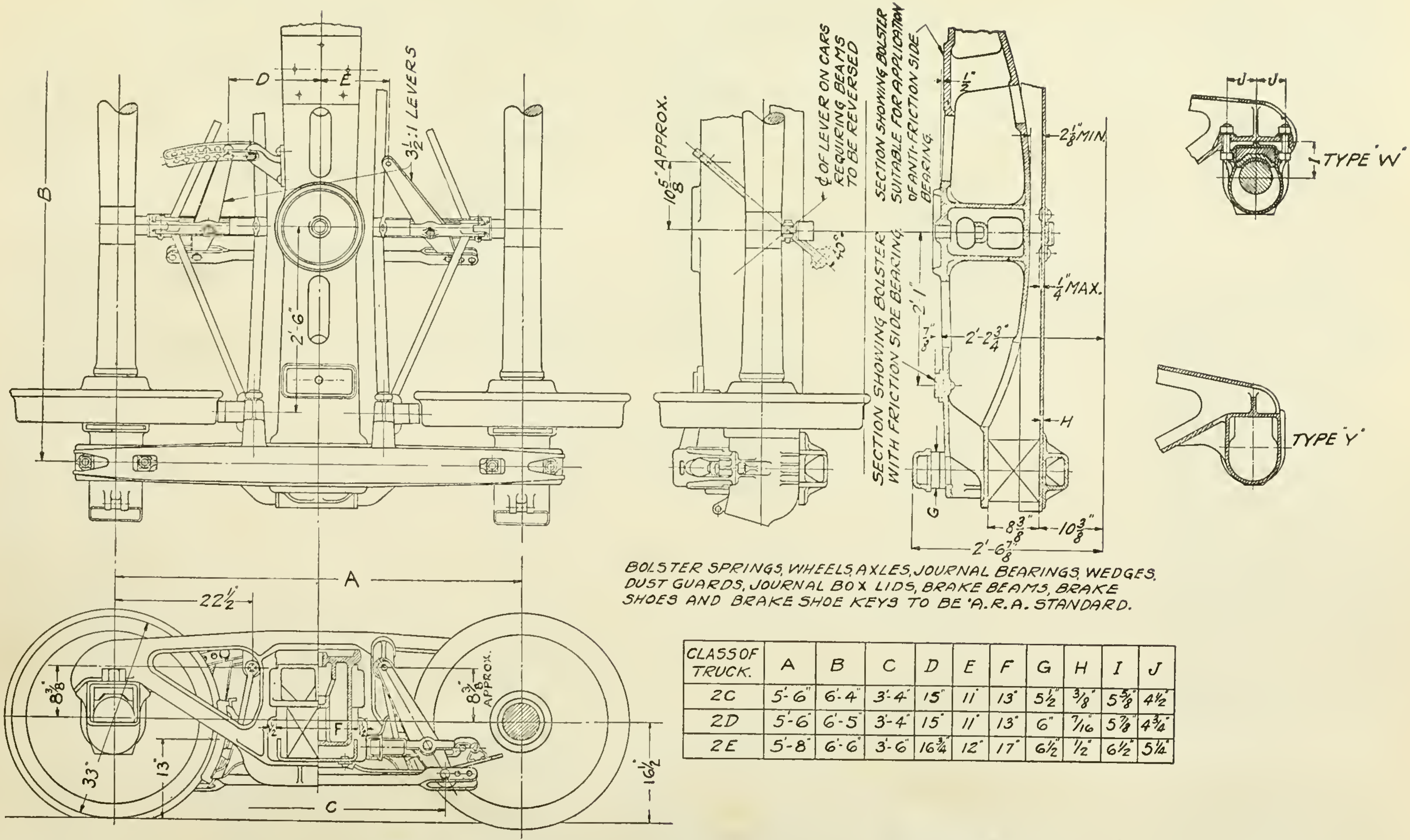
Mullion secured to Ridge Pole with 3"-10d cement coated barbed Car Nail

Note:- Outside Metal Roof of Manufacturers designs must be made to suit dimensions shown and be interchangeable

Roof Arrangement, Single and Double Sheathed Cars with Outside Metal Roof, Classes 4C and 4D



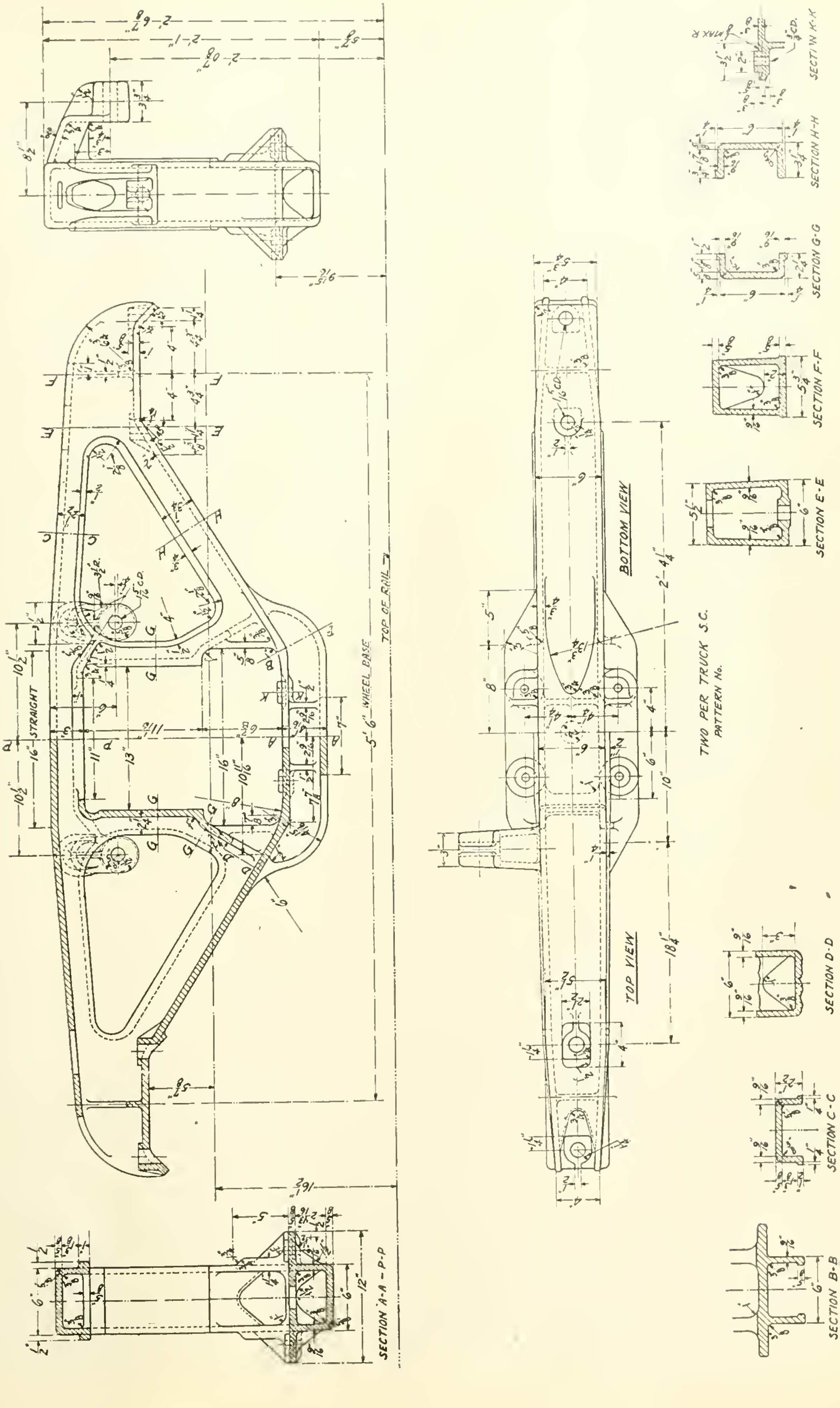
Roof Sheets and Carline, Single and Double Sheathed Cars with All-Steel Roof, Classes 4C and 4D


B
D
E
3½:1 LEVERS
2'-6"
10⅝" APPROX.
℄ OF LEVER ON CARS REQUIRING BEAMS TO BE REVERSED
40°
SECTION SHOWING BOLSTER WITH FRICTION SIDE BEARING.
SECTION SHOWING BOLSTER SUITABLE FOR APPLICATION OF ANTI-FRICTION SIDE BEARING.
½"
2⅛" MIN.
¼" MAX.
2'-1"
7⅜"
2'-2¾"
H
G
8⅜"
10⅜"
2'-6⅞"
J
J
I
TYPE 'W'
TYPE 'Y'
A
22½"
8⅜"
8⅜" APPROX.
F
33"
13"
16½"
C

BOLSTER SPRINGS, WHEELS, AXLES, JOURNAL BEARINGS, WEDGES, DUST GUARDS, JOURNAL BOX LIDS, BRAKE BEAMS, BRAKE SHOES AND BRAKE SHOE KEYS TO BE 'A.R.A. STANDARD.

CLASS OF TRUCK.	A	B	C	D	E	F	G	H	I	J
2C	5'-6"	6'-4"	3'-4"	15"	11"	13"	5½"	⅜"	5⅝"	4½"
2D	5'-6"	6'-5"	3'-4"	15"	11"	13"	6"	7/16"	5⅞"	4¾"
2E	5'-8"	6'-6"	3'-6"	16¾"	12"	17"	6½"	½"	6½"	5¼"

Arrangement with Integral Center Plate Bolster, Trucks, Classes 2C-2D-2E, Types W and Y



Truck Side Frame, Class 2D, Type W

of wrought steel wheels, and reasonable wear on journals and brasses. This opening has also been arranged to facilitate the use of Barber or similar rollers under the bolster ends for roads which prefer that construction.

The guide for the live lever has been entirely omitted. The guide for the dead lever has been made exactly the same for all trucks.

On the 2/E truck the pin connecting the lever with the dead lever guide would have to be applied in the second hole, instead of the first hole. The dead lever guide fulcrum bracket is the same for all trucks of which the bolsters have separable center plates.

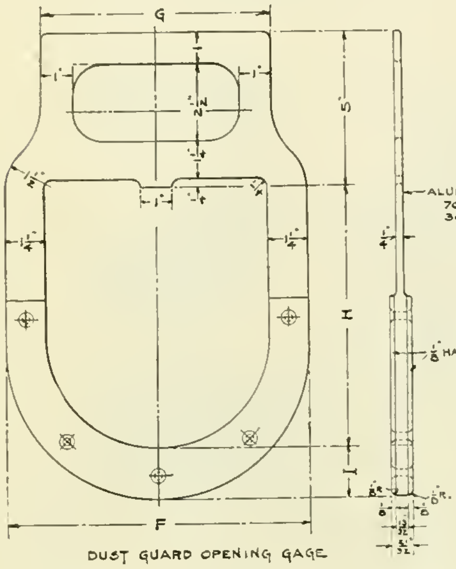

G
F
H
I
N
S
ALUMINUM CASTING 70 ALUMINUM 30 ZINC
1/8 HARDENED STEEL PLATES.
DUST GUARD OPENING GAGE

Fig. 4.—Gage for Dust Guard Opening of Journal Box

Another design of bracket is used for all bolsters in which the center plate is integral.

The thickness of the spring plank for the 2/C truck is ⅜ in.; for the 2/D 7/16 in.; and for the 2/E truck ½ in.

The side frames are provided with bosses, over which the spring planks are set. The holes in the spring planks should be made to fit these bosses closely.

On the 2/C and 2/D trucks a 13 in. channel may be substituted for the pressed spring plank.

Since the instructions to this committee required that it present designs which may be made complete, the committee has included what may be considered the simplest and most efficient details, in each case, and such which would involve the least amount of maintenance cost. It should, of course be understood that other details, of equal strength and entirely interchangeable, may be substituted, such as I-section brake levers, hollow brake lever spreaders, etc.

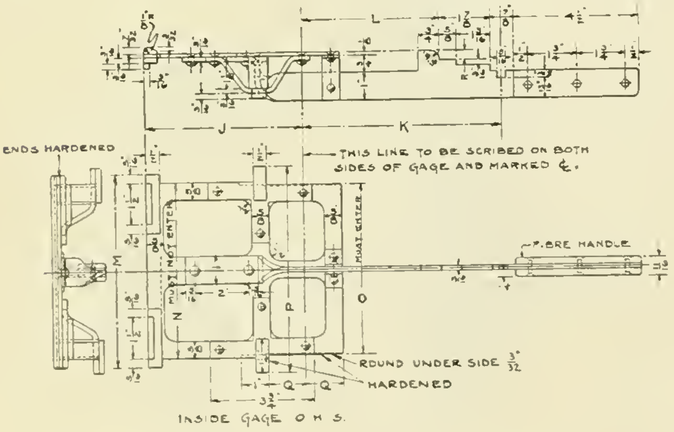


Fig. 5.—Gage for Inside of Journal Box

Many inquiries relating to whether it is intended that these designs become obligatory in every detail impels us to repeat the statement made in our report, dated June 6, 1921:

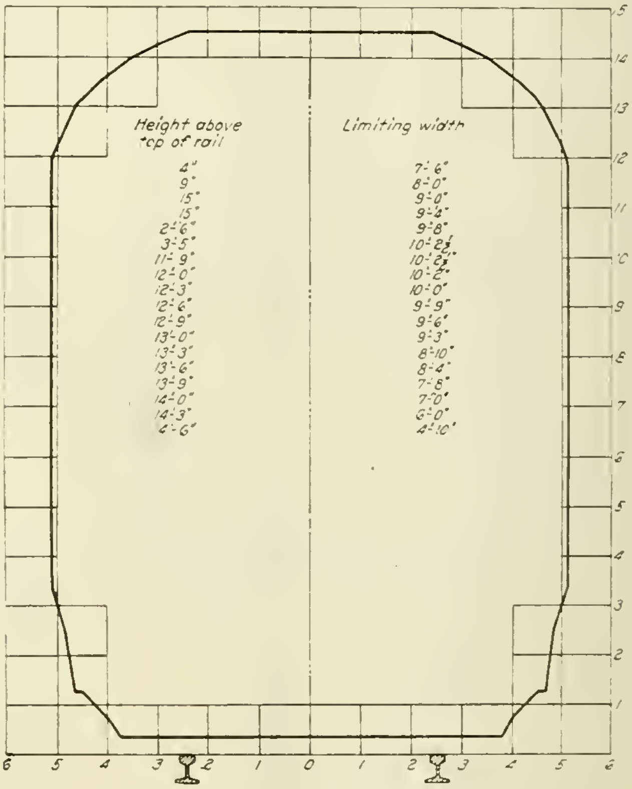
"The intent of the committee is to make designs that will establish fixed conditions, permitting the use of detail designs standardized by the association, or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts, or group of parts, are the equivalent in strength, service and safety of, and interchangeable with, the standard part or group of parts replaced."

Patents

The patent situation on detail parts has been investigated to some extent. A more complete investigation will have to be made, in order to determine clearly in how far patents on which royalties may be required obtain. This committee expects to make modifications that may seem desirable to eliminate the necessity of paying royalties where an equally good design, not subject to patents, can be substituted.

Instructions have been requested concerning how the patent situation shall be handled. It is the intent of the committee to pursue the question of patents as thoroughly as possible, as soon as the instructions requested materialize.

If any members of the association find anything in the designs which are submitted herewith, that they know is patented, we shall be very glad to have them advise the secretary of the association, or the chairman of this committee, in regard to the same, so that the necessary investigation can be made.



Height above top of rail	Limiting width
4"	7'-6"
9"	8'-0"
15"	9'-0"
15"	9'-4"
2'-6"	9'-8"
3'-5"	10'-2½"
11'-9"	10'-2½"
12'-0"	10'-2"
12'-3"	10'-0"
12'-6"	9'-9"
12'-9"	9'-6"
13'-0"	9'-3"
13'-3"	8'-10"
13'-6"	8'-4"
13'-9"	7'-8"
14'-0"	7'-0"
14'-3"	6'-0"
4'-6"	4'-10"

Fig. 6.—Limiting Outline for Freight Cars

The Committee recommends that one or more cars of each of the types covered by this report, be built in the near future.

Specifications for A. R. A. Box Cars

1. General Requirements: Cars, when delivered, shall be complete in all parts ready for service, shall conform to A. R. A. Standards, recommended practice and to the following specifications.

Where the A. R. A. Standards, recommended practice, design and these specifications permit options, there shall be a definite agreement between the builder and purchaser as to which of the optional details shall be used. They shall also agree as to method and place of inspection of cars and of material.

The purchaser shall furnish the builder all necessary information relating to paint, marking, lettering and stamping desired in addition to that covered by A. R. A. requirements for both material and completed car.

All lumber used shall be kiln dried.

All steel plates ¼ in. and less in thickness, pressed parts made therefrom and channel side sills shall include a content of copper of not less than 0.20 per cent.

2. Axles: Journals and wheel fits shall be finished smooth and true to gage. Journals shall be burnished. The heat number of the axle shall be transferred from the black collar to the other end of the axle in the presence of the inspector.

3. Side Frames: The size of journal shall be cast on outer side of each steel frame in numbers not less than 1 in. high.

4. Truck Bolsters: The owners' initials and the car number shall be stenciled in letters and numbers not less than 1 in. high on one side of each bolster.

5. Center Plate Bearing Surface: For center plates cast integral with truck bolster the center plate bearing surface shall be machine finished or ground. All center plate contours shall conform to limiting gages.

6. Fundamentals Governing Areas of Sections: Where such fundamentals are specified in A. R. A. Standards or recommended practice they refer to grade A material in proposed specification for carbon steel castings, which require a yield point not less than 29,250 lb. per sq. in. with an elongation, per cent in 2 in., of not less than 1,450,000÷tensile strength. If Grade B material, having a yield point not less than 36,000 lb. per sq. in., with an elongation, per cent in 2 in., not less than 1,600,000÷tensile strength is used a reduction of area of 12½ per cent will be allowed. Rolled or forged steel which meets the same yield point and elongation requirements shall have the same allowance for reduction of area.

7. Draft gear keys shall be quenched and tempered carbon steel forgings.

8. Rivet holes shall match and drifting shall not be allowed. Holes, which do not match shall be reamed. Rivets, after they are driven, shall completely fill the holes, and shall have heads of the proper shape lying tightly against the sheets or castings.

9. Flanging of sheets must be true to shape to provide close contact with contiguous parts.

10. Joints in superstructure and roof must be water-tight—Asphaltum paper about 1/16 in. thick shall be placed between riveted joints of all-steel roofs.

11. Brake pipes shall have smooth edges free from fins and burrs. A thin coat of graphite grease shall be applied to the male threads only and care shall be taken to keep the grease from the inside of pipe and fittings. Connections shall be tested under 100 lb. gage pressure, using soap-suds to determine leaks. The completed brake installation shall be finally tested to determine proper working and absence of interferences.

12. All metal parts shall be free from scale and rust and thoroughly clean before they are painted.

13. Metal in contact with wood or metal and where not accessible after assembling must be covered with one coat of thick paint, red lead lute or lamp black lute.

14. Trucks (except wheels, axles and parts contained in journal boxes) and underframes shall have two coats of paint, the first preferably of freight car color and linseed oil and the second A. R. A. black paint.

15. Two coats of approved paint shall be applied to the outside of the superstructure and one coat to the inside of steel sheets. All-steel roofs shall have two coats of paint on each side.

16. The joints between floor boards and sheathing or lining shall be carefully filled with an asphaltum or similar compound which will not be brittle at 0 deg. F. and will not flow at 150 deg. F.

17. White lead paint shall be used for all stenciling.

The members of the committee are: W. F. Kiesel, Jr. (chairman), mechanical engineer, Pennsylvania System; A. R. Ayers, assistant general manager, New York, Chicago & St. Louis; C. E. Fuller, superintendent motive power and machinery, Union Pacific; J. C. Fritts, master car builder, Delaware, Lackawanna & Western; C. L. Meister, mechanical engineer, Atlantic Coast Line; J. McMullen, superintendent car department, Erie Railroad; T. H. Goodnow, superintendent car department, Chicago & North Western; John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe; W. O. Moody, mechanical engineer, Illinois Central; J. A. Pilcher, mechanical engineer, Norfolk & Western; H. L. Ingersoll, assistant to president, New York Central; W. H. Wilson, assistant to vice-president, Northern Pacific; F. W. Mahl, director of purchases, Southern Pacific; W. H. Winterrowd, chief mechanical engineer, Canadian Pacific, and G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific.

Discussion

W. F. Kiesel, Jr. (Penn. System): After the heading "Fundamentals: Center Sill Area," add the following: "There has been a great deal of discussion in connection with that in the last two or three years and the committee is now unanimous."

Mr. Kiesel: Since coming to Chicago, quite a number of people have raised the question as to whether it is intended that we recommend permitting interchangeable ends. Possibly this reading does not give the intent of the committee clearly. The intent is that the designs shown on the drawings for single sheathed and double sheathed cars are not of the same width and therefore are not strictly interchangeable as drawn, but it was meant that corrugated ends or any other kind of ends may be substituted since that is already a standard of the Association.

There is no intention of abrogating the rule which is now in the manual relating to corrugated ends. We may be able to make this a little more clear by making the clause read as follows:

"Car ends should not be made interchangeable between single and double sheathed cars. Other ends preferred and applied by individual railroads should be equal in strength, serviceability and interchangeability with those shown."

I believe I could say for the committee that it should be substituted for the reading we have here, and I think it will clarify that point which so many have called our attention to.

I would like to refer again to the question of the ends. It is the full intent of the committee that the rule which is now in the manual in regard to corrugated should remain there and should govern.

Chairman Coleman: The secretary has two communications which he will read.

Secretary Hawthorne: The first is a communication from the T. H. Symington Company, signed by C. J. Symington, president, dated June 18, 1923, and is as follows:

"We have noted the paragraph in the advance copy of the report of the A. R. A. Committee on Car Construction, reading as follows:

" 'The combined bolster filler and backstop casting shown in the design is recommended for use, provided the owner or owners of patents on the combined bolster filler and backstop casting, permit the free use of the combined bolster filler and back stop casting without restriction or any obligation whatsoever, by any railroad or car owner whose cars are used under the jurisdiction of the A. R. A. or its successors.'

"As we are the owners of existing patents and have also numerous pending applications for patents on the combined bolster filler and backstop castings shown in the drawings accompanying the above report, we wish to assure the American Railway Association that our waiver of patent rights as contained in my letter to you of May 19, 1921, constitutes an absolute and unrestricted license to all railroads and car owners whose cars are used under the jurisdiction of the A. R. A. or its successors, to make or have made and to use the combined bolster filler and backstop castings as shown in these drawings, with either the vertical or horizontal yoke attachments, without further license from this company under any patents now owned or controlled by us or that may in the future be issued upon any pending application now owned or controlled by us."

The Secretary: I have another communication signed W. F. Kiesel, Jr., chairman of the Committee:

"The arrangement of side frame with separate journal box, shown in the report, is covered by my patent No. 1,433,380, dated October 24, 1922. Another patent, serial No. 602,138, covering the construction of the central portion of both frames shown in that report, is now pending, on my application.

"I hereby agree that designs adopted by the American Railway Association, either as standard or as recommended practice, and subject to either, or both, of the aforesaid patents, may be built by, or for, any railroad or car owner whose cars are used under the jurisdiction of the American Railway Association, or its successors, without payment of any royalty, or other obligations, on account of said patents."

F. H. Hardin (N. Y. C.): The Committee on Car Construction is to be complimented for the detail in which it has presented this report as it, without question, involved a tremendous amount of work. I have, in the short time that has elapsed since this report was distributed, run through the report and made a number of notations of miscellaneous details that would, I think, require considerable time to discuss and which discussion would probably be profitable.

I realize, however, the hopelessness of undertaking to discuss all minor details and yet I hardly see how it will be possible to cast an intelligent vote without full detailed consideration of all such matters.

There are a few items which I choose to call fundamental to which I wish to draw particular attention. I discussed in a general way some of these matters with Mr. Kiesel yesterday afternoon and he feels that while there may be a difference in interpretation of the words, the fundamentals are not up for discussion. I must take issue with Mr. Kiesel on that point.

I maintain that anything included in this report by omission or commission or inference is subject to discussion and that it is the duty of this convention to discuss fully any points about which there is a doubt.

I would draw attention to the brake arrangement on the two cars submitted. A plan of the brake is given in one drawing presented with the report and on the brake cylinder lever, dimensions are marked *A* and *B*. Immediately thereunder is a notation "Dimensions *A* and *B* to be adjusted to suit desired brake power." On the detail drawing, however, the brake cylinder lever is shown in the upper left-hand corner and includes dimensions *A* and *B* with a note reading "Cylinder levers are proportioned for a total brake power of 31,000 lbs. per car with a cylinder pressure of 50 lbs. per sq. in." This will give in one case a braking power of approximately 72 per cent, and in the other a braking power of approximately 77 per cent. It would appear proper to eliminate those dimensions by making notation thereon similar to the one appearing on the preceding page, or else state that the dimensions should conform to A. R. A. standard practice, which is 60 per cent.

Bottom-Supported Door as an Alternate

Doors of the top-supported type are shown for both cars. Our experience has been that the advantage lies with the door supported at the bottom. It is difficult to operate a freight car door which is hanging from the roof unless the car is alongside the platform. The door supported from the sill, which is the foundation of the car, can be more readily operated and has a better support. It may have been intended that an alternate could be used in this case, but no specific statement is made to that effect. We feel that the drawing involved should bear a notation that a bottom-supported door can be applied as an alternate.

Mr. Kiesel suggested last night that it would be in order to make a motion to the effect that the committee be instructed to submit also a bottom-supported door. I believe that a notation on the drawing would fully cover the matter without the necessity of a complete design.

The drawing showing coupler release details apparently does not include an alternate—whether one was intended or not I do not know. The release rigging shown is one which, while I have not time personally to check it, I understand will not operate the type E coupler. I think this drawing should also bear the notation that other types of rigging conforming to safety appliance standards will be accepted as alternates.

The statement is made in the body of the report that two designs of roof are shown which in the opinion of the committee represent the best of their respective types.

The outside metal roof shown apparently has inclosed carlines of the same section as the U. S. R. A. carlines, which, as a good many of you know, have given considerable trouble. Carlines in this case have been more firmly attached to side plates than in the U. S. R. A. car, but the breakage has been through the carline itself and not through the attachment to the side plate. The same situation applies to a certain extent in the riveted-up steel roof. Carlines used are of a lighter construction than the U. S. R. A. carlines. In addition to this, the riveted-up type of roof involves apparently an excessive number of vertical rivets in the roof, which we consider objectionable. Vertical rivets represent possibilities for leaks in a roof, which could not occur with horizontal rivets. A small content of copper has been specified in the roof sheets. This will no doubt retard but will not prevent corrosion.

It is no doubt also the intention of the committee to permit substitution of other designs, but it is felt that it should be so stated specifically on the drawings. So far as these matters are concerned it may be considered that they are partially covered at least in the statement in the report reading as follows: "The intent of the committee is to make designs that will establish fixed conditions permitting the use of detailed designs standardized by the Association or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts or groups are the equivalent in strength, service, safety of and interchangeable with the standard part or group of parts replaced."

That statement while appearing in the report is not a part of the specification, and will be the source of considerable argument to determine when a substitution is equivalent in strength, in service, in the safety of and interchangeable with the standard part or group of parts replaced.

Take for example the question of roofs. It should appear that it might be reasonable to permit the use of any outside metal roof or any riveted steel roof if conforming to the general dimensions shown in the drawing, and if that should be agreed upon it should appear on the drawing itself and therefore become a part of the specification.

Mr. Kiesel referred to the question of corrugated ends. An end is shown in the drawing for these cars which I believe is heavier, more expensive, weaker and occupies more room or takes up more space than the corrugated steel ends. The recommended practice of the Association adopted in 1914, revised in 1920, specifically mentions the use of corrugated steel ends and on the drawing showing the end of the car we believe should appear the notation that the recommended practice of the Association of 1914, revised 1920, is a part of this specification.

The question of the center sill area, of course, has occupied considerable time and discussion in the past. It may or may not be up for discussion at the present time, but it appears that a lot of material has been added to the center sill for the strengthening of the car and no allowance made for the effect of draft gear capacity. A 150,000 lb. capacity draft gear of approved make, presumably makes the car safe from the standpoint of resistance to shocks. The use of a heavier capacity draft gear to relieve the sills from shock will reduce the ultimate blow to the sills more than can be achieved by adding 6 sq. in. in section area to the sills.

These are the fundamental matters that I had in mind, and, as stated in the beginning, considerable time could be devoted profitably to the discussion of a large number of miscellaneous details, but the time is too short and none of us I believe have had full opportunity carefully to review all the details involved.

Corrugated Ends Recommended

I believe the presentation of this design is one of the most important subjects that has come before the Association in years. There is no haste that I see. There are no exigencies that existed such as confronted the standards of the United States Railroad Administration in their car design, and we are inclined to feel that more time for deliberation and study of this matter should be given, not only to the members of the Association, but possibly to the members of the committee in answering some of the questions which have been raised and which no doubt will be raised in the future. We have no desire whatever to tear down what this committee has built up and we do not take the position of opposition to the policy of a standard car. Quite the contrary is the case, because the New York Central early in 1920 adopted the U. S. R. A. car standards as their own and is using those standards to this day with certain modifications, and that move was made largely to facilitate the work the A. R. A. had undertaken in designing a standard car. This, I believe, was the first definite move in the direction of the adoption of a standard car.

In view of these things, Mr. Chairman, I move that the report of the Committee on Car Construction be accepted as a report of progress only.

Discussion by Mr. Sillcox

L. K. Sillcox (C. M. & St. P.): The Car Construction Committee has done a great deal of work and we should help them with any thoughts we have at this time. An effort has been made to go into this important matter simply from the standpoint of our own experience and not with any desire to tear down the work of the Committee or with any idea of discouraging the principle of the standard car.

Side Doors—The door posts for single sheathed box cars are formed from angles providing an overlap for the door of only 1½ in. while the Committee on Car Construction in 1920 recommended a minimum lap of 2½ in. See circular letter No. S 111-189. A 4-in. Z-bar, which is commonly used in this type of car, forms the desirable overlapping of the doors and also furnishes adequate stiffness against bulging as compared to angle iron door post in the submitted design.

End Doors—The committee recommends that end doors be eliminated. The mechanical department of the St. Paul has been forced to install a small end door, 8 in. by 14 in., in its latest box car. This door is used for loading lumber and is made purposely small to prevent pilfering. We would recommend that the committee consider incorporating a small end door in the standard box car design for railroads desiring to perpetuate the use of end doors.

Fundamentals of Center Sill Area—It is recommended that the area of center sills for cars not equipped with roofs have a minimum of 30 sq. in., while cars equipped with roofs should have a minimum area of 28 sq. in. It is inconsistent to specify two different areas of center sills, inasmuch as both open and closed types of cars are designed with sides of sufficient strength to carry the load. The center sill is primarily designed for buffing and our recommendation would be to specify a minimum area of center sills for all types of cars of 28 sq. in.

Standard Box Cars—(a) The side frame construction for single sheathed box cars is changed from the U. R. A. type of car, which had a Howe truss form of side framing, to a Pratt truss. By making this change the stresses in the members are approximately as follows for 40-ton cars: Door posts changed from 5,600 lb. compression to 0, except for a small load due to the weight of the roof. In the diagonal brace next to door post, the stresses have changed from compression to tension. Intermediate post stresses are changed from 22,400 lbs. in tension to an equal amount in compression. The diagonal brace adjacent to the bolster is changed from 28,400 lbs. compression to an equal amount in tension. The side post at the bolster is changed from 3,600 lbs. compression to 26,200 lbs. in compression. It will be noted that the door post has ceased to function as a vertical load carrying member. The intermediate posts and braces remain unchanged as far as the stresses are concerned, but the direction of the forces have been reversed. The side post at the bolster is most severely affected because the load carried by the diagonal brace adjacent to it is also imposed upon it.

Were the Howe truss to be employed by the Car Construction Committee, it would not involve any additional frame parts. The only reason why the bolster post shows a relatively higher unit stress in the instance of the Pratt truss, recommended by the committee, is that all the members of the frame are not employed to do useful work in load carrying; whereas, in the case of the Howe truss, which has been almost universally employed by the railroads that have built single sheathed cars in the past, each unit of the side frame sustains a portion of the load.

One of the most important commodities carried in box cars is grain. From calculations, it has been found that the pressure of wheat against the side of the car produces a bending movement of 6,200 in. lb. per lineal foot. The combined stresses derived from the vertical and bulging loads in the bolster post and diagonal brace adjacent to it in the 40-ton car is 21,300 lbs. and 27,300 lbs., respectively. Realizing that the grain will occasionally be heaped up in one end of the car, bulging stresses in extreme, conditions will be considerably higher. It is felt, therefore, that these two members in particular are too highly stressed. The diagonal brace would have to be increased in strength regardless of what type of truss is used.

We would recommend that the side frame be redesigned, taking into consideration the bulging stresses produced by grain and other commodities; also designed so as to be able to substitute structural shapes for the pressings shown, in cases where it is desired to do so. The pressed steel posts and diagonal braces should be specified interchangeable with the rolled shape sections.

Cross Bearers—The cross bearer is located at the intermediate side post. It is our belief that better construction would be obtained by placing the cross bearer at the door post. This would decrease the free span of the center sill and reduce the load which is to be carried by the center sill and transfer it to the cross bearer, thence to the side framing.

End Construction—Preliminary calculations indicate that the total section modulus of end post and end braces is approximately 13. The total section modulus of end construction used by some roads is 20.6. It has been proved in service that the minimum requirements for a built-up end construction includes two 3-in., 6.7-lb. Z-bars and two 5-in., 11-lb. Z-bars having a section modulus of 14.4. We recommend that an alternate for the pressed shape construction be made up of structural members. Also provision should be made for the use of pressed steel ends. In this connection, with pressed steel ends, a specification should be made up to give the minimum requirements so far as necessary section modulus is concerned.

Carlines—Carlines applied to the U. S. R. A. cars have proved in operation to be entirely too weak. A large percentage are breaking near the side plate. In some instances the entire roof has caved in, due to broken carlines. If this carline is to be used in the new design, it will be necessary to supplement it with diagonal braces or other suitable means.

Purlines—Purlines are apparently omitted in the roof construction. If a flexible all-steel roof is used, it is necessary to have purlines, but the construction does not make any provision for them.

Inside Dimensions—The steel-frame car and the all-steel car do not have the same inside width. It is desirable that the two be identical, otherwise shippers will discriminate against the smaller car.

Center Plate Height—The center plate height on the U. S. R. A. car was established at 25¾ in. This height was ideal for a 12-in. center sill section, as the center sills provided an ideal column without setting up any secondary eccentric stresses in the structure from buffing shocks. I would recommend that the U. S. R. A. established center plate height of 25¾ in. be used in place of 26¾ in.

Center Sill Construction—The special rolled section for center sills seems objectionable from a practical standpoint on account of being unsymmetrical and it probably would be hard to procure in small quantities for repairs. Considerable cutting of flanges will have to be made to accommodate the draft gears and this operation may retard the production in building new cars. Some roads favor a 15-in. built-up center sill construction because it is stiffer without adding weight. I would recommend that the center sills be reconsidered by the committee and alternate designs made up for standard channel section construction.

Front Draft Lug—This could be redesigned to eliminate coping the top and bottom flanges of the center sill, thus avoiding extra work and saving at least 6 in. of material.

Push Pole Pockets—The designs for the two types of cars are superfluous. These details could be eliminated.

Bolster and Cross Bearer Diaphragms—These are made with open corners. It would be desirable to have closed corners, as it would not cost any more to fabricate and considerable strength would be added.

End and Side Lining—The lining of the steel framed box cars is shown to be 5¼ in. face, tongued and grooved. Our experience has been that it is not possible to obtain a full 5¼-in. face from lumber 6 inches wide, after being kiln dried. This dimension should be changed to 5⅛-in. The thickness of the end lining, which is shown to be 1¾-in., is insufficient; it should be 2¼-in.

All-Steel Box Car—Time has not permitted a study of this design. But we believe that the side posts should also be designed to resist bulging for this type of car. The same thing is true of the end construction.

Truck—(a) The truck side is apparently an entirely new design. Past experience seems to indicate that it is necessary to have the web members of the frame uninterrupted and of uniform section. Introducing other members joining directly or in the immediate vicinity of the web members, such as the bottom portion of the design submitted, or brake hanger brackets, has caused shrinkage cracks. Before this truck side is adopted to any large extent, it would be very desirable to have it thoroughly tested out in actual service.

It seems to be the desire of the committee to use indentically the same contour of truck sides for frames having separate and integral journal boxes. There appears to be no particular advantage in this as separate patterns would have to be made for each design. A better and lighter casting for the integral truck side could be obtained than that proposed.

Journal Box—A new type of journal box is submitted, which is not interchangeable with the present standard inasmuch as the bottom lugs for the journal box bolts are eliminated. The contour of the top surface is also changed from the old standard to make the box fit into a recess in the truck side. The top surface of the box is ribbed, thus reducing the bearing surface. If the journal box bolts become loose, considerable wear will take place on these ribs. By adopting a new journal box without bottom lugs, the standard arch bars cannot be used. Neither can truck sides having bottom tie straps, now on the market, be employed to advantage. There are still a number of roads which object to having cast steel in the truck side construction and, therefore, this should be taken into consideration when designing both the truck side and the journal box.

Truck Springs—It is a well-known fact that the present truck springs are unsatisfactory. It would have been desirable, when submitting a new design of truck side and other details to make provision for new truck springs.

Brake Application—No improvements have been recommended in connection with the hanging of the brake beams to further their safety. The truck brake rigging as ordinarily used at the present time is one of the weakest points in the car, and some improvement in applying these details should be looked for.

Safety Hangers—The three-point suspension brake beam safety spring is recommended. This is a patented device and it would be desirable to submit a design for application of a four-point suspension which would form a better safety device than the three-point suspension.

Spring Planks—The details indicate that a rigid spring plank is employed. A number of roads are using the flexible type of spring plank. This design should be considered and made interchangeable with the rigid type.

Conclusion—The above criticism is not made to discredit the valuable work done by the Committee on Car Construction. A sincere effort has been put forth to design a car having maximum strength with a minimum weight and the committee has succeeded to a large extent. But in its anxiety to obtain the lightest possible car, probably some sacrifices have been made in the strength. It is, therefore, suggested that the designs of box cars and trucks, before being submitted to a vote by the members of the A. R. A. should be referred back to the Car Construction Committee for reconsideration. It would be desirable to have the committee take into account experience, based on practice, herein mentiond and to judge the matter in its broadest aspects in order to obtain a variety of interchangeable parts so that the various railroads could adopt, with the car body, either a structural construction or a pressed-shape design and still maintain interchangeability.

Mr. Kiesel Replies to Messrs. Sillcox and Hardin

Chairman Coleman: Before there is any further discussion, Mr. Kiesel would like the opportunity of replying to Mr. Sillcox and Mr. Hardin.

Mr. Kiesel: We, of course, like to have as much discussion in regard to this matter as possible, but the committee was tied down to the A. R. A. standard and recommended practice.

Mr. Hardin made the statement that I told him that the fundamentals were not subject to discussion. What I intended to say was that the fundamentals which are now your standard and recommended practice are not open for discussion. They should have been discussed and settled at the time when they were adopted.

Both Mr. Hardin and Mr. Sillcox are reopening such matters as 30 sq. in. of center sill area, which is your standard; heights of center plate, which you have adopted as 26¾ in, having been changed from 27¾ in. The Car Construction Committee on the basis of the 30 sq. in. area for all cars with the exception of house cars now recommends a reduction to 28 sq. in. for house cars, which was unanimously adopted by the Car Construction Committee after a full investigation, which extended over two years.

As far as the recommendations of Mr. Sillcox to use the U. S. R. A. center sill height, the committee did not adopt that for the reason that it gives an unbalanced center sill section and requires a heavier car for the 40-ton car, and it necessitates larger trucks and hampers to a great extent the construction of the bolster. It also gives a distance from the top of the rail to the bottom of the side frame with a cast steel side frame of less than 4½ in. when the wheels are worn, and 4½ in. the committee feels is the minimum that should be allowed.

In regard to the question that was raised by Mr. Hardin in regard to brakes, our intent was to leave the question of braking power to be handled by the Committee on Brakes and Brake Equipment. Therefore, we will eliminate the dimensions of brake levers which unfortunately were overlooked when the committee changed the general plan of making that report.

As to the top hung door, the A. R. A. doors, I believe, are all top hung and we followed the A. R. A. standards in that respect. If a large number of the A. R. A. members desire the design of a bottom hung door also, the committee can very readily make such a design but it would not amount to anything if we stated on the drawing that a bottom hung door could be substituted.

The work assigned to the committee was to produce a car design, which we have done. We are submitting to you a design, which, per pound weight, is the strongest box car that has ever been built in this country. That is our firm belief. By refinement of design we have eliminated a lot of weight.

The subject of roofs has been criticised. The report states that any kind of a roof may be substituted, whichever is preferred by the railroad. Each railroad can determine for itself whether the roof that it wants to substitute is the equivalent of what the committee shows. If it cannot do that, it can readily be referred to the American Railway Association and I have no doubt the association can advise them.

Doors with 1½ in. overlap were referred to by Mr. Sillcox. The larger dimension refers only to old doors and especially to old wooden cars. In the rules for new cars that requirement has been eliminated on account of having something else that answers the same purpose.

In regard to the omission of end doors, ultimately the end doors ought to be omitted, but we did not mean in our recommendation that they should be taken off now, but if used they should be maintained just the same as side doors.

The center sill area is the association's standard. Therefore the committee had no option, but had to use your standard.

Now we come to the Howe and Pratt trusses. We can not agree with the stresses that Mr. Sillcox gave. The stresses in the side frames of those cars were checked up in three separate drawings, and there are no stresses in that truss such as he gave. We would be glad to go over the matter with him and check up with him as to the stresses. Furthermore, in the truss that he showed, which is used on the St. Paul, the diagonals are in compression. In the truss that we adopted the diagonals are in tension. There is no reason why it is preferable to put diagonals in compression rather than in tension. In bridge building they use both the Howe and the Pratt trusses and if properly designed either one is satisfactory.

Concerning the pressed steel ends, Mr. Sillcox asked for the specification for the ends. This is already in the manual.

Mr. Sillcox mentioned a great many other things which are more or less matters of opinion. We would be very glad to have him submit them to the committee, and we would be very glad to go over them and see whether there is anything that would help us in making a proper design. He mentioned among other things that we showed tongues and grooves. Among A. R. A. practice you will find that you can use either tongue and groove or ship lap.

Further, you will find that the width of the boards given in the A. R. A. standards as 5¼ in., and we had to use the 5¼ in. wood; there was no option. If he desires that changed to 5⅛ in. he ought to call attention to it in connection with the diagrams of lumber shown in the A. R. A. standards; these have been standard for a good many years.

In regard to journal boxes, he objects to the separate journal box because it is different from the present standards. It is not our intent to substitute this journal box for the present standard.

The Car Construction Committee did not intend and does not intend to ask you to eliminate the present standards in favor of the new proposed standards, because we believe that after you find out that these trucks that we submit to you now will show approximately 500 lb. less weight per truck with the same capacity than those you are using now, you will want the latter.

Three-point suspension for the brake on the truck is put there to complete the truck design. We do not yet know whether we will be subject to a patent in that connection. We have clearly intimated in two or three places that any alternate, whether any part or group of parts, may be substituted providing it is the equivalent, and if an engineer can't determine whether it is the equivalent, a specification can be made to show that.

The final statement of Mr. Sillcox was that we probably sacrificed strength in order to obtain light weight. I can assure you, and this has been checked in four drawing rooms by some of the most competent designers in the United States, that the stresses are not in excess of what is commonly used in practice, and that the side frame and the strength against bulging—that is, the strength of the body of the car—is greater than the average car running today of the same capacity.

T. H. Goodnow, (C. & N. W.): Like the previous speakers, we have two or three pages of personal opinion on details of the standard car which I am not going to take up any time to present. I simply want to say a word in connection with the policy of this standard car.

As a member of the Committee on Car Construction I am offering no defense either for the committee or for myself.

I have attended most of its meetings and where I did not attend I was represented. All that is being brought up today is simply a rehash of what has come up in the committee in some shape or form. With the membership of about 15 on the committee I can appreciate the results of a progress report with some 400 roads expressing their individual ideas as to the final results of the standard car. I will leave it to you just to think it over seriously and if you don't agree with me when you come here next year and go along with your progress report I will miss my guess.

Speed Needed in Developing Standard Car

I think it is well known to most of us that there are certain issues working at the present time which make it very essential that speed be made on the standard car. I do not think it necessary for me to mention what those are, but nevertheless I think it would be very desirable if this association could at the earliest possible date adopt a standard car; in fact, I think it is necessary that it should do so.

If the door fixtures and the uncoupling levers and all of the other items annexed to the car, cause the objections, just leave them off and let us go along with the framing and the trucks, if we can. Let us at least get that far with the car.

Personally there are a number of items in connection with the details that I feel that the Chicago & North Western in building the cars from its experience can probably improve on, but at the same time, it will not affect the interchangeability of repairs and anybody that has that car can repair it with standard parts and we will accept it. That is the broad principle that we will all have to go on finally in the handling of the standard car.

I quite agree with the mention that was made of the administration carline, and also with regard to the end. I think the committee can very consistently change the wording at the end, which apparently is so confusing, and put there the wording of your standards as they were adopted under circular letter S III 159, July 19, 1920. However, I am not going into the details. Whether that appears or not, it is nevertheless your standard. What I want is to push the standard car just as fast as possible.

If anybody had sat through the deliberations of the Car Construction Committee in the past year in dealing with this subject he would fully appreciate that and I hope that any motion that prevails here will not slow up at least the starting of a standard car, because I know that it is important. Changes can be made in the standard car just as we have made changes in the various standards from time to time.

R. L. Kleine, (P. R. R.): I would like to know if it is the intention of the committee to submit the plans to the Eastern and Western Railroad Associations so as to know where we stand on the patents, if any, that exist on these cars.

Mr. Kiesel: We specified in our report that the intent is to get a report on all the various parts of the car.

Mr. Kleine: I understand that, but I didn't know whether you were getting a report from the two associations named or not. That is what I want to clear up.

Mr. Kiesel: Whatever the association directs us to do, we will be glad to do. My own opinion is that the question of patents should be handled by a separate committee. However, if the association directs us to look into the patent matter, we will be very glad to do that and take it up with both associations. We have taken up the question of truck side frames and bolsters.

From the report it would appear that after November of this year, with the letters that the association now has on file, the bolsters and side frames can be built by anyone without infringing on any patents, or paying any royalty. As far as the car itself is concerned, there may be some features that we are not aware of that may be subject to patent, but we have submitted a design complete, and I do not believe we ought to submit it to the Eastern and the Western Railroad Associations. In fact, it is not worth while doing that until the association approves the car, for without this approval the car is useless.

As far as end construction is concerned, the standards of the association now permit corrugated ends, and the committee did not show that for the reason that corrugated ends are patented. Our intent was to show a design as free from patents as possible.

J. J. Tatum (B. & O.): Last night I put in considerable time studying the report and knowing what work is involved in undertaking to please everybody by getting together what might be called a standard car, one can appreciate the work that this committee has had to do. I think it has made a very good report.

Your criticism no doubt will be helpful, but I hope it will not retard the action enabling a sample standard car to be built. The only question that I have in connection with this report is, Why were not the M. C. B. standards made use of to the fullest possible extent in establishing this standard car? My reason for asking that question is that for a number of years we have been getting together various standards and these standards have been approved from time to time until today many of them have met all the requirements.

We have here before us in this report a new truck which I, myself, do not know anything about. I have never seen such a truck. I do not know what sort of work it will do. I do not know what the result will be, but I do know what the M. C. B. standard truck will do, and I do know there is a possibility of improving that standard without departing from any of its dimensions; that is, dimensions which would affect its interchangeability. I might say the same thing about the doors, and the uncoupling arrangement.

The Proposed New Trucks Should Be Tested

Mr. Hardin: There is no disposition in the motion which I made to delay progress. I do not believe it will. As a matter of fact I made that motion for the specific purpose of continuing progress on this report. It will not in any way alter the report as it stands; it will not amend it; it will not exclude anything that is included in there, but merely delay the final action as adoption of the standard of this association. In the meantime it will provide an opportunity for the construction of such cars and the trial of the trucks, which I feel should be done before the car is finally adopted.

Mr. Kleine: I can hardly see how, by accepting this report of the Car Construction committee as a progress report and laying it over for one year, we will expedite the standard car one iota. I think this committee has done excellent work as far as it has gone. It is unfortunate that we did not have the report before us a greater length of time in order to criticise it, but Mr. Hardin made the statement that he is in favor of the standard car and, as I understand it, he is also in favor of getting this standard car adopted as promptly as possible.

I would like to amend Mr. Hardin's motion to this extent: That the committee consider the objections raised and then submit its findings to letter ballot in detail; also authorize sample cars to be constructed during the year so that we will get a study from the manufacturing end as well as a complete review of the opinions of all the railroads of the association insofar as certain details of the standard car are concerned.

Mr. Hardin: I do not understand exactly what the amendment is. Is it to eliminate these details and are they to be specifically referred back to the committee?

Mr. Kleine: The details discussed are to be referred to the Car Construction Committee, as well as any other criticisms of the design, giving the members an opportunity to write the committee concerning those details. Then the committee would consider those as well as any subsequent criticisms and submit to letter ballot the result of its deliberations on these criticisms.

Mr. Hardin: I think I would much prefer to follow Mr. Goodnow's scheme and possibly eliminate for the time being some of these questions in dispute, and if that is done I am in a position to withdraw my motion. Mr. Goodnow refers to ends, roof, etc.

Chairman Coleman: As I understand it, it gives every man an opportunity to present his objections to any of the details in this standard car to the committee, which will take into consideration all of the objections and criticisms. Do I understand, Mr. Hardin, you have withdrawn your motion?

Mr. Hardin: No, sir. I shall be in a position to do this if we can proceed as Mr. Goodnow suggested. If the Car Construction Committee can do that I will withdraw the motion. As it stands, the motion is before the house unamended and I cannot accept the amendment Mr. Kline has proposed.

Mr. Kiesel: Mr. Hardin, do I understand you to say that if we eliminate the requirements calling for specific designs of end, roof, doors and so on that then you will withdraw your motion? That was the committee's intent anyway, and it will certainly put it on the drawing if you would rather have it there than in the specification.

Mr. Hardin: I am willing to put it either in the specification or on the face of the drawing. I prefer the face of the drawing, but if the committee feels that could not be done, I think it should be embodied in the specification itself. That would apply to the door, ends and roof. I believe the truck situation is already covered.

Mr. Goodnow: It is my idea to make definite progress and as the end is a standard we can simply change the report and accept that portion of the committee's report which refers to its design and embody in that the wording of the present A. R. A. standard. That will take care of the big part. The roof is entirely optional. You can use any roof desired under the committee's report. If the question of top and bottom hung doors and release rigging is going to tie up anything in the progress of this car I would leave them off for this year. I think that we can maintain the interchangeability of the trucks. The only thing that impresses me as being essential is the height and general dimensions of the truck. We don't have to have a bolted box. If I want to use the bolted type of truck frame under my car so long as I make it to the general dimensions I can do it.

Mr. Tatum: Suppose a railroad should elect to put in the existing M. C. B. standard truck, is that permitted?

Mr. Goodnow: No.

Mr. Tatum: Then the truck that we have been using for years and years, working on to standardize, goes into the scrap heap.

Mr. Goodnow: I don't think you understand me. The standard height of the truck has been changed.

Mr. Kiesel: It was changed a year or two ago.

Mr. Tatum: Do you know anything about a short box bolt?

Mr. Goodnow: I don't think that is the question. If you want to put a frame under my car that has the short box bolt that you refer to, if my car has a 5 ft. 6 in. wheelbase, if my height is the A. R. A. standard, you can substitute your short box bolt for my type or any other type of truck frame that I have used on the standard car.

Mr. Tatum: You are asking me to run over my railroad a truck that I don't know anything about.

Mr. Goodnow: I am talking just the other way.

Mr. Tatum: Can I use an A. R. A. standard truck under a new car that I am building today?

Mr. Goodnow: What do you mean by A. R. A.

Mr. Tatum: I mean the M. C. B. standard truck as it exists today.

Mr. Goodnow: Is there such a thing?

Mr. Tatum: I have been told that there is.

Mr. Goodnow: It is only the height and wheelbase. I don't know of a design that is standard.

Mr. Tatum: Your Truck Committee certainly reported a design and it was approved by letter ballot; at least I have been credited with being on the committee approving it.

Mr. Goodnow: Well, I do not know it if there is.

Mr. Kiesel: The standard height of truck today is 26¾ in. Some years ago the standard height was 27¾ in. In order to see how much it would affect those trucks I had 100 trucks measured, taken from under cars. The height varied from 26 in. to 27½ in. and any one of those trucks could readily be lowered to the 26¾ in. height. Most arch bar trucks now have a two-inch plank under the springs and if you take that out you have pretty nearly the present standard height of 26¾ in.

Mr. Tatum: I am not talking about dimensions, but suppose I elect to use an ordinary arch bar truck on 1,000 cars, would I be permitted to use the arch bar truck under that standard car?

Mr. Kiesel: We have not presented an arch bar truck. We have only presented cast steel side frames. You can use the old arch bar truck in connection with the new bolsters which we have.

Mr. Tatum: Then I can put the existing M. C. B. standard arch bar truck in use?

Mr. Kiesel: You can in accordance with the way the rules now stand and our report does not change those rules.

Mr. Tatum: That is all I want to know. I will vote for Mr. Kiesel's report with that understanding.

Chairman Coleman: Mr. Hardin, do you withdraw your motion?

Mr. Hardin: I will withdraw my motion and I want to make a motion in this form: First, that on the drawing included with the report of the Committee on Car Construction and entitled, "End Sheets," the following notation be made: "A. R. A. recommended practice adopted 1914, revised 1920, is a part of this specification."

Second: On the drawing accompanying this report which is entitled, "Coupler Release Details," the following notation be made: "Any other type of release rigging conforming to the safety appliance laws may be substituted as an alternate."

Third: On the drawing entitled "Steel Frame Door Arrangement," the following notation be made: "Door of bottom supported type may be used as an alternate if conforming to general dimensions."

Fourth: On the drawing showing outside metal roof, eliminate the note reading "Outside metal roof of manufacturers' designs must be made to suit dimensions shown and be interchangeable," and substitute the following notation: "Any outside metal roof may be used as alternate if conforming to general dimensions shown."

Fifth: On the drawing showing roof sheets of all-steel roof the following notation be made: "Any design of riveted roof may be used as alternate if conforming to general dimensions."

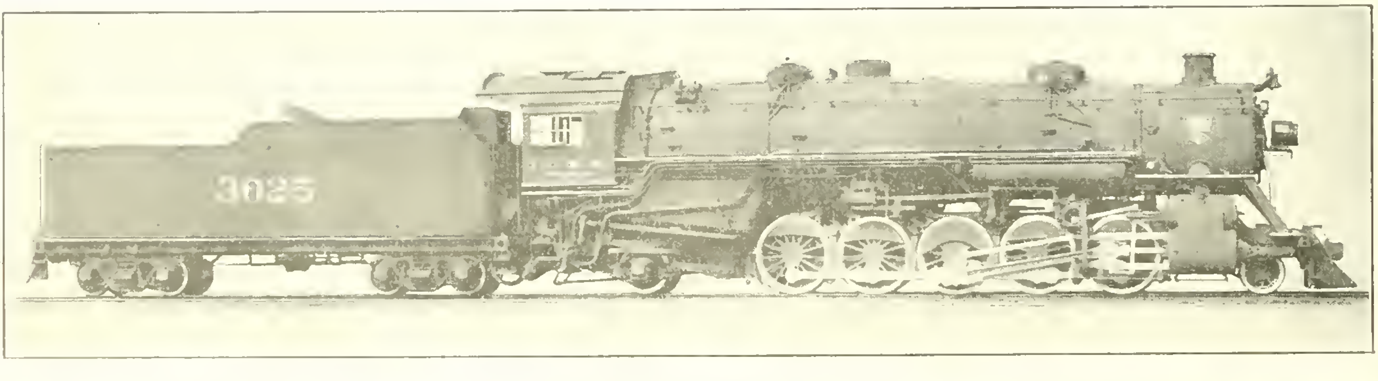
On the drawings showing proposed design for standard trucks, Classes 2-C, 2-D and 2-E, Types W and Y, the following notation be made: "Any truck of proper capacity conforming to the A. R. A. standard dimensions may be used as alternate."

Mr. Kiesel: I can say for the Car Construction Committee that we can accept all of those notations because they conform closely with the intent of the committee in having this a car on which alternates can be used, and this merely makes it a little more specific than what we now show.

(The motion was duly seconded and carried.)

The report of the committee, with the amendments submitted by Mr. Hardin, was put to a vote and was accepted.

* * * *



Illinois Central 2-10-2 Type Locomotive, Built by Lima Locomotive Works

Railroad Cars, Their Origin and Development

What the Growth in Capacity Has Meant to Civilization, and the Factors Making it Possible

By E. F. Carry
President, The Pullman Company

WITHOUT TRANSPORTATION FACILITIES the farmer today would be marooned on his acres; he would be a localized industry. He would be dependent entirely upon what his soil produced; be without a market for his products; clothed in homespun and in skins. With the farmer isolated there could be no great communities, no manufacturing centers. no factories. If some great calamity should destroy railroad connection with any large city, that city in 48 hours would feel the pangs of hunger and inside of a week its inhabitants would either have to seek food elsewhere or die in the streets. Without transportation diet would be restricted. Bread would be a drug in the wheat states and practically unobtainable where wheat does not grow. Meat eaters would have to move to where cattle range; babies in great cities would die from lack of milk. The great fruit orchards and vegetable farms of the South and West which through the aid of the refrigerator car are enabled to supply the tables of the North and East with their products, would go out of business. Ore would stay in the earth; coal would remain unmined; cotton plantations of the South would revert to weed patches and the sheep of the West would remain unshorn. Life would hardly be worth living if we had to rely on the means of locomotion and carriage provided by nature.

Edward F. Carry

Land transportation had its origin in the pre-historic age and in man's primordial state woman was the burden carrier, as she is today among the savage races of the world. Just when primitive man transferred the burden from the shoulders of a woman to the back of an animal is a matter of conjecture but the transfer was final and the first step in solving the problem of land carriage was directly traceable to that occurrence.

Animal-drawn vehicles served the purpose of land transportation until the seventeenth century when the necessity for increasing capacity led to the adoption of wooden rails at the collieries of England for the conveyance of coal to the river or the sea. This marked the inception of tramways or colliery roads, and from the seed thus planted came the railroad. With the introduction of the steam locomotive, passenger cars came generally into use, and it is difficult from this period forward to trace separately the progressive improvements in the development of freight and passenger cars, as most of the mechanical features were developed concurrently on both classes of equipment.

Freight Car Development

On the Mauch Chunk, one of the earliest coal roads, each car had a dead weight of 1,600 lb. and a capacity of 3,200 lb., the ratio of dead-weight to carrying capacity thus being as 1 to 2. On the Little Schuylkill, another early coal road in Pennsylvania, the cars were built to carry three tons of coal and were equipped with wheels three feet in diameter, two of which were loose on the axles in order to lessen friction on the curves.

With a rapidly growing population and a gradual widening in areas of distribution, however, the constantly increasing traffic demands upon the early railroads necessitated an increase in the number of the small capacity cars, but the addition of these extra units to the train so increased length as to render it unwieldy and difficult to handle. The necessity for an increase in the unit capacity of freight cars became apparent and the introduction of four-wheeled trucks not only rendered this possible but, also, marked the first step in the evolution of distinctively American types of freight cars.

Prior to 1870, however, freight cars were still of limited capacity as an average load of nine tons per eight-wheeled car and four tons per four-wheeled car was considered heavy loading. The eight-wheeled cars in use on one road were 28 ft. to 33 ft. in length, had an average dead-weight of 16,000 lb. and a loading capacity of 18,000 lb., the ratio of dead-weight to carrying capacity thus being 1 to 1⅛. Up to 1876 the average capacity of freight cars remained at 20,000 lb. although it was customary to load in excess of that figure. In 1877 some cars were built to carry 30,000 lb. and beginning in 1879 the standard cars built for the principal lines were constructed to carry 40,000 lb.

The comparative weight of a standard Pennsylvania Railroad box car, with its load, in 1870 and 1881 was as follows:

Year	Weight of car, lb.	Weight of load, lb.	Total	Load to total weight per cent	Ratio of dead weight to carrying capacity
1870......	20,500	20,000	40.500	49.38	1 to 1
1881......	22,000	40,000	62,000	64.52	1 to 1.8

This shows considerable progress was being made in the matter of increasing the carrying capacity of freight cars with little, if any, increase in the dead-weight. Notwithstanding the gain of 30 per cent in the ratio of paying weight to gross weight the ratio of dead-weight to paying load was 1 to 1.8, indicating the difficulty which the roads were experiencing at that period in obtaining the ratio of 1 to 3 which Jonathan Knight, civil engineer of the B. & O., as early as 1832 submitted as the most economical.

As contrasted with the situation 40 years ago ,the following table, showing for certain types of modern freight cars the ratio of dead-weight to carrying capacity, will indicate the remarkable progress made by the railroads and the car builders in designing cars that give an economical ratio between the weight and load which is to be carried:

	Weight of car lb.	Load, lb.	Total, lb.	Per cent of load, total weight	Ratio of dead weight to carrying capacity
1919 U. S. R. A. sinble sh. box.	46,900	110,000	156,900	70	1 to 2.35
1919 U. S. R. A, double hopper.	41,000	120,000	161,000	74	1 to 2.93
1919 U. S. R. A. gondola......	43,100	110,000	153,100	72	1 to 2.55
1921 Virginian coal car.......	78,900	240,000	318,900	75	1 to 3

This indicates that the predicted ratio of 1 to 3 has been attained for certain types of coal cars and in the case of an experimental ore car a ratio of 1 to 4 was reached. The economies to the railroads and to the public resulting from these developments are obvious.

Coal Car in 1830 and a Coal Car of Today

Three Important Events of 1867-68

The year 1867 was a vital one in the annals of American railway car building. The predecessors of you gentlemen assembled here today met and formed The Master Car Builders' Association, and on Washington's Birthday of that same year there appeared on the transportation stage a young man, who was destined to become one of the world's greatest master car builders, a man whose vision and genius enabled him to surmount what had seemed insuperable obstacles; a man who foresaw the possibilities of giving to the American public comfort and luxury in travel—George Mortimer Pullman. He was a pioneer, the creator of a new business.

In the same period there came another advancement of great significance, the invention of the Westinghouse airbrake, and its successful application in the winter of 1868-1869 to eight cars and an engine on the Steubenville accommodation train on the Pittsburgh, Cincinnati & St. Louis.

The organization of the Master Car Builders' Association marks what was virtually the first step in the standardization of interchange parts of American cars. The work accomplished by the association in this respect has been and will continue to be of incalculable value to railroad operation. In its Standards and Recommended Practices the association has created a monument appropriate to the purposes of its organization, viz.: "The formation and dissemination of correct views regarding car construction." To the railroad officers of which the association was composed we are indebted for the progress in railroad equipment. Some idea of what the M. C. B. has accomplished in the way of standardization of car parts may be observed from the following list which summarizes the achievement up to the present time:

Journal boxes—58 kinds reduced to 5 sizes, one interchangeable type.
Axles—56 kinds reduced to 5 sizes, one interchangeable type.
Couplers—26 kinds reduced to 1.
Brake Shoes—20 kinds reduced to 1.
Brake heads—27 kinds reduced to 1 interchangeable standard.
Wheels at present, three types—4 sizes.
Brake beams at present—all interchangeable.
Grab-irons fixed by law.
Draft gear—standards being prepared by Mechanical Division, A. R. A.

The Westinghouse air brake opened the way for the safe handling of trains of increased length and cars of higher capacity. Its value to operation was demonstrated in 1887 by a test on 50 freight cars, a train of 1,900 ft. and a weight of 1,700,000 lb., which was brought to a stop from a speed of 20 miles an hour in a distance of 171 ft. To stop the same train at the same speed by the use of hand brakes by five men, all ready for simultaneous action, required a distance of 1,563 ft.

In 1857 an eastern railroad had 30 box cars fitted with double sides, roofs, floors and the interstices packed with sawdust. This in its crude form was probably the first refrigerator car. In 1871 there was introduced a refrigerator car equipped with ice bins, or compartments, at the ends of the car and about 1881 the first stock car with watering troughs and feed bins was constructed.

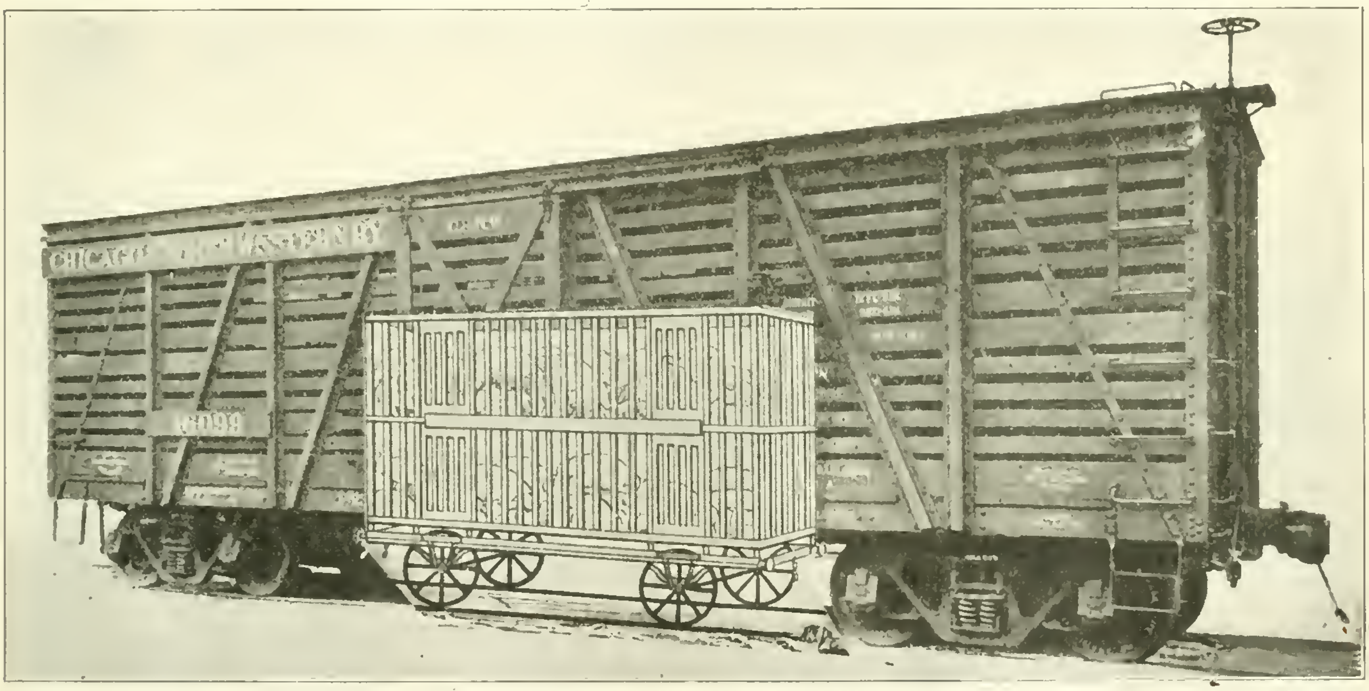
Automatic Couplers and Air Brakes Made Steel Underframes Necessary

The introduction of the automatic coupler, extending over a period from 1883 to 1888, tested by the Pennsylvania in 1883 and 100 sets tested by the C. B. & Q. in 1884, marked another great forward step in the safe and prompt handling of freight equipment, obviating the need of a man between cars in coupling.

With the advent of the air brake and the automatic coupler, permitting high speed and quick handling of heavy equipment, the inadequacy of the wood frame car became apparent. Wooden draft timbers bolted to the bottom of wooden center sills pulling out, wooden center sill breaking at bolsters and the difficulty in obtaining an adequate supply of timbers for the gradually increasing sizes of cars, made a change to stronger and more readily obtainable materials imperative. Thus, born of necessity, came draft sill reinforcements of steel, steel underframes for wood cars, steel frame cars and steel cars.

Development of Steel Freight Cars

The use of steel in car construction probably was first introduced in 1874 in the form of channel iron for sills and bolsters in a car operated in stock service on an eastern line. In the late seventies or early eighties a peculiarly shaped iron body hopper car, known from its shape as a three-pit hopper, was introduced. This was of 13 tons capacity, weighing 12,800 lb. Southern Iron Car Line in about 1882 introduced what was known as the pipe car, the center and side sills of which were of truss type, pipes acting as top and bottom members held apart by separating clamps. End sills were of malleable iron and later trussed iron bars, bolsters were of angle iron. This type of car proved unsatisfactory in service.



The Progress of 92 Years—Early English Stock Car Compared with Modern American Type

It was not until 1894 that the modern steel car became a recognized unit of American railway service. In that year the Carnegie Steel Company had six flat cars built, and in 1896 the Keystone Bridge Company built two 100,000-lb. capacity steel hopper cars which were exhibited at a convention at Saratoga and afterward placed in service on the Pittsburgh, Bessemer & Lake Erie. This railroad in 1897 placed the first large contract for building steel cars in this country when 1,000 cars were built, 600 of pressed steel and 400 of rolled structural shapes.

From that period forward, progress in the construction of steel freight cars has been rapid, as indicated by the following comparison of cars in service on Class I roads as of December 31, 1921:

Total number of cars in service	2,378,682
Steel freight cars in service	640,891
Proportion of steel cars, per cent	27
Steel underframe cars in service	903,240
Aggregate number of steel and steel underframe cars	1,544,130
Proportion of steel and steel underframe cars to total, per cent	65

One of the most remarkable features in connection with freight car development has been the rapid increase in the number and carrying capacity of freight cars as well as the extent to which maximum utilization of the increased capacity has been secured. The following tabulation shows the number, capacity and average loading of freight cars during 1921 as contrasted with 1902, the earliest year for which reliable data are available regarding capacity of all freight cars in service. It presents a striking picture of the advance made during that 19-year period.

Growth in Capacity and Utilization of Freight Cars

	Number of cars	Aggregate capacity, tons	Av. capacity per car, tons	Average net tons loaded per car
1902	1,546,101	43,445,438	28.1	16.92
1921	2,378,682	101,093,985	42.5	29.30
Per cent increase, 1921	53.9	132.7	51.2	73.4

Notwithstanding the remarkable expansion reflected above in the number of freight cars it will be noted that their aggregate carrying capacity has increased at a rate nearly two and one-half times faster than the increase in units.

In the United States, the old Concord stage coach was adapted to railroad usage by the application of flanged wheels. Other accounts depict the first passenger cars as nothing more than clumsy, covered box wagons fitted with planks for seats, while the first passenger car on the B. & O. was like a small clap-boarded wagon on wheels, similar in appearance to a North Carolina mountain hut. The first cars were propelled by horse power, with a capacity of from 12 to 24 passengers.

Development of Passenger Cars

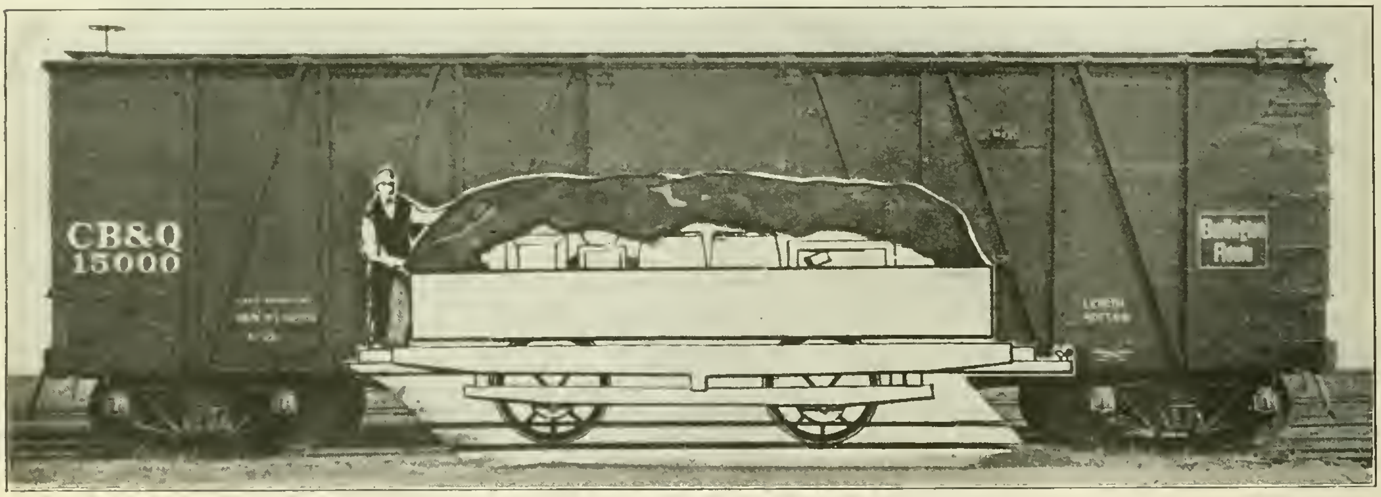
The introduction of the bogie truck by Ross Winans on a B. & O. passenger car about 1831 ushered in the first eight-wheeled car, and marked the beginning of the radical difference between the English and American cars. The ability of this eight-wheeled car to round curves which abounded on most railroads led to its general adoption by about 1835.

The typical eight-wheeled passenger coach built between 1840 and 1850 was devoid of springs aside from the ordinary rubbers in the pedestals; the only ventilation was by means of a 10-in. flue in the center; the windows did not raise but the panels between them could be lifted instead; there were no lighting arrangements except a candle placed at each end of the car; heat was supplied by one stove; there were no closets, lavatories, or water coolers; the wheels were outside of the bearings on the original trucks; the seat frames were of iron with walnut arms and upholstering of plain leather; and the body of the car was 36 ft. in length, 8 ft. 4 in. in width and 6 ft. 4 in. in height. While the arrangements of the car indicated marked progress in passenger car construction it was conspicuously lacking in a number of modern improvements.

From 1860 to 1870 passenger cars in general use had seating capacity for about 60 passengers and a body about 50 ft. long, 10 ft. wide and 7 ft. high; seats were cushioned and heat was furnished by stoves and light by oil lamps. These cars were equipped with rubber and elliptic springs, the metal for axle bearings was in process of experimentation, hand brakes were still in use and attempts were being made to devise a reclining seat.

During the seventh decade sleeping cars on through lines first became effective and dining and parlor cars made their initial appearance. The influence of the Pullman car has seemingly been a potent factor in the development of passenger carrying equipment. As the Pullman Company was the originator of de luxe sleeping car service, so also it was the initiator of complete hotel service as applied to trains. In 1867 it introduced the hotel car "President," a sleeping car with a kitchen at one end, and this was the forerunner of the dining car (a later development by the company) which supplanted the hotel car.

The original wood frame passenger cars were improved by increases in size and carrying capacity so far as consistent with safety in connection with wood construction. Next came composite steel construction and finally the all-steel passenger car and the transition from wood to steel construction assumed such proportion that there was virtually created a new industry in connection with car building, viz., the production of steel cabinet work for the interior finish. The first all-steel passenger car turned out by the Pullman Company was built in 1908, although the Pennsylvania had acquired some steel cars at an earlier date.



Pioneer English Goods Wagon Compared with Present American Box Car

With the arrival of the steel age it is of interest to note the evolution in interior decorations. From the wood interior of the early days which were entirely devoid of any attempt at embellishment there came the era of highly ornate style with inlays, heavy carvings, and other embellishment which was followed by gradual reversion to plainer styles with less ornamentation and, finally, there was adopted the plain, sanitary and modern steel finish of today with a minimum of decorative features.

Contrasted with the original crude passenger car, there are now many and varied types of cars. Light wooden passenger cars are being rapidly displaced by all-steel and steel-underframe cars. The extent to which these types are superseding the wooden car is disclosed by contrasting the classified passenger and Pullman car ownership as of January 1, 1922, with the ownership as of January 1, 1911, as follows:

	1911	1922	Increase	
			Number	Per cent
Wood cars	53,274	33,433	*19,841	*37
Steel-underframe cars	1,636	9,505	7,869	481
Steel cars	3,589	20,569	16,980	473
Totals	60,499	63,507	3,008	5

*Decrease.

The criticism has been made that the passenger coach of today differs but little from the coach of 25 years ago, but a comparison of a typical coach of 1898 period with one built in 1922 will readily disclose the radical differences between both cars.

Passenger Coaches—Today and 25 Years Ago

	1898 Model	1923 Model
Length	48 ft. 6 in.	70 ft.
Weight	53,000 lbs.	140,400 lb.
Capacity	56 passengers	84 passengers
Construction	Wood	Steel
Wheels per truck	4	6
Platform	Open	Vestibuled
Lighting	Oil lamps	Electricity
Heating	Coal stove	Steam

Modern American passenger equipment has been subjected to criticism as being too heavy. Safety is the first consideration in the minds of every master car builder and high speed has made it necessary to so construct cars that their various parts must be heavy enough to provide an ample margin of safety and strength, not only to resist the sudden shocks and distortion stresses on the structure which use imposes, but also to give ample provision against deterioration and reduce the cost of maintenance to a minimum. Light cars have proved unequal to the requirements of American passenger travel. The weight of modern passenger equipment is the result of service demands—the safety and comfort of passengers—and these requirements are its adequate defense.

When it is considered that the modern passenger car is equipped with electric lights and steam heating systems, toilet and wash-room facilities supplied with running hot and cold waters, coolers for drinking water, drinking cup vendors, electric fans, upholstered seats with headroll and automatic foot rest, continuous parcel racks on each side of car, window shades, windows that can be raised and lowered, exhaust ventilators in deck sash in body of car and in men's and women's saloons, an interior finish of mahogany color, etc., it will be seen that the all-steel passenger coach in its present stage of development embodies the maxima of safety, comfort and convenience insofar as engineering ability, mechanical ingenuity and scientific research can contrive.

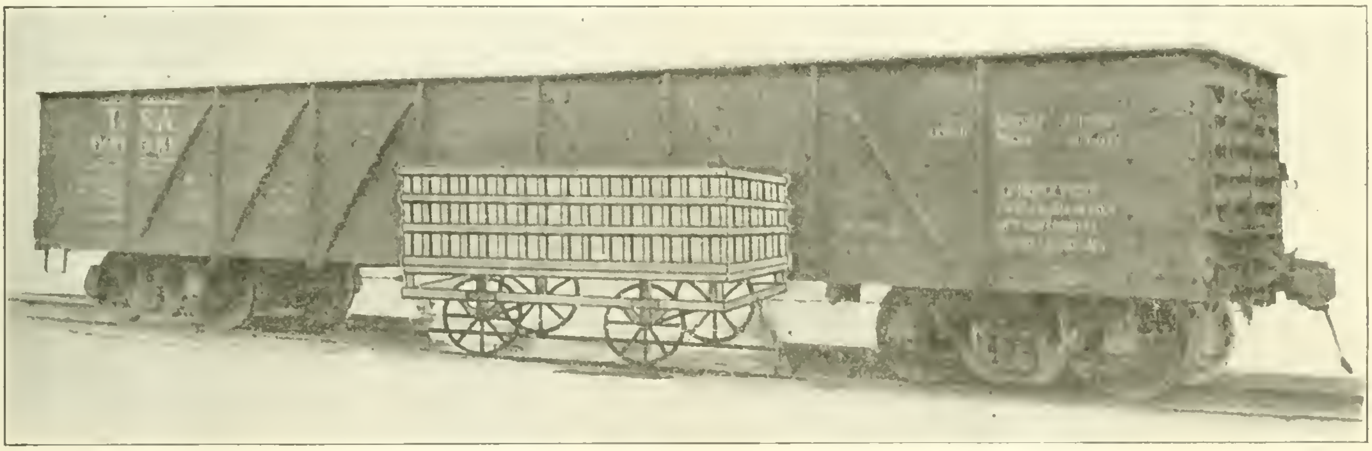
Development of Car Equipment in Relation to Traffic

To illustrate the extent to which railroad traffic has increased the following is presented:

	1890	1920	Increase per cent
Population	62,947,714	105,710,620	68
Total revenue ton-miles (millions)	76,207	413,674	443
Ton mile revenue freight per inhabitant per annum	1,200	4,000	233
Ratio increase in ton-miles per inhabitant to increase in population	1	3⅓	...

These figures afford an index of the extent of our industrial expansion and direct attention to the service which the railroads have rendered as builders of business by effecting a solution for the multitude of problems which such expansion has involved. To the skill of the master car builder much of the credit is due.

In attempting to solve this problem the railroads found that a mere increase in the number of locomotives and cars of the same types and capacities as were in service 20 or 30 years ago was not practicable. The adoption of such a method would result in congestion of physical plants with all the attendant evils such as traffic embargoes, exorbitant costs, etc., which would prove burdensome alike to railroads, shippers and consumers. A given mileage of main track complemented by a given mileage of yard and side tracks can accommodate only a certain number of cars and locomotives and this situation therefore is the limiting factor as regards the number of trains that can be moved daily.



Early English Gondola Compared with Its American Big Brother

Furthermore, if the simple process of multiplying rolling stock were confronted by no obstacle other than physical limitations, the twin factors of increased capital investment and rising operating costs would act as a check upon such a method. The construction of additional track mileage, entailing enormous capital expenditures and constantly increasing expenses for maintenance, replacements, taxes, and other incidental costs, can be justifiably and economically undertaken only when maximum utilization of the existing facilities of that character has been obtained.

The necessary alternative of the railroads, therefore, has been to secure the most intensive and efficient utilization of the existing plant and to accomplish this the first step was an increase in the efficiency of the motive power, thereby enabling it to haul greater loads at the same or at a lesser expense. An increase in motive power can accomplish only a small fraction of the desired results, however, unless it be accompanied with a corresponding increase in the capacity of freight cars and an improvement in their structural design, the cumulative effect of which is a greatly increased train load. This is the most effective method of condensing the occupancy of line and terminal trackage, thereby reducing tractive resistance by minimizing wheelage and deadweight, at the same time decreasing maintenance costs and dead-time by curtailing the number of units.

The extent of the development from 1902 to 1921 (the last year for which complete statistics are available) is shown in the following figures:

	1902	1921	Increase, per cent
Total number of freight cars owned	1,546,101	2,378,682	54
Aggregate carrying capacity	43,445,438	101,093,985	133
Unit carrying capacity, tons	28.1	42.5	51
Ton-mile traffic handled (millions)	157,289	309,443	97
Miles of yard and side tracks	58,221	100,705	73

Had the traffic demands for greater carrying capacity been accommodated during the intervening years by the seemingly simple process of adding locomotives and freight cars without any attempt at changing their design or capacity, it would have been necessary to add 2,051,550 freight cars, making the total number of freight cars required under such a plan 51 per cent greater than the actual number of freight cars in service during 1921. The addition of this number of freight cars, ratably determined, would have required 77,250 miles of additional yard and side trackage, an increase of approximately 133 per cent over the trackage of 1902, or 35 per cent more yard and side trackage than was in existence in 1921. Furthermore, 22,823 additional freight locomotives—or 97 per cent more than the number in service in 1902—would have been required to handle the additional gross tonnage. It may be well to leave to your conjecture the tremendous expansion which would have been required in all other complementary facilities to accommodate the demand for increased capacity had the railroads attempted to meet the problem by the impracticable method of simply increasing the number of equipment units.

The addition of 2,051,550 freight cars alone during the 19 years referred to would have been in excess by 1,218,969 cars of the number of freight cars actually added during that period; at an average cost of $1,500 per car these 1,218,969 extra cars would have required an additional investment aggregating $1,828,454,000, the capital charges on which, alone, at 6 per cent would have amounted to $109,707,240.

Furthermore, if during the period from 1902 to 1921 the railroads had simply added 2,051,550 freight cars with an average unit capacity of 28.1 tons, corresponding to that of the equipment in service in 1902, they would have been forced to handle 6,449,000,000 additional loaded car-miles in 1921 to accommodate the traffic actually transported in that year, the direct transportation cost of which alone, on basis of 1921 costs, would have added over $300,000,000 to their expenses.

The effect upon transportation rates—which vitally affect the shipper and consumer—resulting from these inordinate increases in capital and operating expenses cannot be appraised, but it is obvious that any attempt to maintain a freight rate level sufficiently high to protect these burdensome costs would have proved inhibitive of traffic.

The output of the transportation industry is measured in traffic units of tons and passengers carried one mile, and the efficiency with which the transportation machine has functioned by reason of the increased unit capacity and weight of equipment, more intensive utilization of facilities, reduction of curvatures and gradients, etc., is strikingly reflected by a comparison of results during the period from 1890 to 1920.

	1890	[illegible]	Increase per cent
Capital[illegible]	[illegible]	[illegible]10,620	[illegible]
Tra[illegible]	[illegible]	[illegible]7,524	[illegible]
Tons handled per [illegible]	[illegible]4[illegible]	[illegible]2,410	[illegible]
Freight train [illegible]	[illegible]	[illegible]748,351	[illegible]4
Passenger train [illegible]	[illegible]	1[illegible]	[illegible]4
[illegible] tive	[illegible]	[illegible]	[illegible]
Index number of wholesale prices of commodities	8[illegible]	[illegible]	[illegible]
Average freight rate per ton[illegible]	[illegible]41	[illegible]5	12

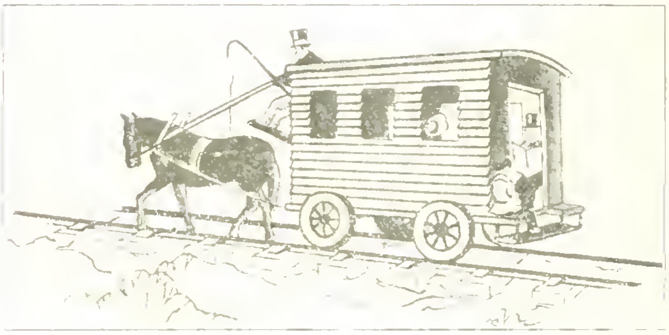
The normal development of railroad equipment was limited by war restrictions during the four-year period, 1915-1918, and by financial restrictions during the ensuing years, 1919, 1920 and 1921, but notwithstanding the fact that only 100,000 freight cars were purchased during the 26 months of Federal control—approximately 46,000 cars per year—the average number of new freight cars added by the railroads over a period of 10 years, 1913-1922, has amounted to 101,009 annually. To overcome any existing freight car shortage and to accommodate present and future traffic demands of commerce the railroads, in recognition of the necessity confronting them for the maximum improvement and expansion of their transportation facilities, expended $200,000,000 for freight cars in 1922 and have authorized additional expenditures for freight cars of, approximately, $515,000,000 for 1923. When we add to this the actual expenditures during 1922 and the authorized expenditures for the year 1923 for locomotives, additional trackage and other facilities the sum total of money invested in expansion of railroad properties will approximate one and a half billion dollars.

Conclusion

Ninety years ago Mons. A. Notre of Paris, a farsighted Frenchman, wrote:

"The public and private advantages, already derived from this (railroad) system, have reduced it to a certainty that this mode of construction can be adopted on long roads, with a view to both swiftness and economy. Agriculture, commerce and manufactures will acquire a new impetus, from the communication with the most distant markets, being rendered more rapid and cheaper; the poor man will no longer be obliged to deny himself that which was formerly beyond his means; the rich man will be conveyed with a velocity which formerly all his wealth could not have procured for him, and in a political and military point of view, the mind is lost in its imaginings; nations may collect their armies on their frontiers as if by enchantment."

His vision was prophetic. He painted a large picture, a picture which doubtless in his day was viewed with skepticism. Today there is still the opportunity for vision and prophecy when one discusses the subject of transportation.



Type of Passenger Car Used on the Baltimore & Ohio in 1829

To a close student it is evident that the development of railroad equipment has not only kept pace with the traffic requirements of the country, but, thanks to the master car builders of America, has anticipated and is anticipating the necessities and demands of the future. The art of car building has progressed from the rough and ready cut-and-try methods of the old wooden car days to the execution of carefully developed engineering designs in steel construction. Experts in structural details and construction features are constantly on the job. American inventive genius is producing specialties that increase service, give added security and keep American railroading in the van.

H. C. Oviatt (N. Y. N. H. & H.): In consideration of the very fine talk and pictures presented here this morning at the convention, I move that we extend a rising vote of thanks to Mr. Carry.

(The motion was unanimously carried.)

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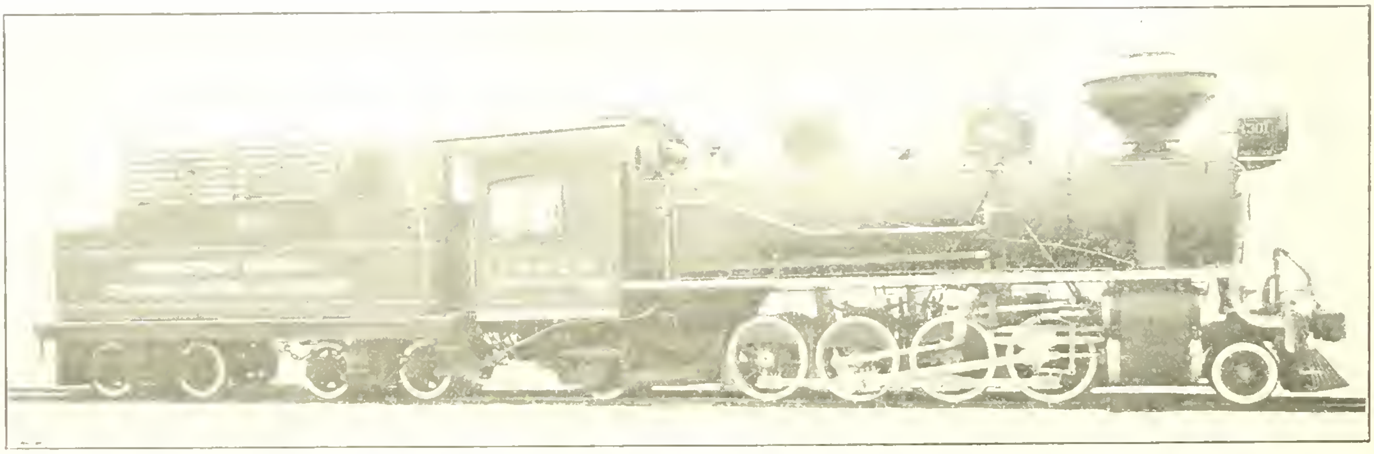


Contractor's Locomotive for Irrigation Project in Northern Brazil, Built by American Locomotive Company

The Report of the Arbitration Committee

Responsibility for Car Conditions to Meet Interchange Requirements of Rule 3 Placed on Owner

During the year Cases 1233 to 1286, inclusive, have been decided and copies sent to the members. A vote of concurrence is requested by the committee.

With the approval of the General Committee, the committee has discontinued the rendering of interpretations of questions under the Rules of Interchange and considers only those disputes presented in the form of arbitration cases in accordance with Rule 123. This change in practice has been of great benefit to the committee and also to the members as all arbitration cases are published and the decision thus made available for the guidance of all the members.

Recommended Changes in the Rules of Interchange

Changes or additions in the text of the rules, as far as possible, are shown in italics.

Rule 2

The committee recommends that Section (b), third paragraph, of this rule be modified to read in accordance with proposed form shown below, to improve the handling of such cars:

"A leaky tank car shall have stenciled *on both sides*, in letters three inches in size, adjacent to the car number, the words 'Leaky tank. Do not load until repaired,' and the owner shall be immediately notified. Stenciling must not be removed until the tank is repaired."

The committee recommends that a new paragraph be added to Section (f) of this rule as follows:

"*For inside door protection, the car transfer check as shown on page 172, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section G. A. R. A. Car Service Rule 14.)*"

This change is to conform to joint recommendation of Committee on Car Service of the Transportation Division and Arbitration Committee, Mechanical Division, making originating road responsible for absence of or improper inside door protection. This recommendation has been approved by the general committees of both Divisions and the necessary changes in Car Service Rule 14 were approved at the session of the Transportation Division at Chicago, April 25, 1923.

The committee recommends that Section (h) of this rule and form, Authority for Transfer or Adjustment of Lading, be modified as shown below, to provide that, when used as a bill it will show that the work was performed:

"The car transfer check authorizing transfer or rearrangement of lading be of the form shown on page 172. *All of the information required by the reading of the form must be filled in.*"

[The billing instructions at the side of the form are changed to provide that the form itself may be used as a bill.—Editor.]

Rule 3

The committee recommends that the effective date of Sections (b) and (d), second paragraphs, be extended to January 1, 1925. It is felt that the present situation justifies these extensions.

To prevent the transfer of lading enroute and to enable car owner to apply device which has been adopted as standard for his cars, the committee recommends that Section (f) be modified to read in accordance with proposed form shown below:

"After January 1, 1924, no refrigerator car equipped with brine tanks will be accepted *from owner* unless provided with suitable device for retaining the brine between icing stations."

The committee recommends that the effective date of Section (i) be extended to January 1, 1925, and that the section be modified to read in accordance with proposed form shown below:

"*After January* 1, 1925, cars with trucks of less than 60,000 lb. capacity will not be accepted *from owner* unless equipped with wooden or metal draft arms extending beyond the body bolster, metal draft arms integral with body bolster, metal draft arms extending to metal body bolster and securely riveted to same, or transom draft gear."

The present situation justifies this extension. It is also felt that transfer of lading enroute should be prevented and car owner held responsible for compliance with the rules.

The committee recommends that the effective date in the second sentence of Section (l) be extended to January 1, 1925.

To prevent the transfer of lading enroute and to require car owner to comply with the rules, the committee recommends that Section (o) be modified in accordance with proposed form shown below:

"(o) Cars built after November 1, 1920, will not be accepted *from owner* unless equipped with 6-in. by 8-in. shank A. R. A. Standard Type D couplers."

Rule 9

The committee recommends that the following new paragraph be added to this rule:

"*When charge is made for adjusting safety valves on tank cars, billing repair card must specify the pounds pressure at which the valve opened before adjusting.*"

It is felt that this information should be given the car owner to justify bill for adjusting safety valves.

Rule 17

To conform to the recommendation of the Committee on Wheels, the committee recommends that a new section be added to this rule to be designated as Section (i) and to read as follows:

"*The application of cast iron wheels cast after June 30, 1924, of nominal weight less than 650 lb., 700 lb. and 750 lb. shall be considered as improper repairs.*"

The committee recommends that Interpretation No. 7 of this rule be modified in accordance with proposed form shown below:

"(7) Q.—(No change.)

"A.—The substitution of the Schaeffer patented brake lever connection does not constitute wrong repairs. If such connection *is not standard to any of owner's cars*, charge for same should not exceed cost of that of owner's standard."

It is reasonable for the car owner to accept charge for this device where used by the owner, even though not yet applied to the particular car in question.

Rule 30

To remove present inconsistency, the committee recommends that Section (c) of this rule be modified in accordance with proposed form shown below:

"(c) Wooden and steel underframe cars (except refrigerator cars) should be re-weighed and re-marked each year during the first two years the car is in service, and thereafter once every 24 months. All-steel cars and all refrigerator cars should be re-weighed and re-marked at least once every 36 months. *Such re-weighing and re-marking may be done after expiration of 18 months (for wooden and steel underframe cars) and 30 months (for all-steel and all refrigerator cars) from the month in which previous weight was obtained.* This paragraph does not apply to tank cars."

Rule 32

The committee recommends that a new item, "discharge valve caps," be added to the first paragraph of this rule.

The committee recommends that Item 4 of Section (d) be modified to read as shown below:

"(d) 4. No rider protection, when necessary, *if car is damaged to the extent shown in footnote to Rule 43.*"

The committee recommends the following interpretation to Section (d), Item 3, of this rule:

"*Q.—Does this apply to cases of damage to cars in hump switching where rider protection is furnished?*

"*A.—No. This provision is intended to refer to wharves or other inclines on which cars are not handled with rider protection.*"

These changes and interpretation are to improve and clarify the rule.

Rule 33

To clarify this rule, the committee recommends that the first paragraph be modified as shown below:

"Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except damage to running boards (*including their supports and attachments*) on tank cars when sideswiped or cornered."

Rule 58

The committee recommends the following interpretation to this rule:

"Q.—Is car owner responsible for damage to air brake hose, angle cock or train line due to couplers passing?

"A.—Yes, unless otherwise provided in Rule 32."

Rule 72

The committee recommends that this rule be modified as shown below:

(Owners responsible.) *"Any seam running lengthwise and within the limits of 3¾ in. from flange, as shown in Fig. 5."*

This is recommended by the Committee on Wheels, as all longitudinal seams are dangerous regardless of apparent small extent on surface.

Rule 98

The committee will designate all paragraphs of this rule with letters for ready reference, and recommends that a paragraph be added to this rule reading as follows:

"If new cast iron or new cast steel wheels are applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand wheels whether or not a defect card is involved. Similarly, if new A. R. A. standard axle is applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand axle whether or not defect card is involved."

Owner receives the betterment and would not be penalized in being billed for it. Also, it creates incentive to apply new material which is preferred by car owner and because it is in line with rule on wrought steel wheels.

Rule 111

The committee recommends that the following note be added to this rule in order to make it more clear:

"Note: In cases where annual air brake cleaning is not performed, but triple valve is renewed account of defective body, charge may be made for material only. Also in such case if brake cylinder, brake cylinder piston or non-pressure head are renewed, account of defective, charge may be made for material and labor."

Rule 112

Attention has been called to a misprint in Note 1 to this rule as shown near top of page 161 of the 1922 Code.

This note should read as follows and will be corrected in the first supplement to the rule issued:

"Note 1—These rules are for the purpose of settlement between *carriers and between* carriers and private lines, for destroyed or dismantled cars, handled under the Rules of Interchange, and are not intended to be applied to cars of the same particular types in the accounts of individual carriers."

The committee recommends that a new paragraph be added as the third paragraph of this rule reading as follows:

"Second hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value."

The members of the committee are T. H. Goodnow, chairman, C. & N. W.; J. J. Hennessey, C. M. & St. P.; J. Coleman, Canadian National; F. W. Brazier, N. Y. C.; T. W. Demarest, Pennsylvania, and G. F. Laughlin, Armour Car Lines.

Discussion

T. H. Goodnow (C. & N. W.): The committee has withdrawn the paragraph contained on the last page of the report under Rule 112, reading as follows: "Second-hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value," and substitutes the following: "The age of trucks, in settling for destroyed cars, shall be considered the same as that of the car body."

In connection with that last paragraph, the sub-committee on billing data will make a report and in accordance with whatever action you take on that report the Arbitration Committee will frame certain rules to be included in the interchange rules so that the provisions of that report will be carried out.

H. T. Bentley (C. & N. W.): *I move that the report of the Arbitration Committee be accepted, with the amendment or change which it proposes in the report.*

(The motion was duly seconded and carried.)

R. L. Kleine (Penn. System): The report of the sub-committee on regulations governing inspection and repairs of foreign cars and billing therefor under the A. R. A. rules of interchange has already been approved by the Arbitration Committee and it was also submitted to the General Committee and received its approval and went to the board of directors, which approved the principles involved but left to the association any changes that it might wish to make in the details. The purpose of the report is to correct some of the things that the Inspection Bureau of the Association is finding.

In general these inspectors find that in-so-far as the billing itself is concerned it is being carried out fairly well, and that not much exception can be taken to it, but in-so-far as the mechanical details and the originating records are concerned there is room for improvement, and this report is for the purpose of giving to all railroads an approved method. I will read the principles and that part of the report that relates to the mechanical details. [Mr. Kleine here read from the proposed regulations, the purpose of which is to provide a correct basic method of recording the repairs made and material applied to foreign cars; a system of records sufficient to insure correct determination of responsiblity for the repairs, according to the interchange rules; and also the proper preparation and handling of the billing covering the cost and responsibility for repairs. The regulations include instructions for systematic checking of the way in which repairs and the billing therefor is being handled, the results of which are to be available to the A. R. A. Mechanical Inspection department. A system of refunding for improper charges discovered by these checks is outlined and a number of forms designed to show the minimum information required to carry out the purpose of the regulations are included.—Editor.]

Chairman Coleman: You have heard the report. What disposition do you want to make of it?

J. J. Tatum (B. & O.): I move that the report be accepted and referred to the Arbitration Committee so that it can make the necessary changes in the rules of interchange to make them effective.

F. W. Brazyer (N. Y. C.): We should not let this report go by without paying a compliment to Mr. Kleine. It is one of the best reports that has been gotten up and I believe it is going to clear the atmosphere on these questions. Possibly it is going to mean a lot more work for you to carry out the recommendations contained in the report, but it is going to be decidedly worth while in the end.

(A motion was carried to accept the report and refer it to the Arbitration Committee and to be embodied in the rules. A rising vote of thanks was then extended to Mr. Kleine for his very able report.)

Mr. Kleine: I want to thank you for this honor and to say in justice that it does not belong to me. It belongs to the sub-committee of the Arbitration Committee and the inspectors of your Interchange Bureau. They have done all the work and they have prepared it. I have simply been the coordinating officer.

In the Derailment of a passenger train on the Canadian National near Jardine Brook, New Brunswick, on June 19, two coaches fell down a bank and 12 passengers were injured.

The Plans for Removing Grade Crossings and making other extensive railroad improvements in the southern part of Philadelphia—elaborate plans involving both the Pennsylvania and the Baltimore & Ohio, based on studies and negotiations which have been going on for several years—have been finally completed and have received the approval of the Pennsylvania Public Service Commission. One of the first features of the work to be begun will be the elevation of the tracks on Washington avenue, and the continuation of this line on Gray's Ferry avenue between Fifth and Thirty-first streets.

Report of the Committee on Wheels

Revision of Specifications for Chilled Iron and Wrought Steel Wheels Proposed—New Gage for Steel Wheels

In 1917 the new arch plate 700 lb. design for cast iron wheels for use under cars of 80,000 lb. capacity was made recommended practice. In 1920 the new design of wheels of weights 650, 750 and 850 lb. were made recommended practice. No change has been made in the specifications to provide tests proper for these wheels. Furthermore, investigations of failed wheels have indicated that the chemistry of the wheel has a bearing on its service-ability, therefore, a demand has arisen for a chemical clause in the specifications. Your committee has prepared a new cast iron wheel specification to take care of these new features, and also to clear up certain clauses, which have been subject to criticism because of being indefinite. A meeting was held with representatives of the Association of Manufacturers of Chilled Iron Wheels, at which they were given an opportunity to criticise the proposed specifications. We wish to acknowledge the assistance and support, which these representatives gave. The final specifications, as proposed, are as shown below:

Proposed Specifications for Cast Iron Wheels

[As far as possible the important changes in the specifications and Code of Rules are shown in italics.]

1. SCOPE.—These specifications cover all 33 in. cast iron wheels for railway service, for loads of maximum gross weights not exceeding 95,000, 132,000, 169,000 and 210,000 lb. based on units of eight (8) wheels.

Manufacture

2. MATERIAL.—(a) Wheels shall be made of a mixture of such composition, that with good foundry practice and proper annealing, they will have the required chill in the tread and meet the following requirements:

FRACTURE.—(b) The fracture shall show a soft clean grey iron free from defects such as holes containing slag or dirt more than ¼ in. in diameter or cluster of such holes, honeycombing the hub; white iron in the plates or hub; or clear white iron around anchors and chaplets at a greater distance than ¼ in. in any direction. Steel chaplets are preferable to iron chaplets.

CHILL.—(c) The depth of clear white iron shall not exceed *⅞ in. at the throat* and 1 in. at the center line of tread and must not be less than ½ in. at the center line of tread and 7/16 *in. at the throat.* These limits apply to *all weights* of wheels. The blending of clear white iron with the grey behind it shall be *without any distinct line of demarcation*, and the iron shall not have *a mottled appearance* in any part of the wheel at a greater distance than 1¾ in. from the throat and the tread. The depth of clear white iron shall not vary more than ¼ in. around the tread in any one plane in the same wheel.

Chemical Composition and Tests

3. CHEMICAL COMPOSITION.—(a) The wheels shall conform to the following *requirements as to chemical composition.*

Combined carbon, maximum, 0.90 per cent.
Sulphur, maximum—0.17 per cent for 1923 to 1924 incl.
0.16 per cent for 1925 to 1926 incl.
0.15 per cent for 1927 to 1928 incl.
0.14 per cent for 1929 and after.
Manganese, minimum, 0.50 per cent.
Total carbon desired, minimum 3.35 per cent.
Phosphorus desired, maximum, .35 per cent.

Analysis shall be made by manufacturers from test blocks poured during the day's melt from each cupola from which wheels purchased to these specifications are poured, to determine the percentage of manganese, phosphorus, sulphur and silicon. The determination of carbon shall also be furnished merely for information. A copy of this analysis shall be given purchaser or his representative on request.

CHECK ANALYSIS.—(b) An analysis shall be made by the purchaser from one of the test wheels representing each 100 wheels. The chemical composition thus determined shall conform to the requirements specified in Section 3-a.

Drillings for analysis shall be taken from a drill hole bored into the back double plate of the wheel midway between the core holes.

4. PATTERNS.—(a) Patterns and chillers must be such that they will produce wheels according to dimensions shown in A. R. A. drawings for wheels.

DIMENSIONS.—(b) The normal diameter of the wheels produced by the chiller must be A. R. A. Standard 33 in. measured at a point 2⅝ in. from the outside of tread of the wheel. Wheels shall not vary more than 5/16 in. above or below the normal size measured on the circumference. *Each wheel shall be so nearly circular that a true metallic ring placed on its tread, and bearing somewhere on the cone, shall, at no point, be more than* 1/32 *in. from the tread.* The thickness of the flange shall be within the maximum and the minimum flange thickness gages adopted by the A. R. A. for new wheels. *The flange thickness on any individual wheel must not vary more than* 1/16 *in., the thickness to be measured at a point ⅝ in. above base line of tread.*

TAPING.—(c) All wheels shall be taped by the manufacturer with A. R. A. standard tape. The normal wheel having a circumference of 103.67 in. shall be designated as Tape 3 wheel, limited by 1/16 in. over and under the normal circumference. The smallest diameter of wheel acceptable under the specifications will be designated as Tape 1 wheel, the largest diameter acceptable under the specifications as Tape 5 wheel. Each tape size will cover a range of ⅛ in. in circumference. The wheels will be made with five small lugs cast on the hub. When taping the wheel a sufficient number of these lugs are to be cut off allowing the proper number to remain to represent the tape size. *Under no circumstances are any of these lugs to be cut off after the wheel is received from the foundry.* These instructions are for new wheels coming from the foundry.

WEIGHTS.—(d) Wheels shall be in accordance with the weights shown in Table 1, based on 1917-1920 A. R. A. Drawings.

[Standard sizes of cores have been added to Table I.—EDITOR.]

CORES.—In cases of wheels ordered with cores smaller in diameter than the standard, the additional weight should be considered as an addition to the normal weight and paid for by the purchaser.

Physical Properties and Tests

5. TEST SPECIMENS.—(a) When ready for inspection, the wheels shall be arranged in groups, all wheels of the same date grouped together and for each *102* wheels which pass inspection and are ready for shipment, 2 wheels *furnished free of cost* shall be taken for test. *One of these shall be the highest tape wheel and shall be subjected to drop test; the other which will be the lowest tape shall be subjected to the thermal test. If the inspector of the railway company so desires, he may make his drop test on a low tape wheel and demand a third test wheel of the highest tape size to be broken up to determine the chill; this third wheel also to be furnished free of cost.*

TABLE II

Weight of wheel, pounds	Weight of tup, pounds	Height of drop, feet	No. of blows
650	250	9	12
700	250	*10½*	12
750	250	*12*	12
850	250	*13*	12

DROP TEST.—(b) The anvil of the drop testing machine shall be supported on rubble masonry on a concrete foundation at least 2 ft. deep and shall weigh not less than 1,700 lb. The striking face of the tup shall be *9 in.* in diameter and flat. *When bottom of the face of the tup assumes a round or conical form by wear it shall be replaced.* The face of each of the three bosses supporting the wheel under test *shall be flat* and measure 5 in. in width.

(c) The test wheel shall be so placed on the three supports with the flange down, that the tup will strike centrally on the hub. The test wheel shall pass the requirements given in Table II *without breaking in two or more pieces. If the test wheel fails all wheels bearing the same tape size shall be rejected.*

(d) *If test wheel cracks with three blows or less it will be considered as having failed.*

6. Chill Test.—(a) The *wheel selected for drop test and the wheel which has been given the thermal test shall be broken* so that the chill may be examined *in at least four different portions* of the wheel. The depth of pure white iron shall conform with the requirements in Section 2-c. If the sample does not conform to the requirements stated all wheels of the tape size represented by the sample shall be rejected.

7. Thermal Test.—(a) In making the thermal test, the wheel shall be laid with the flange downward in the sand with the channelway 4 in. deep and *width as shown in Table III*, molded in green sand around the wheel, the tread of the wheel to form one side of the channelway, and the clean flange forming as much of the bottom as its width will cover. This channelway shall be filled with molten cast iron which shall be hot enough when poured, so that the ring cast, when the metal is cold, will be solid and free from wrinkles. The time when pouring ceases shall be noted, and after the time *given in Table III* has elapsed, an examination of the wheel shall be made. If a crack develops in the wheel within the *time limit specified in Table III*, all wheels bearing the same tape size shall be rejected.

Table III

Weight of wheel, pounds	Cooling time, minutes	Width of channelway, inches
650	2	1¾
700	2	1¾
750	2	2
850	2	2

(b) *In order to prevent spitting while pouring, the tread and flange may be covered with a coat of shellac. Wheels selected for test which are wet or which have been exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances shall the thermal test be applied to a wheel that in any part feels warm to the hand. Thermal wheels shall be broken so as to determine the chill and not the fracture.*

Additional Tests

8. Drop and Thermal Tests.—If the test wheel fails in either drop or thermal tests all wheels bearing the same tape size shall be rejected. *The remaining wheels of the lot shall be tested as a new lot of wheels.*

Workmanship and Finish

9. Workmanship.—(a) Chill shall have an inside profile that, in the finished wheel, will produce the exact form of flange and tread contour as shown by A. R. A. drawings adopted in 1917 and 1920.

Finish.—(b) *All wheels shall be thoroughly cleaned by removing all core sand and foreign substances. Wheels offered for inspection shall not be covered with any substance which will hide defects.* The body of the wheel shall be smooth and free from slag, shrinkage or blow holes, *swollen rims or other defects.* The hubs and rims shall be solid. The tread *and throat* shall be smooth and free from deep and irregular wrinkles, slag, *sand wash,* or chill cracks and sweat. *The hub core shall not be more than 1/16 in. out of center.*

Marking

10. Marking.—All wheels shall be *marked and* numbered consecutively in accordance with instructions issued by the purchaser. All wheels shall bear the initials of the purchaser, wheel number, weight of wheel, month, day and year when made *and for indicating the tape number, five small lugs ⅜ in. in diameter and ⅜ in. high to be cast on the inside of the wheel.*

All wheels shall have the name of the manufacturer and place cast on the outside plate of the wheels.

Wheel numbers once rejected shall remain unfilled.

Wheels conforming to requirements of these specifications shall have plainly marked on the outside plate A. R. A., 1920, for wheels of nominal weight of 650 lb. and 750 lb. and A. R. A. 1917 for wheels of nominal weight of 700 lb. and 850 lb.

Inspection and Rejection

11. Inspection.—(a) *The manufacturer shall notify the purchaser when ready for shipment, and shall furnish all the necessary facilities and labor to enable the inspector to make test and proper shipment of the wheels. The inspector shall have free access to parts of the manufacturer's works which concern the manufacture of all wheels ordered, or at any time while the work is being performed.*

Rejection Limits.—(b) If any lot of wheels submitted for test fails to meet the requirements of drop, chill, fracture, thermal *or chemical test as regards combined carbon contents,* all wheels of the same tape size shall be rejected.

(c) *Any lot of wheels which fails to meet chemical requirements, all wheels of that lot shall be rejected, except as regards the combined carbon content, which condition is covered in paragraph* 11-(b).

Individual Rejection.—(d) *Individual wheels will be considered to have failed and will not be accepted or further considered which:*

(d-1) Do not conform to standard measurements, special consideration being given to dimensions of rim and hub and contour plates and location of hub core.

(d-2) Are over or under weight; overweight will be accepted if no overweight is charged for.

(d-3) Have physical defects described in paragraphs 4-2 and 4-b.

(d-4) Do not bore out readily due to hard hub or hard spots.

(d-5) In all cases where wheels are rejected, the letter "R" must be chipped out of the legend A. R. A. unless such wheels meet the requirements as to chill, thermal, drop and chemical tests, set forth in these specifications.

Rejection at Destination.—(e) Wheels which show injurious *defects while being finished* by the purchaser, or which crack while being pressed on axle, *shall be rejected* provided the axle pressure is not excessive and the bore of the wheel shows no evidence of faulty machine work for gouging.

12. Rehearing.—Samples for chemical analysis which represent rejected material shall be *preserved for fourteen days* from date of test report, in case of dissatisfaction with the results of the test, the manufacturer may make claim for *rehearing* within that time.

Cast Iron Wheel Design

In 1917 the 700-lb. wheel was made recommended practice. This wheel differs from the old design in that it was the arch-plate type and had 25 lb. additional metal. In 1920 the arch-plate design of weights 650, 750 and 850 lb. were also made recommended practice. Your committee feels that these wheels have now been in service long enough to demonstrate their merit and that they should therefore be advanced to recommended practice, with the exception of the 850-lb. wheels. There are few of the latter in service and sufficient data has not been accumulated to warrant this design being advanced to standard practice. At present there are a number of private car lines and railroads who are still applying the old type light weight wheel. It is not fair in interchange to have these wheels put under cars, as the committee feels they are not safe for mountain grade service. If the designs are advanced to standard practice, a rule can be included in the code of rules which will prohibit the use of light weight wheels in interchange after a certain date. We recommend that the following rule be placed in the code of rules:

If cast iron wheels, other than A. R. A. Standard 650, 700 *and* 750 *lb. are applied, this should be considered as wrong repairs after July* 1, 1924. If the date of casting shown on the wheel is later than July 1. 1924, the owning line may bill for improper repairs. It is understood that wheels having different tread contours and flange sizes greater than those shown in standard drawing will not be included under the class of improper wheels.

The reason for excluding the tread contour and the flange dimensions is, that this subject is still open for discussion by the committee and a number of roads are using special tapers and also special reinforced flange, which in no way affect the safety of the wheel.

Taper of Tread of Wheels

At the request of the American Railway Engineering Association, the committee held a joint meeting with the sub-committee of this association on Track Stresses, at which there was a full discussion of tread design of wheels and its relation to the canting of rail. It developed there was little data available in regard to the effect of small or large tapers on wheel tread, so far as the effect on the rail was concerned. The representatives of the A.

R. E. A. brought out the fact that the spreading of rails and the wearing into tie plates and ties on the outside is a serious problem and on many of the roads they are meeting this by the canting of rails. Some of their representatives have felt that the wheel tread should have a lighter taper than 1 in 20 to help relieve this condition. It was brought out that wheels and rails both wear quickly after being put into service and any relation between the tread contour and the contour of the rail was soon lost. Thus it would not appear likely that making a slight alteration in the taper would remove this condition, and furthermore, the main cause of the spreading of the rail was entirely independent of tread taper.

The sub-committee of the A. R. E. A. asked for a statement as to the possibility of a change in the taper of the wheel, in order that they might have a permanent basis from which to start recommendations for canting rails. Your committee advised them that they had not received any data that would warrant making a change in the taper. The present taper is thought to be most advantageous, as regards flange wear. The last change made in the taper was in 1907, when it was changed to 1 in 20 from 1 in 25. At present practically all wheels made in the United States are being made with this standard taper. Your committee advised the sub-committee of the A. R. E. A. that they did have under consideration the making of the tread with a single taper in 1 in 20 instead of the present double tread, and this procedure met with the approval of the sub-committee of the A. R. E. A.

Grinding Cast Iron Wheels

The committee was requested to give consideration to the question of grinding new cast iron wheels. Studies were made to determine the actual amount of eccentricity found in new wheels after mounting. This eccentricity is of course due to two conditions: First, eccentricity in casting; second, eccentricity in mounting. Members who are grinding slid flat cast iron wheels report, that they frequently find a high spot at a distance from the slid flat spot, which would indicate that the high spot helped to produce the sliding, due to catching on the brake shoe. They also report that the wheels which have been ground give much better riding effect than ordinary new wheels, which would also indicate that the average new wheels have considerable eccentricity. Measurements of new wheels have shown eccentricities as high as 3/16 in. though the average is much below this. One large road in the southeast is grinding new cast iron wheels and they report that this practice has proven a desirable one and has resulted in better wheel service. Investigation indicates that in modern machines, it is possible to grind new cast iron wheels for approximately 60 cents a pair.

The committee feels there is a possibility of better results by grinding mounted new cast iron wheels and it therefore recommends that where roads have facilities they give consideration to this practice.

Seams in Cast Iron Wheels

A communication was received regarding the weakness of present Rule 72, regarding condemning limit for seams calling attention to the fact that a seam, whenever found, should cause the condemning of the wheel, regardless of its length, because of the fact that the seam is often covered over with good metal and it is impossible to determine its extent. The actual presence of a seam is a great hazard, and the majority of broken flanges are due to this defect. The committee agrees with this criticism and suggests that it be changed to read:

Any circumferential seam within 3¾ in. limit from flange.

The present rule allows an inspector to pass a wheel having a seam 2⅞ in. long and located close to the ½ in. limit from the flange, which the committee feels is dangerous practice.

Flange Thickness for Cast Steel Wheels

A request was received from the manufacturers of cast steel wheels, that the flange thickness limitations be reduced to the same as those for wrought steel and steel tired wheels, instead of the cast iron wheel limit. The manufacturers presented a series of tests which indicated that the strength of the flanges was in excess of that of the cast iron wheel. The committee had a representative make a test of flanges worn down to the two limits and these tests indicated that the strength of the flange of the cast steel wheel was much greater than that of the cast iron wheel and equal to that of the wrought steel wheel. Under these circumstances, we feel that the claim for a lower scrapping limit on flanges of cast steel wheels is a justifiable one and therefore, recommend that the limit be made 15/16 in. for all cast steel wheels under both freight and passenger cars and that changes in the Code of Rules be made accordingly.

Condemning Limit for Steel Wheels

At the 1922 convention the Wheel Committee recommended rolled steel wheels be allowed to wear ¼ in. lower than the present limit under tenders of switching locomotives. The committee now feels that such a test would not produce reliable figures for many years, as a great many of the roads use cast iron wheels under tenders. The present scrapping limit for rolled steel wheels under freight cars is entirely too high in comparison with the scrapping limits of the steel tired wheels; the steel wheel limit is ¼ in. higher than that for steel tires, through the critical line from the throat to the underside of the rim. This appears unjustifiable, as the tire is more liable to breakage due to its fastening to the center than is the rolled steel wheel. Experiments made to determine the strength of the flange of the wheel when worn to the present limit and to ¼ in. below the present limit indicate that the flange with the ¼ in. lower limit has a strength greatly in excess of that of the cast iron wheel and should be entirely satisfactory for freight service. The committee therefore recommends that the condemning limit for rolled steel wheels in freight service be reduced ¼ in. and the limit for locomotive tenders and passenger cars be left as now shown in the Standard. After the passenger car and the locomotive tender wheels have worn down to their limit, they can be transferred to freight car service and an extra ¼ in. of service secured. The practice will result in a saving of large sums, as there are now millions of rolled steel wheels in service in this

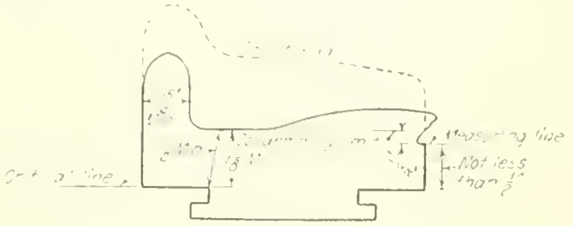


FIG 1
STEEL TIRE
RETAINING RING FASTENING

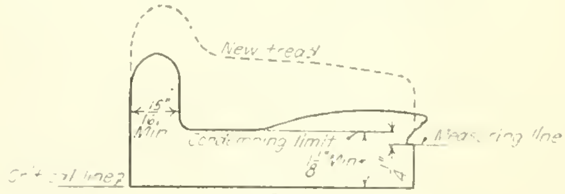


FIG. 2
STEEL TIRE
SHRINKAGE FASTENING ONLY

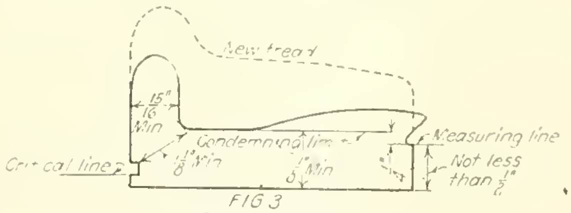


FIG 3
STEEL TIRE
RETAINING RING FASTENING

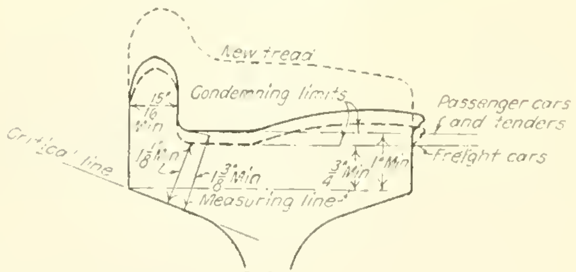
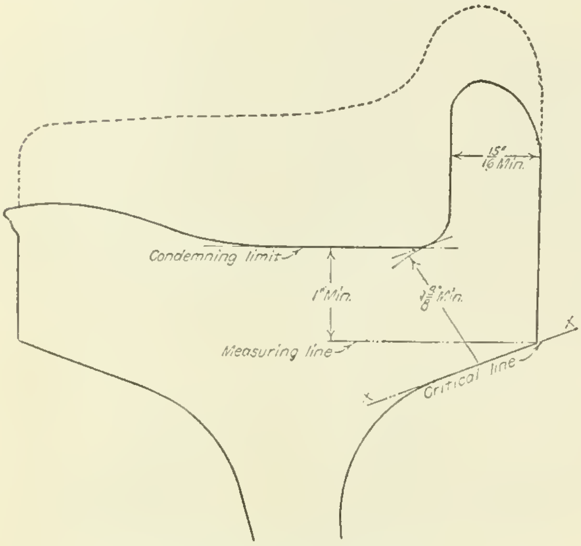


FIG 4
STEEL WHEEL

country. The committee recommends changes in the Code of Rules in another portion of this report, which will cover this change in scrapping limits.



MINIMUM DIMENSIONS FOR STEEL WHEELS IN PASSENGER CAR AND LOCOMOTIVE TENDER SERVICE

Proposed Specifications for Steel Wheels

The committee has written complete new specifications covering wrought steel wheels. The old specifications contained a number of clauses which have resulted in confusion and argument in inspection at wheel plants. Furthermore, some of the tolerances were not practical. The committee held a joint meeting with representatives of the steel wheel manufacturers and each member of the committee visited the plant of a manufacturer, in order to be thoroughly familiar with the details of the manufacture. The committee therefore, submits the specifications shown to replace the present specifications:

1. Scope.—These specifications cover all solid wrought carbon steel wheels for locomotives and cars.

I. Manufacture

2. Process.—The steel shall be made by the open hearth or electric process.

II. Chemical Properties and Tests

3. Chemical Composition.—The steel shall conform to the following requirements as to chemical composition.

Carbon	0.65 to 0.85 per cent
Manganese	0.60 to 0.85 per cent
Silicon, not less than	0.15 per cent
Phosphorus, not over	0.05 per cent
Sulphur, not over	0.05 per cent

4. Ladle Analyses.—To determine whether the material conforms to the requirements specified in Section 3, an analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. A copy of this analysis shall be given to the purchaser or his representative.

5. Check Analyses.—A check analysis may be made by the purchaser from *a wheel selected by him,* representing each melt, and this analysis shall conform to the requirements specified in Section 3. A sample for *check* analysis *may be hot punched or taken by means of a core drill* from any one point in the plate, or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drillings for *check* analysis shall be taken by pouring entirely through the *sample,* parallel to the axis of the wheel; they shall be clean and free from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

III. Mating

6. Mating.—(a) Wheels must be mated as to tape size and shipped in pairs.

(b) *When specified all wheels of any one type and rough bore shipped in any one carload lot shall be so selected as to permit mating and mounting within a five-point carbon range according to the carbon content stamped on the wheels; i.e.,* 65-70, 66-71, 67-72, 68-73, 69-74, 70-75, *inclusive, etc., the preferred ranges to be considered as* 70-75 *and* 75-80.

IV. Tolerances

7. Tolerances.—Wheels shall be furnished rough-bored, and with faced hubs, and with contour of tread and flange as shown on Standard Drawing, *A. R. A. Manual, Section "D" Page —,* and shall conform to the dimensions specified subject to the following tolerances:

Flange

(a) Height of Flange.—The height of flange shall not be less than 1 *in. nor more than* 1⅛ *in.*

(b) Thickness of Flange.—The thickness of flange shall *fall within the limits of the maximum and minimum standard flange thickness gages shown on Page* 41, *Section "B," A. R. A. Manual.*

(c) Throat Radius.—The radius of the throat shall not vary more than 1/16 in. from that specified.

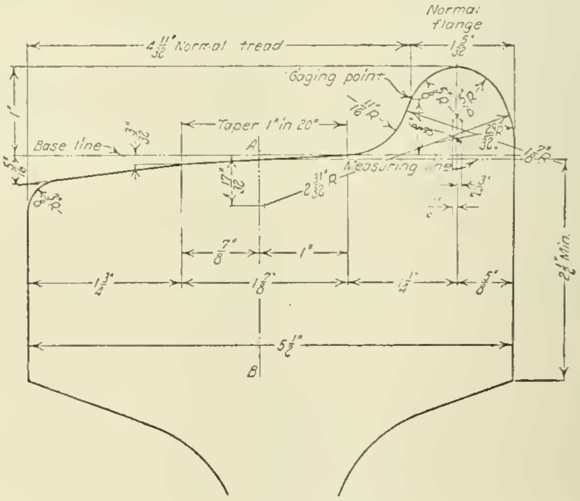
Rim

(d) Tape Size.—The tape size of 28 in. wheels shall not be less than Tape 32 nor more than Tape 46, 30 in. wheels shall not be less than Tape 82 nor more than Tape 96; 33 in. wheels shall not be less than Tape 157 nor more than Tape 171, and 36 in. wheels shall not be less than Tape 233 nor more than Tape 247.

(e) Rim Interior Diameter, Back Face of Rim.—The rim interior diameter, back face of rim, shall not be less than 22⅝ in. for 28 in. wheels, 24⅝ in. for 30 in. wheels, 27⅝ in. for 33 in. wheels, and 30⅝ in. for 36 in. wheels. The maximum rim interior diameter, back face of rim, shall be governed by the tape size and rim thickness.

(f) Rim Interior Diameter, Front Face of Rim.—The rim interior diameter, *front face of rim shall not exceed the rim interior* diameter, back face of rim, *nor vary* under that dimension by more than ¼ in.

(g) Thickness of Rim.—The thickness of the rim shall be measured *radially of the wheel, on the back face of the rim, between the inside diameter of the rim and the point at which a line drawn through the intersection of Line "A"-"B" and tread of the wheel, parallel to the axis of the wheel, meets the back face of the rim. The thickness of rim thus measured with a standard A. R. A. steel wheel gage, or an approved equivalent shall not be less than 2½ in. and shall not vary more than ⅛ in. on any two radii in any one wheel.*



WHEEL TREAD AND FLANGE FOR STEEL WHEELS

(g-1) *The rim thickness when measured radially on a plane* 1 *in. from front face of rim shall not vary more than ⅛ in. on any two radii in any one wheel. The contour of the underside of the rim shall be practically symmetrical either side of the plate.*

(h) *To facilitate measurement of rim thickness the radius of the inside edge of back face of rim shall not exceed ⅛ in. A sharp corner is preferable.*

(i) ROTUNDITY.—All *rolled to finish* wheels when gaged with a *rotundity* gage shall not show an opening between the gage and tread at any point greater than 1/16 in.

(j) BLOCK MARKS ON TREAD.—The maximum height of block marks shall not be greater than 1/64 in.

(k) WIDTH OF RIM.—The width of rim shall not vary more than ⅛ in. from that specified.

(l) PLANE.—Wheels shall be gaged with a *plane* gage placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of 1/16 in. from the plane of the same gage when so placed.

Plate

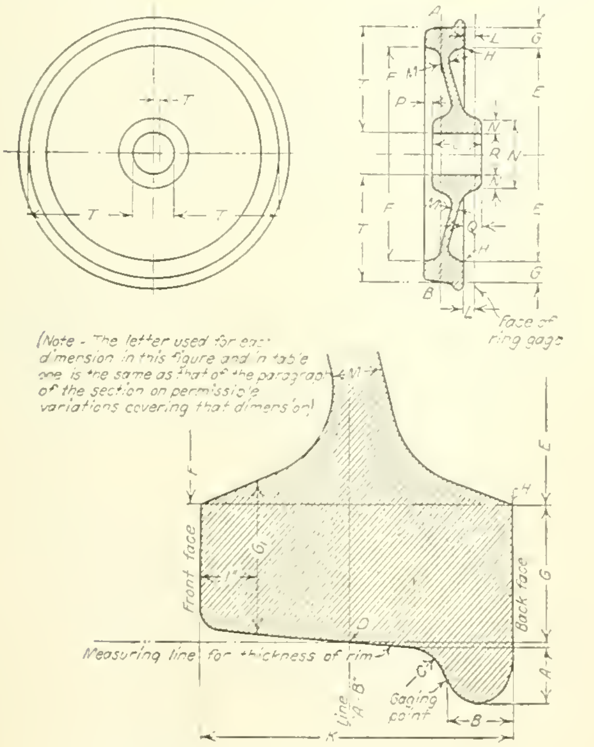
(m) THICKNESS OF PLATE.—*The plate thickness may vary but shall not be less than that shown on the drawings.*

Hub

(n) DIAMETER OF HUB.—Hub diameter may vary, but wall thickness of finish bored hubs shall not be less than 1¼ in. at any point for bores 7 in. or less in diameter, nor less than 1½ in. for bores more than 7 in. in diameter, and wall thickness for finished bored hubs shall not vary more than ¼ in. at any two points on the same wheel.

(o) HUB LENGTH.—The length of the hub shall not vary more than ⅛ in. from that specified.

(p) DEPRESSION OF HUB.—In connection with wheels to be used *with journal boxes bearing on front face* of hub, such as car and tender wheels, the *depression of hub below front face* of rim shall not be less, but may be as much as ⅛ in. more, than that specified.


T
T
T
A
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G
H
F
M
E
P
N
Q
R
E
F
T
G
B
L
face of ring gage
(Note - The letter used for each dimension in this figure and in table one is the same as that of the paragraph of the section on permissible variations covering that dimension)
M
F
E
H
Front face
G₁
1"
D
Back face
G
Measuring line for thickness of rim
C
A
Line "A-B"
Gaging point
B
K

General Dimensions Referred to in Table 1.

(q) PROJECTION OF HUB.—Wheels to be used *with journal boxes bearing on back face* of hub, such as locomotive truck wheels, shall be furnished with back face of *hub machined* to smooth dimensions, or there shall be left on the hub face from 1/16 in. to 3/16 in. stock for finishing.

Bore

(r) DIAMETER OF BORE.—The diameter of rough bore shall not vary more than 1/16 in. over nor more than ⅛ *in. under* the dimensions specified. When not specified, the rough bore shall be ¼ in. less in diameter than the finished bore, subject to the above limitations.

(s) BLACK SPOTS IN HUB.—Black spots will be allowed within 2 in. of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.

(t) ECCENTRICITY OF BORE.—The eccentricity between the tread *at line "A" "B"* and the rough bore shall not exceed 3/64 in.

Gages

[Gages referred to are those shown in the Manual, Section B, pages 37, 38, 39, 40, 41 and 43.]

8. BRANDING.—(a) The date, *(day, month and year)*, brand of manufacturer, manufacturer's serial number and *heat number and carbon content designation* shall be legibly stamped on *the back face of the rim approximately ¼ in. from the inner edge of the rim, as shown on sheet 49, section "D," A. R. A. Manual. The height of characters sholl not be less than ⅝ in. for hot stamping or ½ in. for cold stamping.*

TABLE I. PERMISSIBLE VARIATIONS IN DIMENSIONS OF WROUGHT CARBON STEEL WHEELS—SEE PAGE 1629

Dimensions	Permissible variations in dimensious	
FLANGE	OVER	UNDER
(a) Height	⅛ in.	0
(b) Thickness	1/16 in.	1/16 in.
(c) Radius of throat	1/16 in.	1/16 in.
RIM		
(d) Tape sizes	14	0
(e) Rim interior diameter—Back face of rim	Limited by tape size and rim thickness	⅜ in.
(f) Rim interior diameter—Front face of rim in relation to interior diameter—Back face of rim	0	¼ in.
(g) Rim thickness from inner edge of back face to intersection of line A, B and tread	Limited by tape size	0
MAXIMUM ECCENTRICITY IN RELATION TO TREAD ⅛ IN.		
(g-1) Variation when measured radially on plane 1 in. from front face of rim	⅛ in.	
(h) Inside edge—Back face of rim (measuring line) maximum radius	⅛ in.	
(i) Maximum departure of tread from rotundity	1/16 in.	
(j) Maximum height of block marks on tread	1/64 in.	
(k) Width of rim	⅛ in.	⅛ in.
(l) Maximum departure of any circle on back face from plane	1/16 in.	
PLATE		
(m) Thickness, variation from that specified		0
HUB		
(n) 1. Diameter		Limited by wall thickness
2. Minimum thickness of wall, for bores 7 in. or under	1¼ in.	
3. Minimum thickness of wall for bores over 7 in.	1½ in.	
4. Maximum variation in thickness of wall in any one wheel	¼ in.	
(o) Length	⅛ in.	⅛ in.
(p) Depression below front face of rim	⅛ in.	0
(q) Projection beyond back face of rim:		
When furnished finished	0	0
When furnished rough	1/16 in. to 3/16 in.	0
BORE		
(When not specified, rough bore shall be ¼ in. less than finish bore)		
(r) Diameter of rough bore	1/16 in.	⅛ in.
(s) Maximum depth of black spots in rough bore within 2 in. of face of hub	Must finish clean	
(t) Maximum eccentricity of rough bore in relation to tread	3/64 in.	

(b) The tape size shall be plainly *stencilled on the back of the plate in figures at least* 1 *in. high.*

V. Finish

9. FINISH.—(a) The wheels shall be free from injurious defects, and shall have a workmanlike finish.

(b) Wheels shall not be offered for inspection if covered with paint, rust or any other substance, to such an extent as to hide defects.

VI. Inspection

10. INSPECTION.—(a) Inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's

works which concern the manufacture of the material ordered.

(b) The manufacturer shall afford the inspector, free from charge, all reasonable facilities and necessary gages to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment and free of charge to the purchaser.

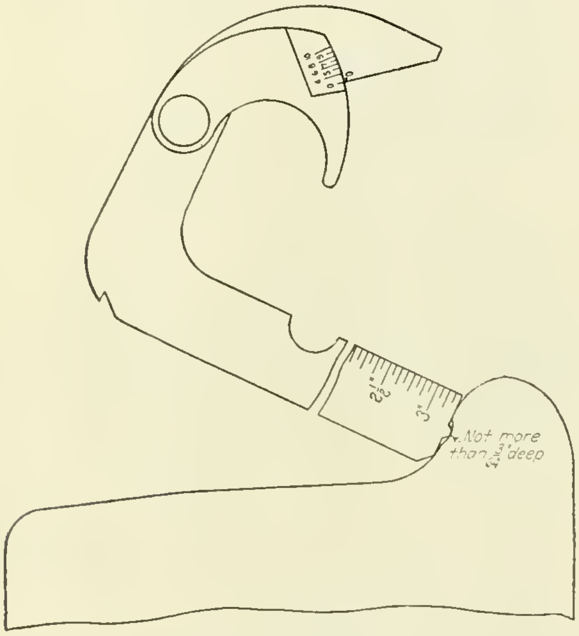
(c) The purchaser may make the tests to govern the acceptance or rejection of material in his own laboratory or elsewhere, as may be decided by the purchaser. Such tests, however, shall be made at the expense of the purchaser. *Any rejection based on such tests shall be reported to the manufacturer within five working days from receipt of samples.*

(d) Wheels which show injurious defects while being finished by the purchaser shall be rejected, and the manufacturer promptly notified.

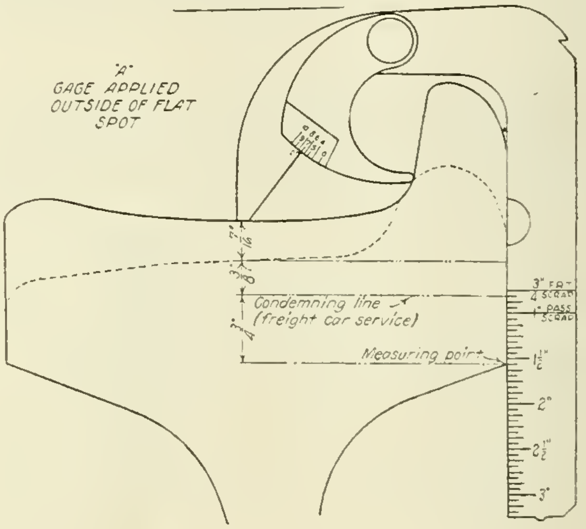
(e) Samples tested in accordance with Section 5, which represent rejected wheels, shall be preserved for two weeks from date of test report. *In case of dissatisfaction with the results of the tests the manufacturer may make claim for a rehearing within that time.*

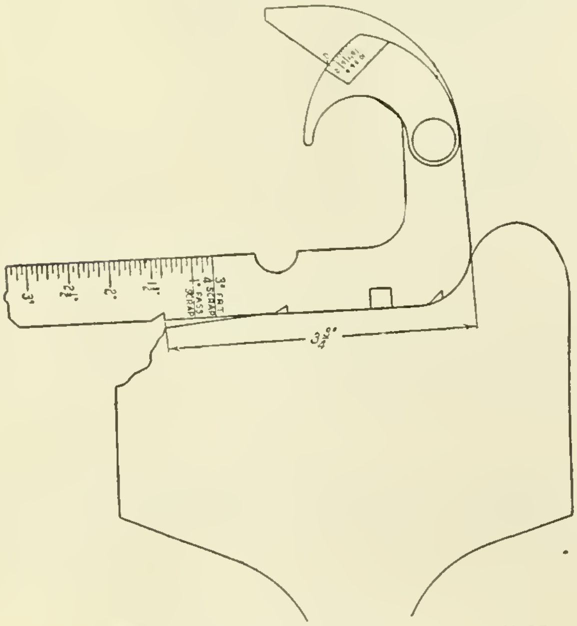
Gage for Steel Wheels

The present gage for gaging steel wheels has not been found satisfactory, as it is too complicated for the average inspector or wheel lathe hand and there has been a demand for a simpler gage to answer all the requirements, and at the same time a revision of the Code of Rules governing billing for metal in rolled steel wheels through the use of such a gage. The limit of wear line which has been placed on wheels has been found to be an unsatisfactory method of gaging the wheels, because of the fact that the treads wear hollow, and no way is provided to take care of this measurement. Furthermore, the rules governing the maintenance of locomotives issued by the I. C. C. place the limit on the dimensions from the throat to the underside of the

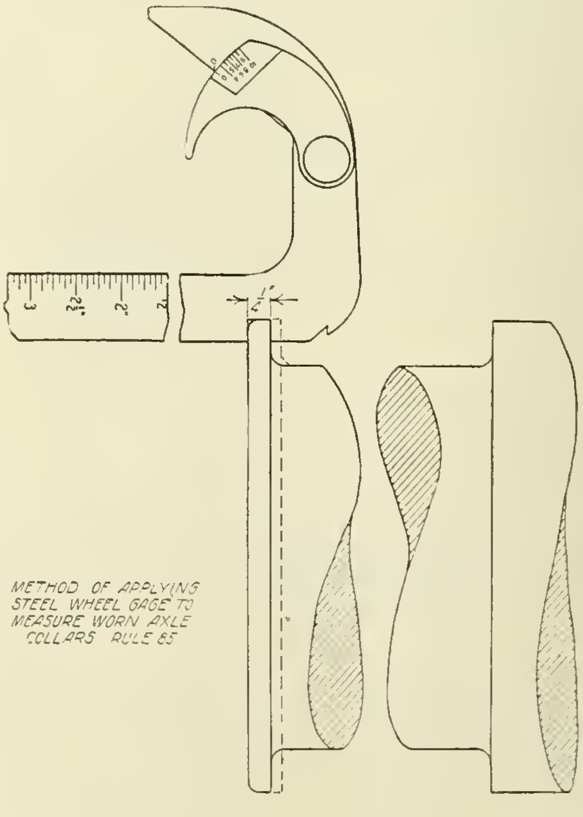


METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK DEPTH OF WITNESS GROOVE IN FLANGE.



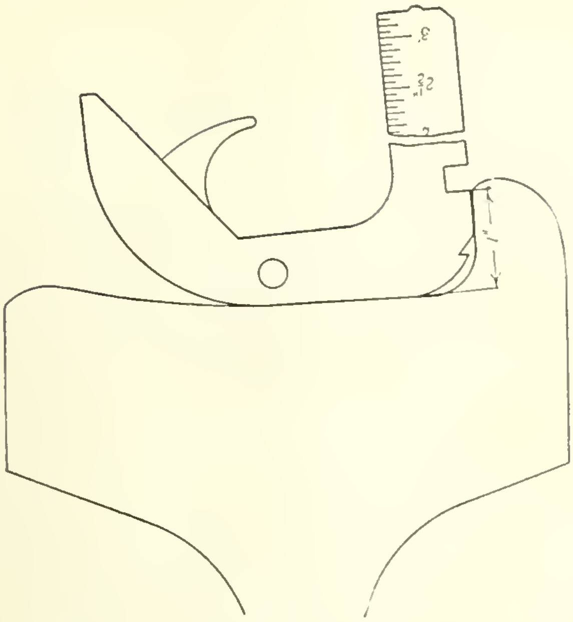


METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE LOCATION OF CHIPPED RIMS. RULE 78

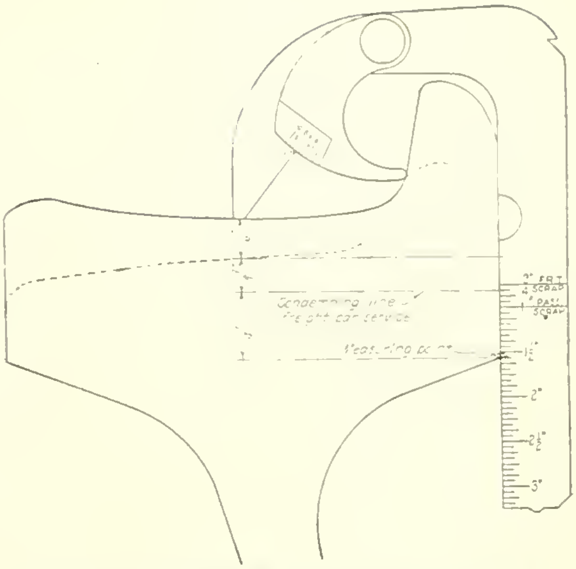


METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE WORN AXLE COLLARS RULE 85

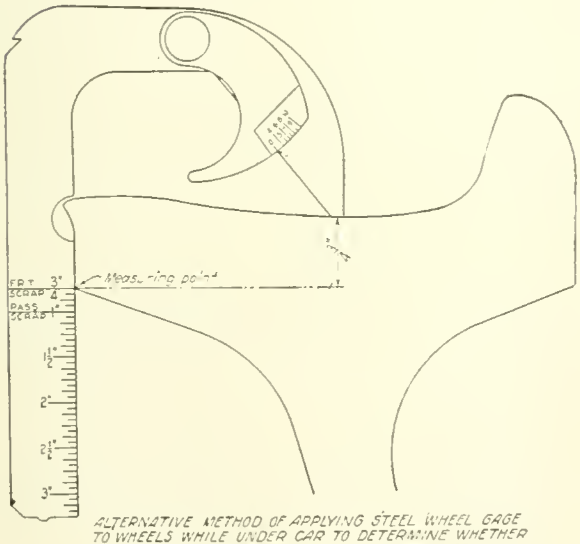
Various Uses of Wheel Gage



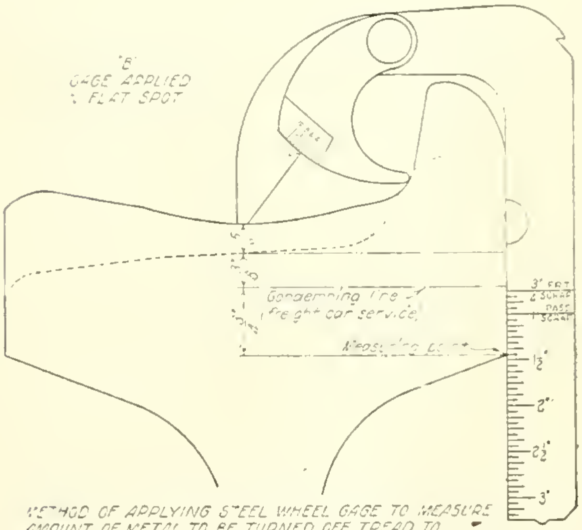
METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE VERTICAL FLANGES UNDER RULE 74



METHOD OF APPLYING STEEL WHEEL GAGE ON WORN FLANGE WHEEL THE POINTER INDICATES AMOUNT OF METAL IN SIXTEENTHS OF AN INCH TO BE TURNED OFF TREAD TO RESTORE FLANGE CONTOUR WITH WITNESS GROOVE. THE SIDE SCALE SHOWS AMOUNT OF METAL ON TREAD ABOVE MEASURING LINE

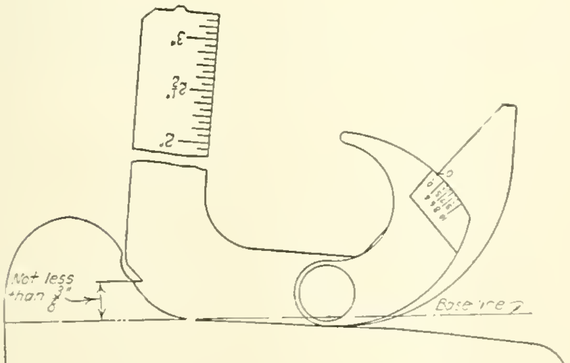


ALTERNATIVE METHOD OF APPLYING STEEL WHEEL GAGE TO WHEELS WHILE UNDER CAR TO DETERMINE WHETHER THEY ARE TO SCRAP LIMIT OF TREAD THICKNESS. WHEN WHEELS ARE REMOVED FINAL CHECK MUST BE MADE ON FLANGE SIDE OF RIM.

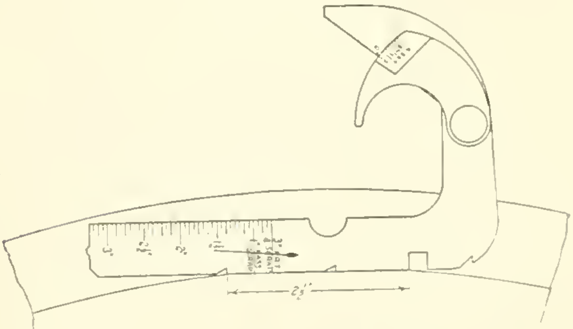


METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE AMOUNT OF METAL TO BE TURNED OFF TREAD TO REMOVE FLAT SPOT AND ALSO EXTRA METAL TO BE TURNED OFF TO RESTORE FLANGE CONTOUR.

IN THIS ILLUSTRATION ONE EIGHT OF AN INCH PLUS ONE SIXTEENTH OF AN INCH OF TREAD METAL SHOULD BE CHARGED TO DELIVERING LINE ACCOUNT FLAT SPOT AND ONE QUARTER OF AN INCH CHARGED AGAINST OWNING LINE ACCOUNT RESTORING FLANGE CONTOUR. THE EXTRA ONE SIXTEENTH OF AN INCH CHARGED FOR THE FLAT SPOT IS MADE TO ALLOW FOR CUTTING UNDER HARD SURFACE AT FLAT SPOT



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK LOCATION OF WITNESS GROOVE IN FLANGE.

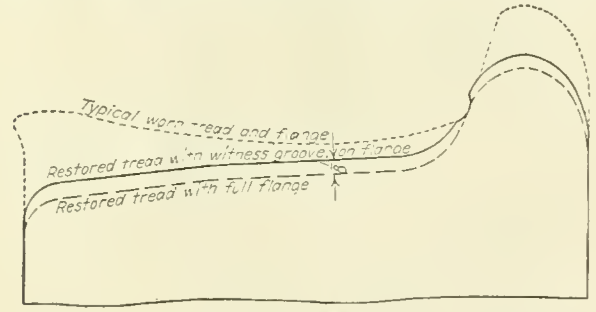


METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE SLID FLAT SPOTS AND SHELLED SPOTS RULES 68 & 71

Various Uses of Wheel Gage

back rim. This latter dimension is really the correct dimension for limiting the wear of steel wheels, inasmuch as this is the danger point and not the front rim. The Committee has gone into this matter carefully and has developed a gage which is submitted for approval. This gage takes care of the measurement of amount of metal to be turned off the tread to restore full flange contour as well as the limit of rim thickness. It should be noticed, that it also provides a gage checking the depth and location of witness groove in the flange after turning. It is the practice of most roads to leave this witness groove in the flange after turning, inasmuch, in this way a large amount of serviceable tread metal is saved. The committee feels that inasmuch as this is a good practice, it should be sanctioned by the Code of Rules, but limitations should be put on the depth and location of the groove. The maximum depth is limited to 3/64 in. and the location to a minimum of ⅜ in. above the base line. Changes in the Code of Rules will be necessary to cover this point and are given in another portion of this report. All final gaging of wheels with this new gage will be on the back rim of the wheel. The committee realizes that while the wheels are under the cars, it is difficult to take this measurement, particularly, on the middle wheel of a six-wheel truck. The gage has therefore been designed so that it can be applied to the outside of the wheel by the inspectors on the track, in order to make decision as to whether to remove the wheel. However, the final check after wheel has been removed must be taken from the back side of the flange, as this is the real limiting dimension. The new specifications are drawn up with such tolerances on the inside rim diameter as to make it more readily adaptable to this type of gage.

The illustrations show the methods of applying the new gage for the various measurements. In addition to the uses shown, inspectors can adapt the gage for use in measuring couplers by cutting off the lower end, so that length over all is 5⅛ in. The gage may also be used by inspectors to gage thin flanges. Figure 8 on the moving finger of the gage represents a flange of 1 in. thickness. Figure 9 represents a flange of 15/16 in. thickness.


Typical worn tread and flange
Restored tread with witness groove in flange
Restored tread with full flange
⅛

SKETCH SHOWING SAVING IN TREAD METAL WHEN A WITNESS GROOVE IS LEFT IN FLANGE AS COMPARED TO FULL FLANGE CONTOUR

It will be noticed that in the proposed changes in the Code of Rules, it is recommended that either the standard A. R. A. gage must be used for the measurement of the metal in billing or an approved equivalent. One other gage has been presented to the committee and changes have been made which bring it into conformity with the requirements of the A. R. A. gage. This gage which is known as the I. D. Service Metal Wheel Gage, meets with the approval of your Committee and will be considered as an approved equivalent, under the Code of Rules. Any other gages which may be developed will be considered and either approved or condemned.

Changes in Code of Rules

Your Committee recommends the following changes in the Code of Rules to agree with recommendations made in this report:

Rule 72.—*Any circumferential seam within 3¾ in. limit from flange.*

Rule 74.—Worn Flanges.—*Cast iron wheels* under cars of less than 80,000 lb. capacity with flanges having flat vertical surface extending 1 in. or more from tread, or flanges 15/16 in. thick or less, gauged at a point ⅜ in. above tread.

Wheels under cars of 80,000 lb. capacity or over, with flanges having flat vertical surface extending ⅞ in. or more from tread, or flanges 1 in. thick or less, gaged at a point ⅜ in. above tread. See Figs. 3 and 4.

Worn Flanges.—Wrought steel, steel tired, or *cast steel* wheels: Flanges having flat vertical surface, extending 1 in. or more from tread, or flanges 15/16 in. thick or less. See Figs. 3 and 4.

Note: Wording under Figs. 3 and 4 should be changed so as to eliminate cast steel wheels from grouping with cast iron.

Rule 79.—Thin Tread Steel Wheels.—*If tread is worn so that tread thickness, as shown by A. R. A. standard wheel gage or its approved equivalent is ¾ in.*

Steel Tired Wheels.—If tread is worn to within ¼ in. of the measuring line which is the inside edge of the limit of wear groove.

Rule 98, page 101.—Wrought Steel Wheels.—The price for new wrought steel wheels shall be based on scrap value of $1.90 for metal inside the condemning limit, which is ¾ *in., as shown by the Standard A. R. A. steel wheel gage or its approved equivalent,* plus $1.52 for 1/16 in. of service metal (on radius of tread) in connection with standard full flanged contour *with allowance for witness groove.*

Second Paragraph on page 101 should have the following added: *The amount of service metal available will be measured on back face of the rim, using the standard A. R. A. steel wheel gage or its approved equivalent.*

Third Paragraph on page 101 should read: When repairs are not covered by defect *charge,* the proper credit for any *allowance of service metal* must be given the owner at the rate of $1.52 for each 1/16 in. of service metal removed, measured on radius of tread, in connection with full standard tread and contour *with witness groove left in flange* and charge shall be made against owner for any increase in service metal. *The amount of service metal available to be measured on back face of rim, using the standard A. R. A. steel wheel gage or its approved equivalent. In cases of slid flat wheels, loss of service metal shall be calculated, using standard A. R. A. steel wheel gage or its approved equivalent, measuring on the back face of rim. The measurement of amount of metal to be turned off to true up the flange or tread will be calculated by the use of the standard A. R. A. steel wheel gage or its approved equivalent, measuring on the back face of rim.*

Interpretation No. 1: *Should be removed from the Code.*

Interpretation No. 3: *Should provide an allowance for witness groove.*

Rule 107.—Under Item 420-D: Change to agree with above rule.

Passenger Car Code of Rules

Rule 7.—Item 5: This rule should be *changed to permit cast steel wheels to have the same flange thickness limit as the wrought steel wheels.*

Item 6: Should be *changed* so as to *group the cast steel wheels* with *the wrought steel wheels and steel tired wheels as regards flange wear limit.*

Item 13: *To Be Changed as Follows*: If tread *of steel tired wheels* is worn to within ¼ in. of measuring line, which is the inside edge of the limit of wear groove. *On steel wheels if tread is worn to 1 in. thickness, as shown by standard A. R. A. gage or its approved equivalent.*

Service metal on steel wheels is to be measured by the standard A. R. A. steel wheel gage or its approved equivalent.

Rule 8.—Item (f): Note under this rule should be changed.

Rule 21.—Item 26: *Allowance should be made for witness groove in the flange and note changed accordingly.*

Rule 22.—Note under Item 55 should be *changed, eliminating reference to the limit of wear groove and also limitations of metal in excess of 1½ in.*

Recommendations

The Committee on Wheels recommends the following questions as discussed in this report be submitted to letter ballot:

1. New specifications for cast iron wheels.
2. New specifications for wrought steel wheels.
3. Change in scrapping limit of wrought steel wheels.
4. Change in flange thickness limit for cast steel wheels.
5. Advancement of 650 lb., 700 lb., and 750 lb. cast iron wheels to Standard Practice.
6. Adoption of new steel wheel gage as recommended practice.

The committee also recommends that the various changes in the Code of Rules as listed in this report be considered by the Arbitration Committee.

This report is signed by C. F. Ripley (Chairman), A. T. & S. F.; O. C. Cromwell, B. & O.; L. K. Silcox, C. M. & St. P.; H. C. Manchester, D. L. & W.; E. W. Smith, Penn. System, and P. H. Dudley, N. Y. C.

Discussion

[Instead of reading the report the chairman, C. T. Ripley, commented briefly on the different subjects, with explanatory remarks covering the reasons for the conclusions reached by the committee.]

Mr. Ripley: There are several changes in the specification for cast-iron wheels which are the result of discussions and various new ideas brought forward in the last few years. Chemical specifications have been added.

The committee recommends the advancement of the new weight, arch plate wheels to standard practice instead of recommended practice, and also suggests to the Arbitration Committee that the use of these wheels be made compulsory in interchange. Our object was to do away with the practice which now exists on some railroads and on some private car lines of using lighter weight and differently designed wheels which are not felt to be safe in operation in mountainous territory. This subject has already been covered in the report of the Arbitration Committee.

The taper of the tread on both steel and cast-iron wheels was discussed at a joint meeting of the committee and representatives of the A. R. E. A. The committee felt that the existing taper should be retained for the present, but that consideration should be given to a change in the length of the 1 in 20 taper; that is, to come to something approaching a continuous taper or at least an extension of the present 1 in 20 taper closer to the edge of the rim. The idea in this is to get a large bearing area on the rail and thus increase the life of the rail. This committee desires to do everything to co-operate with the civil engineers which it can do without decreasing unduly the life of the wheels.

The committee was requested to go into the question of grinding new cast-iron car wheels before they are put into service. We have in former reports discussed the grinding of slid-flat wheels, and this practice is now followed by a number of the large railways.

There is an advantage also in the grinding of new wheels, due to the fact that they are out of round, and due both to defects in casting and defects in mounting. Making them truly round will make them run better and should reduce the number of flat spots and be easier on both track and cars. One large railroad is following this practice, and I hope their representative will discuss the results.

The next subject is seams in cast-iron wheels. The committee recommended that the Arbitration Committee increase the severity of this rule in order to avoid any chance of accident due to hidden seams, and the Arbitration Committee's report has covered this.

The next subject has reference to flange thickness for cast-steel wheels. The manufacturers of cast-steel wheels are loath to believe that they should be thrown in the class of the cast-iron wheels, due to the strength of their flanges. This committee made experiments on the breakage of flanges in a few classes of wheels for scrapping limits, under specially constructed devices in drop-test machines, and found this claim was well warranted. We have, therefore, recommended that the code of rules be changed, throwing the cast-steel wheel into the class of the rolled-steel and wrought-steel wheels.

I would also like to call attention to the drawing of the steel wheel gage. There is an error in this drawing in the dimension in the right hand upper corner which was designed for measuring vertical flanges of cast-iron wheels. This should be ⅞ in. There is also one other error in the drawing showing the saving involved in the use of a witness groove. There is a small lip of metal which projects beyond the line shown for the worn flange. This is an error.

I have a gage of this type here if anyone is interested in seeing it and its application.

F. M. Waring (Penn. System): We have had no experience in buying cast-iron wheels to chemical specification and therefore have no suggestion to offer on the proposed specifications. There were just a few points to which I would like to call the attention of the committee and possibly ask for a little further explanation.

On the table showing the height of drop for the different weights of wheels, the 850-lb. wheel is given a 13-ft. drop. It seemed to us that might possibly be 15 ft., in order to be in line with the proportion existing in the drops of other weights of wheels.

Under the section on chemical composition we have been getting some cast-iron wheels in which the combined carbon would run as high as one per cent, and we questioned whether those wheels (apparently good in every other respect, sound, good chill, met all the thermal and drop tests satisfactorily) should be rejected because they were one per cent instead of 9/10 per cent combined carbon.

Manganese is limited to .50 as minimum, but we sometimes get wheels which run .13 or 14 sulphur with .45 manganese, and it was a question in our minds whether those wheels were properly rejected as they would be under a strict interpretation of these specifications.

Condemning Limit for Steel Wheels

The only other point we have to bring up is in connection with the rolled-steel wheel condemning limit. Your committee recommended that the condemning limit for rolled-steel wheels in freight car service be reduced ¼ in. and the limits for tender and box car wheels be left as they are now shown in the standard 1 in. We think that this does not fully cover the present conditions where larger axles, such as the *E* and *F* axle, and heavier wheel loads have come into use since the original limits were prepared.

We would be glad to have the committee give consideration to this suggestion, and if it meets with their approval, perhaps incorporate it with their report today or make such modification of our suggestion as they may see fit.

We would suggest that the recommendation read as follows:

"The minimum rim thickness for condemning limit shall be ¾ in. for wheels on all axles in freight service up to and including the *E* axle, 6 in. by 11 in., and for all axles in passenger service up to and including the *D* axles, 5½ in. by 10 in. The minimum 1-in. thickness of rim shall be maintained for wheels on the *F* axles, 6½ in. by 12 in., in freight service, and for the *E* and *F* axles in passenger service and for all tender and engine truck wheels.

Mr. Ripley: As regards the height of drop, this was a question given considerable discussion. You will note in our report we did not recommend that the 850-lb. wheel be advanced to standard. There are some indications that our design in that weight is not what it should be as yet.

The experiments at the plants with the drop tests which have been made seem to indicate that in this design 13 ft. is a proper height for the test. However, that particular wheel is going to be studied further by the committee in the coming year, possibly recommending changes in the design and in the specification for the axle.

I wish to call to your attention that under that table there is a new clause which makes the drop test mean something; that is, it says that if a wheel cracks at the third blow, or if it is rejected under the old system, we had to keep hammering it until it broke in half; in other words, we put the teeth into that test, as well as several other tests, that make them mean something, so that this specification for 13 ft. means a whole lot more than the old specification for 15 ft.

As regards the carbon allowance, that question was one which involved a great deal of argument. In the majority opinion of the committee, 0.90 per cent was as high as the carbon should go, the idea being that this carbon indicates the annealing. That is the real story, how it is annealed after being taken out of the molds. If not handled properly, the combined carbon is liable to be high and this causes wheels to snap in service, breaking at the plate.

As regards manganese, sulphur and carbon content, the manufacturers in their meeting, after much argument, finally accepted this specification as one which they could meet and which they felt would make a good wheel. I believe the limits which we have set, while not as close and as fine as some representatives have wanted, are fair both from the users' and manufacturers' viewpoints and should result in a high quality product.

When it comes to the condemning limit for steel wheels, I must say that the committee did not give particular consideration to this *F* axle. Unfortunately there are very few roads using this axle and there is a limited experience from which we could judge. We will, however, be very glad to give that consideration and gather some data. It is possible that the limit should be different on this very large axle. We do not, however, wish to go along with the recommendation that the passenger car wheels have their condemning limit cut down at the present time. We may feel that it is proper practice, but inasmuch as we can get the service life out of these wheels by transferring them from passenger service to freight service after they have reached this limit, why not go along at least for a year or two in that way? Then, if the practice proves as we believe it will, to be entirely safe, we can go still further and make the limit the same on passenger cars and freight cars.

Mr. Coddington (N. & W.) (written discussion): After reviewing this excellent and thorough report the Wheel Committee has prepared on this subject, it was with some hesitation that the writer consented to prepare a discussion upon certain features of the report.

The action of the committee in recommending a reduction of ¼ in. in the rim thickness condemning limit for wrought steel wheels in freight service is going to result in marked economy in the use of steel wheels if adopted as a standard practice, since it increases the available service metal of the wheel 16 per cent. In confirmation of the findings of the committee as to the safety of such wheels, it may be of interest to state that before the Federal laws fixed the limits of wear for wrought steel wheels in tender service, it was the practice on the road with which the writer is associated to use under locomotive tenders wheels that were outlawed by the Interchange Rules for rim thickness, and no wheel failures ever resulted from this practice. A number of wrought steel wheels have been removed from freight service with only ⅝ in. rim thickness. In no instance has a wrought steel wheel with rim thickness even below the recommended limits failed or shown any indication of failure in service.

Carbon Content and Flange Wear

Under the caption "Mating," it is specified that steel wheels be stamped by the manufacturers with the carbon range. There has been a general impression that the carbon content was a very potent factor entering into the rate of flange wear. The opinion on the Norfolk & Western was that the carbon content was an important factor in flange wear until the conclusion of some extensive tests indicated that unless the carbon range was ten or more points, the influence did not necessarily affect the flange wear. This conclusion was reached after the following information was established:

Difference in carbon between wheels of each pair considered (per cent)	No. of service periods	Average flange wear in inches	
		High carbon	Low carbon
.00	12	.12	.09
.01	55	.11	.09
.02	27	.13	.11
.03	34	.11	.13
.04	35	.11	.09
.05	32	.11	.13
.06	24	.08	.12
.07	18	.14	.10
.08	15	.09	.11
.09	11	.14	.08
.10	7	.10	.17
.11	4	.09	.13
.12	7	.09	.14
.13	6	.08	.10
.14	6	.05	.22
.01 to .09	263	.11	.11
.10 to .14	30	.08	.15
.01 to .14	293	.11	.11

The first column in the table refers to the number of points difference in carbon; the second column shows the number of runs the wheels considered have made, while the flange wear is shown in the third and fourth columns. For instance, where the difference in carbon is one point, the average flange wear of the higher carbon is entered under "High Carbon" and the low carbon under "Low Carbon." It will be noticed that the maximum flange wear does not follow the condition of high and low carbon until a difference of ten points is considered. From ten points up to fourteen points, both inclusive, the flange wear on the low carbon wheels is greater.

The summary under this table puts the subject in a more condensed form. With a carbon range of one to nine, inclusive, in which 263 service periods were considered, the average flange wear for the high carbon wheels and the low carbon wheels was identical, viz., 0.11. From ten to fourteen points difference, inclusive, 30 service periods considered, the average flange wear was .08 for the high carbon and .15 for the low carbon wheels.

The recognition of the influence of the carbon content with reference to wearing properties, is all right, but it is believed that a difference of ten points would be a more practical range than five points.

Interior Diameter of Rim

Under the subject, "Rim Interior Diameter, Back Face of Rim," the minimum rim interior diameter for the 33-in. wheels is fixed at 27⅝ in. Reference is made particularly to the 33-in. wheels, as this size of wheel is in more general use. In fixing this dimension consideration should be given the diameter at which wheels would be scrapped according to the proposed rules. A wheel with 27⅝ in. inside diameter of rim, plus 1½ in. diametrical rim thickness, equals 29⅛ in. tread diameter at the scrapping limit. This dimension is ⅞ in. under the existing scrapping limit, which is ¼ in. above the limit of wear groove based on a diameter of 29½-in.

Some trouble has already been experienced in wearing 33-in. diameter wheels down to their present scrapping limit on account of the shimming required to maintain coupler height and truck clearances, and for this reason the scrapping diameter of the wheel measured over the rim should be lowered as little as possible below the existing practice, and in order to better meet this condition, it is believed, and it seems consistent, that the minimum interior rim diameter should be 27⅞ in. instead of 27⅝ in. This change will bring the diameter at the scrapping limit more nearly to what it has formerly been and will avoid the use of wheels with excess material in the rim that cannot be utilized in service. Since the committee recommends that the minimum tape be increased five points, it does not appear consistent to recommend a decrease in the rim interior diameter.

While reference is made only to the 33-in. diameter wheels, the same deductions might apply to wheels of 28, 30 and 36 in. diameter.

Reference is made to Interchange Rule No. 98, which fixes the basis for accounting for the value of wrought steel wheels, but it does not fix a maximum limitation for this charge. The existing rule specifies that the charge for wheels shall not be in excess of 1½-in. service metal. In view of the changes made to provide for utilizing ¼ in. additional tread thickness, it is believed that the present 1½-in. limit should be increased to 1¾-in. of service metal.

The purpose for recommending such a limit is that under certain conditions a road applying new wheels of maximum tape dimensions and minimum interior rim diameter would be charging an extortionate price for the material furnished. For example, and to use an extreme case, should a wheel with 27⅝-in. minimum rim diameter, with a maximum tape of 171, be applied on a foreign line, according to the proposed ruling, charge could be made against the owning road for 2¼-in. service metal, which, at the existing rate, would amount to $54.72 per wheel.

At the present time, wrought steel wheels can be purchased in quantities at between $30 and $35 each. This additional charge of approximately $20 in excess of the cost of the wheel would be a hardship upon the owning road, and it is quite probable that railroads applying steel wheels to foreign cars might exploit this practice as a matter of revenue.

Steel Wheel Gage

The adoption of a wheel gage as recommended marks a step of progress in wheel gage design. A gage of this design is not new and untried, as a similar one has been employed on the Norfolk & Western for a number of years. Its adaptability for the service and advantages gained by its use have been thoroughly established.

One point of particular importance is that with this system of measuring, the rim thickness is gaged from the inside edge of the rim, from which point the critical dimension for rim thickness is measured and no provision has previously been made for determining this very important dimension.

The convenience by which the amount of service metal to be removed in restoring the contour of a worn wheel and at the same time determine the amount of available service metal remaining, after the restoration of the contour, are particularly advantageous features of the proposed gage.

It is also observed that in this gage, provision has been made for taking care of all wheel tread and rim dimensions, thus making it unnecessary to carry additional gages.

Re-mating Worn Wheels

The committee in the introduction of the proposed standard wheel gage has referred only to its application in interchange proceedings. Since the same gage can be employed in the conservation of service metal when wheels are scheduled for turning, brief mention will be made of possible economies resulting from its use in this connection. By using this gage and a conveniently arranged table, the finished tape size of a worn wheel can be readily determined and this size marked on the plate of the wheel. It has been found profitable, as well as practicable, in handling steel wheels scheduled for turning, to strip and re-mate wheels that vary five tape points in finished tape size. By following this practice and re-mating wheels marked to finish at like tape sizes, the turning operation can be accomplished with a minimum loss of available wearing material.

Anticipating that the remounting program will immediately come into the minds of many, assurance is given that it has been found by careful selection, the wheels can be remounted without having to refit by boring the wheels or turning the axles. In a shop where this practice has been standard for several years, it is rarely ever necessary to refit by boring or turning.

The economies resulting from this practice of handling wheels are of such proportions as to appear almost spectacular. Considering a group of 50 pairs of wheels as they went through the shop without selection, a record was kept of the available wearing material saved on these 50 pairs or 100 wheels by re-mating and turning according to the dictation of the wheel gage. It was found that 25 7/16 in. of service metal was saved in this one group of wheels over what would have been the experience had they been turned as pairs.

The value of this service metal on the basis of the A. R. A. allowance for 1/16 in. is $390.64. Allowing $90 additional cost for stripping and re-mating, which is a liberal allowance, there is still a net saving of $300 or an average of $3 a wheel.

By requiring the wheel shop to make a report of all wheels turned according to a standard form, it is possible for the proper supervising officer to determine if the wheels were turned with the minimum loss of service metal. The form referred to has the following headings:

> Report of Wrought Steel Wheels Turned for Week Ending......
> Wheel No.... Gage Reading.... Tape Before Turning.... Tape After Turning.... Turned Acct. of....

The same practice of conserving service metal can be applied in the handling of locomotive flanged tires as well as the handling of car wheels. In addition to the use and the conservation of metal in the handling of steel wheels, the same application of the gage will apply in the handling of steel tires.

H. M. North (Pullman Company): Our experience supports the conclusion of this committee as shown in this report in that feature which intimately concerns the Pullman Company—the conservation of metal in the rolled steel passenger wheels. There has been under way at the Pullman Car Works at Pullman and in the shops of the Pullman Company about the United States for about nine months past a faithful effort to determine if we were securing the utmost mileage consistent with complete safety which the wheel we purchase can render. We found great need of some such mechanical device as he has shown for determining what amount of metal should be turned off from the wheels and how it should be done. It need not be one precise type of gage or gages, but the result should be that which the committee recommends in its report.

The old question of whether a witness groove is safe or unsafe has been treated thoroughly. Speaking for the Pullman Company, I wish to subscribe to the depth measuring horizontally into the flange which the committee recommends; that is, 3/64 in. In many sections which were laid out on the drafting table from worn wheel sections, secured by plaster of Paris casts, in no case did the groove of that depth encroach to the throat of the wheel. In no case was there evidence that it might engage a sharply worn switch, switch point, or sharp frog.

The results of the Pullman Company study and effort are shown in carefully made-up graphic forms which are at the disposition of the members who are particularly interested.

H. J. Force (D. L. & W.): I want to refer to one or two points brought out by Mr. Waring with reference to the carbon and sulphur contents of cast iron wheels. I have done a great deal of work with this committee in connection with the chemical and physical requirements of cast iron wheels and every member of that committee fully realizes the responsibility upon his shoulders for a new specification for cast iron wheels.

Tests Determine Cause of Wheel Failures

The committee in going into this work has tried first of all to find out why it was that some of these cast iron wheels have failed in service, and I have taken a large number of wheels which have failed and which have caused wrecks and derailments and submitted them to very careful chemical analysis, we find that in nearly every case those wheels are sometimes as high as 1.25 and 1.30 and the combined carbon in many of them is around .90 and .95. Therefore by taking into account these various elements we can arrive at a conclusion that a composition of that kind is more or less dangerous and the specification therefore has been set at not more than .90 carbon.

On the other hand, higher carbon than .90 will increase the shrinkage in the cast iron wheel, making it much more difficult to anneal and relieve shrinkage strains. Therefore, with a carbon very much lower than .90 we have less difficulty in making the proper annealment.

Sulphur Content in Cast Iron Wheels

In reference to the sulphur content, that is probably one of the most sinister elements we have to deal with in cast iron, and as you gentlemen all know in no other specification have we a sulphur content above .12 and with the cast iron wheels we allow it to go up as high at the present time as .16 and to be gradually reduced down to .14 per cent.

In order to test out these theories we have taken a number of wheels and repeated the thermal test. The new thermal test as applied in this specification has been increased from 1½ in. to 1¾ in. and 2 in., according to the weight of the wheel. We have also said in the specification that the wheel must stay in the thermal test two minutes and not crack, while in the old requirement the wheel may crack in the thermal test but not crack through into the rim.

I have taken those wheels and laid them in the sand, put on the test and held it for ten minutes, and have taken the wheel out and have reapplied that ten or eleven times before I was able to break that wheel. There is a wonderful improvement over the old wheel and the composition on those wheels is very close to .70 combined carbon, proving again that if we go into the higher carbon we are more than likely to have failures.

I would also remind you, that your specification for steel wheels is not more than .85 carbon. In that case your carbon is all combined. Therefore we certainly should have a lower combined carbon in the cast iron for the reason that the carbon in cast iron and in steel is in exactly the same combination. The higher the combined carbon the more brittle the steel or the iron will become. On the other hand, with cast iron wheels we have high sulphur and high phosphorus. Therefore it is important that these elements should be controlled as closely as possible.

The Association of Manufacturers of Chilled Car Wheels has endorsed these specifications. The wheel manufacturers realize that a better wheel must be produced and the only way it can be produced is by closely controlling the chemical composition.

When wheels are placed in the soaking pit, they are piled 14 or 15 high, and the wheels that are on the top and the bottom are going to be the weakest wheels for the reason that they will not be as thoroughly annealed as the wheels in the middle. Therefore, if the carbon content is at the extreme top limit, of nearly one per cent, it is very evident that that type of wheel is going to fail if placed in service, and those things must be taken into consideration.

Being closely connected with a foundry for the past 14 years, I know that there is no difficulty whatever in making wheels with combined carbon, well below .90. It is the practice of many car wheel makers when they are melting iron to use a mixture where they are trying to melt ten pounds of iron with one pound of coal. The result is they never get the iron hot enough to absorb the carbon, and the result is low carbon, high shrinkage, and a very defective, inferior and dirty wheel, sometimes with blow holes in it. There is no reason whatever why the quantity of iron cannot be reduced in proportion to the coke charged, and make it a formula of 1 to 8. In each case if the process is properly carried out by men of experience, they can produce and have produced, on these tests, over 45,000 cast iron wheels which we closely followed through, and which do meet these specifications.

O. C. Cromwell (B. & O.): The chemical analysis of wheels is a matter that has been studied for a number of years and has been considered by the wheel committee, necessarily for a considerable period of time, because of the location of the makers in the different sections of the country. Conditions vary so that it is necessary to take time and considerable data before coming to a conclusion.

The Baltimore & Ohio has been studying this question of chemistry of wheels for about 30 years. I think some other railroads have studied it nearly as long. The difficulty of the wheel committee was to arrive at proportions that would not bring hardship on anybody, and yet produce the best results.

There has been a demand for improvement in the specifications, and that is one of the clauses that is introduced. We have also increased the severity of the tests. Mr. Waring spoke of the decrease in the number of blows on the 850-lb. wheel from 15 to 13.

That was very thoroughly discussed, and that wheel is under further consideration.

The manufacturers of chilled iron wheels have been in very close touch with the committee in the preparation of these specifications and action has not been taken without being thoroughly in conference with them.

The thermal test is one that has been made considerably more stringent. We believe that that more nearly approximates service conditions than any other of the tests, and we are giving it very close consideration.

In our investigation of the service of wheels we found a great many rolled steel wheels being taken out of service because of not having sufficient metal in the tread to get the third turning, and for that reason we have increased the number of tape sizes so as to be sure in all cases we will get a life of three runs out of the wheel. The use of the rolled steel wheel on 6-in. by 11-in. axles in freight car service is a matter that the committee had not very much data upon and consequently was glad to have the information that is presented to them today.

Mr. Knapp (N. Y. C.): I would like to say in behalf of the committee that in writing steel wheel specifications we attempted to overcome some of the uncertain features that were present in the former specifications and finally concluded that each member of the committee should become as thoroughly familiar with mill practice as it was practicable to do in addition to his knowledge of railroad practice in using solid steel wheels.

Each member of the committee has visited for some length of time, at least one wheel plant; some of us, several of them. The specifications were gone over with the manufacturers paragraph by paragraph and the final development represents our best thought in promoting the interests of the purchasers of wrought steel wheels.

In connection with the paragraph relating to mating by carbon content, the New York Central has required wheels to be related in carbon content for ten years and we have not as yet developed any reason for abandoning that practice. The specification ranges of five points as mentioned really permit a range of six points in carbon content. This only applies when specified by the purchaser. Each railroad may follow its own best judgment in indicating the carbon ranges for its wheels.

The principal change in the specification is in reference to the rim. Heretofore the specifications touched but lightly upon rim dimensions, although the rim is the only thing that we get out of a steel wheel for the money we pay for it. The rims were permitted to vary to the extent of 3/16 in. under the 2½ in. that we bought and paid for, the only requirement to the manufacturer touching upon average rim thickness. It was perhaps overlooked many times that two wheels of the same tape size might have 3/16 in. under in one rim and 3/16 in. over the standard in the other, but in the practice of nearly all railroads the wheels would be mated to the tape size and scrapped together. The average rim thickness did not appear to the committee as a proper method of judging wheels in accepting them at the steel wheel plants.

Regarding the rim interior diameters to which Mr. Coddington referred, I would like to call the attention of the members of the association to the fact that the rim interior diameters were never mentioned heretofore. The only definite control of the wheel rim was by tape sizes, five tapes under and nine tapes over. There was an additional feature, the limit of wear groove. We have finally drawn the specification in such a way as to fix the interior diameter of the rim and the exterior diameter so that no wheel purchased will have less than a 2½-in. rim thickness. If there is any tolerance or variation in that important dimension it is required to be over.

As to the 27⅝-in. particularly referred to by Mr. Coddington for the 33-in. diameter wheel, we considered seriously specifying a fixed diameter for the interior diameter of the 33-in. and all other diameter wheels. We soon found that if we were to specify that dimension the manufacturers would simply machine off the metal that might be rolled into the rim. It is a rolling proposition and we would pay for the machining and we would lose whatever extra metal might obtain in the rim under 28 in. maximum diameter. We have drawn these specifications so as to specify that no wheels shall be less than 33 in. outside diameter and if any variation in the interior diameter obtains it will thicken the rim rather than make it less in thickness.

The other feature referred to by Mr. Coddington is in connection with interchange charges. The rates per 1/16 in. of metal, I understand, are fixed by the Arbitration Committee. We feel that we have drawn the specification in reference to sixteenths service metal in such a way as to insure every purchaser the full thickness to start with.

The price that one wheel may bring in interchange is so far as I can see amply protected by the rules governing the interchange of various wheels. The elimination of the limit of wear groove and the measurement of the wheels on the back insures that no wheel may be placed in service with a less thickness than is considered proper through the critical line and all measurements for interchanges will be conducted by means of that gage and through that dimension.

J. H. Gibboney (N. & W.): I hesitate to make any further addition to this discussion, but the Norfolk & Western wants to go on record in favor of any movement toward adopting a chemical limitation for cast iron wheels. The Norfolk & Western has not been buying wheels in any great quantities in the past years, but it has been manufacturing wheels in large quantities for 40 years, and the question of chemical limitations to control our practice has been closely followed for at least 30 years to cover such features as the proper selection of materials, scrap and pig irons, and measuring of those materials on that basis and following the product as it came from the cupola.

We want to go on record that the chemical composition of cast iron has a direct bearing on safety and service. That is established by our records. The limitations that have been advanced by the committee are liberal and really workable. I believe they would defeat the entire purpose we have in mind by making those limitations too exact or too liberal. The committee has struck a happy medium, one that we have been following with a slight modification with reference to carbon for a great many years.

Ten years ago or more our railroad commenced to agitate the question of controlling sulphur. The controlling of sulphur in cast iron is not only in the matter of cupola operation but it is a matter of economics.

We have thousands and thousands of cast iron wheels in this country of high sulphur content and those wheels must be remelted into the product we get today if the cast iron wheel is to be economical. Therefore, it is up to us to determine how far we can go. On the Norfolk & Western we use a certain proportion of foreign wheels and a large proportion of our own wheels. In that way we have been able to keep our sulphur content low. The committee in dealing with the matter of sulphur has adopted the suggestion of a sliding scale for sulphur content which will allow the use of a great number of wheels for remelting.

H. T. Bentley (C. & N. W.): The committee should be commended for an important step in advance and *I would like to suggest a rising vote of thanks to the committee.*

(Whereupon the convention arose en masse.)

Mr. Ripley: *I move that the report be adopted and the recommendations contained submitted to letter ballot for adoption.*

(This motion was seconded and carried.)

* * * *

Union Station at Toronto, Used as an Office Building, but Not Yet by Trains

Report of the Committee on Tank Cars

Investigation of Proposed Designs of Bottom Outlet Valve —Other Changes in Construction Considered

This committee during the past year has given consideration to various detailed devices which tend toward the improvement of tank cars; a number of such devices having been submitted to the committee for approval.

Safety Valve

In view of the results obtained from safety valve tests, as covered in previous reports of this committee, it was decided to appoint a sub-committee to work in conjunction with a similar committee of the American Petroleum Institute.

This sub-committee will prepare gages for existing valves with a view of securing greater accuracy in the construction and maintenance of these valves so as to avoid leakage at low pressures. The sub-committee will also consider safety valves of new design which may be submitted to the association, and will give special consideration to a safety valve using a frangible disc in order to overcome the leakage of low pressure.

This sub-committee will also give consideration to safety valves for Class V chlorine tank cars, with a view toward standardization of the bolting flange.

Bottom Outlet Valve

The sub-committee appointed to investigate this subject has secured valuable data in connection with valves of various designs submitted to them for trial service. The report of the sub-committee states, in part, as follows:

"Up to March 1, 1923, 35 designs were considered by the committee, of which 20 are modifications of the present plunger type, 11 are designs of the plug type, two are the rotary disc type, one a combination of valve and outlet cap, and one a new design of bottom outlet chamber, above which any type of valve may be used.

Of the 36 ideas considered by the committee 27 have been approved for service trial.

Of these 27 nine have been abandoned on account of having proved unsatisfactory under service trials.

Of the 27 ideas approved for trial 6 have not been heard from since their installation, or have neglected to report to the sub-committee. However, general claims of satisfactory performance have been made by the designers of several of these valves.

Of the 27 ideas approved for trial, 3 have not been installed on tank cars for service trials.

Of the 27 ideas approved for trial 2, one for outlet valve chamber and one for outlet cap combined with a valve, are still undergoing trial, although neither of them is intended to solve the problem of a tight bottom outlet valve, and so far no definite reports of performance have been submitted to the sub-committee.

The remaining seven valves are still undergoing trial and reports of performance are being submitted regularly on the sub-committee's standard form of questionnaire. Out of these seven valves, Nos. 2, 7, 17 and 22, show signs of being equal, if not superior to the ordinary valve now in use. Valve No. 8 has given fairly good results, but is quite complicated. Numbers 13 and 18 have not made a satisfactory showing, although still undergoing trial. It is a question whether further trial should be allowed."

The sub-committee's detailed report is attached as an appendix.

In order to make an intelligent comparison of the valves under test as compared with the existing standard outlet valve, the sub-committee was instructed to compare the performance of valves under test with present standard valves on an equal number of cars. This comparison to be made by two tank car companies, (Union Tank Car Co. and Texas Company) each company to make test of 15 valves.

Dome Closing Arrangement

Circular No. D. V.-274 has been issued on account of a misprint in the first paragraph of Section 7 (d) of the Specifications for Class III Tank Cars, as revised in 1922, to include "New cars."

Several designs of the bolted type cover have been submitted to the committee by various tank car builders, and in a majority of cases, the design has been approved after certain modifications were made.

It appears to the committee that certain fundamentals could be established by them in connection with this type of dome cover and it has, therefore, been arranged for the sub-committee on safety valves to also undertake the study of various types of dome closing arrangements with a view of standardizing certain features. The committee appointed by the American Petroleum Institute is to co-operate in this matter.

Failure of Heads of Tanks

There have been reported a number of cases of failures of heads on tanks originally anchored by head blocks but afterwards transferred to steel underframes and center anchorage applied, those failures being traceable to damage from impact on the head blocks.

This matter has been referred to the Arbitration Committee, which recommends that a circular be issued by the Committee on Tank Cars, calling attention to the importance of seeing that cars with heads damaged by impact are returned to the owners for application of reinforced shoes as required by the specifications. Circular No. 299 has been issued covering this matter.

Tests of Tanks of Class IV Tank Cars

It is recommended that Paragraph 23, Page 35, covering Specifications for Tank Cars be revised to the extent that the test period for Class IV tank cars should be made the same as for Class III tank cars.

Flashing Openings in Dome Casing Class IV Tank Cars

The Bureau of Explosives called the committee's attention to Section 7, (a) of the Tank Car Specifications for Class IV Tank Cars which provides that—"Openings through the lagging shall be flashed around projections to prevent admission of water." This does not specifically state that the tops of the domes must be so constructed that liquid cannot enter between the dome wall and outer shell. On account of numerous accidents due to the absorption by the lagging material of gasoline, thus giving off a dangerous vapor, the committee recommends that the specifications be changed accordingly.

Special Marking on Multiple Unit Tank Cars

The question was brought up by a shipper of multiple unit tank cars making regular shipments of liquid chlorine in drums, whether or not these cars shall bear some marks of identification which will indicate that the design of the car has been approved by the Tank Car Committee.

As shipments of this character are now covered by Interstate Commerce Commission regulations, the transportation of this material in drums is under the jurisdiction of the Bureau of Explosives, which passes upon certain constructive features of these cars. The Tank Car Committee has tabled this subject until some decision is made by the Interstate Commerce Commission.

Adjusting Safety Valves on Tank Cars

Specifications for tank cars standard, revised 1920, specify that safety valves on tank cars adjusted to 25 lb., a tolerance of 3 lb. above and below the specified pressure, is allowed. This means that valves opening at 22 lb. or 28 lb. do not require adjusting.

Owners of tank cars are not receiving any benefit from this specified tolerance, because billing repair cards do not specify at what pressure the valves opened, nor is any reason given why it was necessary to adjust the valves. The committee, therefore, recommends that the Arbitration Committee add a requirement to Interchange Rule No. 9 to show the pressure at which the safety valve opens to justify the charge for adjusting.

The following changes are recommended in the Tank Car Specifications:

Safety Valve Plug, shown in Fig. 9-A, should indicate a groove at the end of the thread in order to facilitate the threading. The bottom of the 1 in. cored recess should be provided with a fillet so as not to weaken the plug at the clearance groove.

Under paragraph 2-B, specifications for rivets for Class III tank cars, should be revised to read the same as paragraph 2-B under specifications for Class IV tank cars. It is recommended that the drainage hole in the safety valve housing be raised 1/8 in., making the dimension from the top of the housing to the center line of the drainage hole 2-5/16 in. instead of 2-7/16 in. in order to lessen the probability of drilling the drainage hole through and into the housing proper.

Appendix to Report of Committee on Tank Cars

Report of Sub-Committee on Bottom Discharge Outlets

(In the appendix the sub-committee presented a list of all the bottom discharge outlets submitted for trial. The ones shown below are those which the sub-committee reports are equal or superior to the standard design. Of the others referred to No. 8 is the Carr Valve, No. 13 the Dodge Valve and No. 18 the Garrett Valve. Editor).

No. 2. Positive Self-Locking Valve, designed by the American Car & Foundry Company, 165 Broadway, New York, N. Y., plunger type, employing the use of special outlet valve casting. The valve mechanism is all in the bottom of the tank, which is attached to the bottom discharge casting by a tapered thread joint. This permits removal of the mechanism for replacement or repairs without disturbing the outlet casting. This valve was installed on T. C. X. 177 about March 2, 1922, and, together with another valve of the same type recently installed on T. C. X. 3026, has made a total of 21 trips under load, reports of which show only two cases of sticking and two cases of leakage. Leakage was at the rate of but 50 to 150 drops per minute. The last report on this valve was dated February 13, 1923. No objectionable features have been reported, and the general opinion is that the valve is easy to operate. There is practically no difference in time required for unloading through this valve as compared with the ordinary plunger type in general use.

No. 7. Carll Valve, designed by A. B. Carll, assistant engineer, Gulf Refining Company, Pittsburgh, Pa., double seated plunger type with seat on outlet chamber which screws into outlet flange. Installed September 15, 1921, on two cars, G. R. C. X. 2864 and G. R. C. X. 2865, which are used for transportation of kerosene and gasoline. Eleven trips under load have been reported, two of which show slight leakage. The latest report received covering the performance of this valve is dated June 15, 1922, at which time Mr. Carll advised that on account of one of these cars having been involved in a wreck, two new bottom outlet flanges were being made of cast steel and will be used to replace the two cast iron flanges with which these cars are equipped. The matter of further reports of performance of these valves has been taken up with Mr. Carll.

No. 17. Everlasting Valve, designed by the Everlasting Valve Company, 2 Rector street, New York, N. Y., sliding disc type. Installed on T. C. X. 2906, used in the gasoline service. Reports of 27 trips under load have been received, six of which show slight leakage. Trials extend over a period of about three years. The valve has been shopped three times for repairs. Practically all reports comment favorably on the way this valve functions. One of the reported leakages was supposed to have been caused by corrosion, but as the valve made a successful trip without further attention or repairs immediately following this reported leakage, corrosion was evidently not the cause. Two of the leakages were reported by the inventor of another valve, which is also under trial.

No. 22. Merco-Nordstrom Valve, designed by the Merrill Company, Chicago and San Francisco, plug type. Valve self-lubricating. Complete unit attached to outlet flange. This valve has been installed on tank cars G. A. T. X. 6198 and 6187, used in the gasoline service. Fifteen trips under load have been reported, two of which show slight leakage of from 15 to 35 drops per minute. No sticking of the valve reported, but in two cases the valve showed stiffness. One of the leaks reported was due to the valve not being entirely closed. Closing the valve stopped the leak.

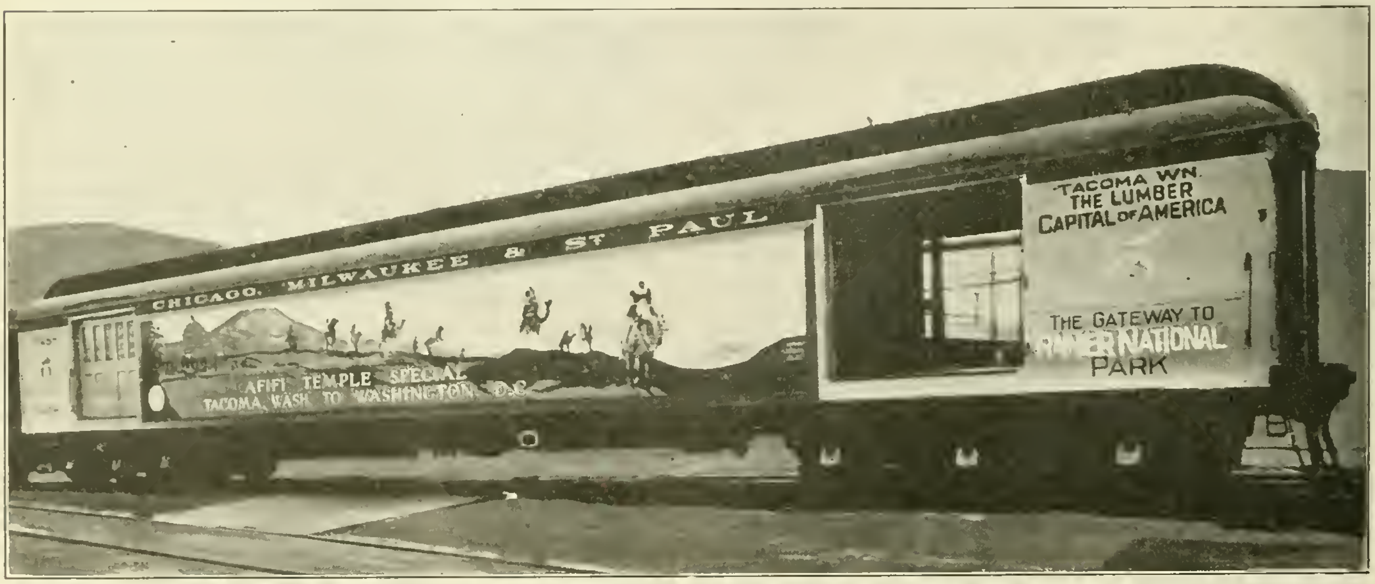
The report is signed by C. E. Chambers (Chairman), superintendent motive power and equipment, Central Railroad of New Jersey; C. T. Ripley, chief mechanical engineer, Atchison, Topeka and Santa Fe; Geo. McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania System; Col. B. W. Dunn, chief inspector, Bureau of Explosives; A. E. Smith, vice-president, Union Tank Car Company; Geo. Hartley, Hydro Asphalt Products Company, and C. W. Owsley, superintendent, railway traffic and sales department, The Texas Company.

Discussion

R. L. Kleine (Penn.): *I move the report be accepted and the recommendations be submitted to letter ballot.*

(The motion was seconded and carried.)

* * *



Baggage Car of Special Shrine Train from Tacoma, Wash., to Washington, D. C., Advertising Tacoma as "the Lumber Capital of America"

Report on Brakes and Brake Equipment

Brake and Signal Equipment Rules Carefully Reviewed—A Number of Subjects on the Docket Continued

The Mechanical Division's standard rules and instructions governing the testing, inspection, maintenance and operation of brakes and signal equipment have been carefully reviewed and the following recommendations are submitted by the committee:

Maintenance of Brake and Train Signal Equipment

Rules and regulations for testing, inspection, maintenance and operation of power brakes (freight and passenger):

(1) Replacing the air brake and train air signal instructions, shown on pages 65 to 74 of Section "E," Manual of Standard and Recommended Practice, with a suitable code of rules governing the operation of this equipment.

The committee has, therefore, prepared a proposed set of rules governing the operation of brake and train air signal equipment. These rules are shown in Exhibit 1 of the appendix of this report and are recommended for adoption as standard.

(2) A set of proposed rules governing the maintenance of brakes and air signal equipment on passenger cars, as shown in Exhibit 2 of the appendix of this report, similar to the standard rules governing the maintenance of freight brakes, and the same is recommended for adoption as standard.

The committee has carefully reviewed the rules and instructions in the Manual of Standard and Recommended Practice on the maintenance of freight brakes and while it does not find that these rules and instructions are subject to important fundamental revision there are a number of cases in which the rules can be clarified.

(3) It is, therefore, recommended that they be revised to conform to Exhibit 3 in the appendix of this report. In view of there being no important changes involved, no attempt has been made to enumerate the revision in detail.

(4) If the foregoing recommendations are adopted, the instructions for operating the Standard No. 1 and No. 2 triple valve test racks on pages 41 to 54 of the Manual should be added to Exhibit 3 and bound with Exhibits 1, 2 and 3 in one pamphlet for distribution.

The general arrangement and details of the air brake parts, shown on pages 3 to 9 and 11 to 13, and the details for high speed foundation brake gear, shown on pages 20 to 31 of the Manual, are not suitable insofar as dimensions are concerned for cars of present-day construction. In fact, owing to the many different types of cars in use and being constructed it would be difficult to prepare complete detail drawings for the various parts of the brake rigging that would be suitable for the many types of cars involved.

(5) It is, therefore, recommended that the details shown on pages 3 to 9, 11 to 13, 20 to 31 and the six paragraphs appearing on page 19 of the Manual under "Designation of Rods and Levers" be stricken out of the list of standards and recommended practices and supplemented by specifications covering fundamental requirements for foundation brake gear and application of brake equipment to the car.

If this recommendation is adopted the committee will prepare specifications to cover.

We understand the design of standard freight cars, which is in the hands of the Car Construction committee, will include brake rigging for such cars.

The report is signed by G. H. Wood (Chairman), A. T. & S. F.; T. L. Burton, N. Y. C.; L. P. Streeter, I. C.; B. P. Flory, N. Y., O. & W.; Wm. Clegg, C. N. R.; W. J. Bohan, N. P.; R. B. Rasbridge, P. & R.; J. M. Henry, Penn. System.

Exhibit 1—Brake and Train Air Signal Equipment Operating Rules

1. Engine house foremen must have engine and tender air brake and air signal apparatus inspected and required repairs made before each trip.

2. When taking charge of an engine, the engineman must know that the air brake and train air signal apparatus on the engine and tender is in good order, and at the end of the run must inspect the apparatus and report any defects.

3. Enginemen must know that hose on engine and tender are properly hung in dummy couplings.

4. Air compressors must be started slowly with drain cocks open. Air cylinders must be oiled only through the oil cup.

Car Inspectors

8. Foremen of inspectors and inspectors are jointly responsible for the condition of the air brake and train air signal equipment of cars leaving their station.

Standard Air Pressure and Piston Travel

10. Air pressure regulating devices on engines and cars must be adjusted for the following standard pressures:

	Lb Pres. in	
	Brake Pipe	Main Reservoir
Engines, freight service, with single governor	70 to 90*	100 to 110
Engines, freight service, with duplex governor, low pressure	70 to 90*	100 to 110
Engines, freight service, with duplex governor, high pressure	70 to 90*	110 to 140
Engines, passenger service	90 to 110	110 to 140

*For heavy grade service.

	Lb. Pres.
Governor valve, water raising system	60
Reducing valve for independent or straight air brake	40 to 50
Reducing valve for train air signal	40 to 50
Reducing valve for water raising system	20
Reducing valve for high speed brake	60
Safety valve for straight air brake	45 to 55
Safety valve for LT control and ET distributing valves	40 to 68
Safety valve for LN and UC brakes	60

11. The piston travel with a full service brake application must be as follows:

	Inches
Engine truck brakes	5 to 6
Engine driver brakes	4 to 6
Engine tender brakes	6 to 9
Passenger equipment cars	6 to 8
Freight equipment cars	6 to 8

12. Before adjusting piston travel or working on brake rigging, cut-out cock must be closed, and reservoirs bled except where cut-out cock is in cylinder pipe.

Draining and Blowing Out Equipment

15. Air compressor drain cocks must be opened and left open while compressor is shut off.

16. Before engine leaves engine house the main reservoir must be drained and brake pipe and signal pipe blown out.

17. Air hose on engine must be blown out immediately before being coupled to train. Air hose on cars must be shaken (not blown out) to remove dirt from coupling.

18. Yard lines must be blown out at intervals and immediately before being coupled to cars or engines.

Time Allowed for Testing Brakes

20. Ample time must be allowed to properly inspect and test air brakes in all trains and place them in proper working order before leaving terminal.

Signals for Testing Brakes

22. Signals to engineman for testing brakes must be given by verbal request or by train air signal from forward car to apply, and by air signal from rear car to release. In the absence of air signal, hand or lamp signal must be given. Brakes must not be applied or released during a standing test until proper signal is given.

Brake Pipe Leakage

24. Freight trains must not leave originating points nor leave terminals where car inspectors are located and engines are changed when brake pipe leakage exceeds 8 pounds per minute (preferably it should not exceed 5 lb. per min.) following a

15-lb. service reduction from standard brake pipe pressure with brake valve in lap position.

Train Brake Test

26. When brakes are to be tested from yard plants, after blowing out yard line, train must be charged to the required pressure.

While brake system is being charged, a visual inspection of retaining valves and retaining valve pipes must be made, and position of angle cocks and hose ascertained. Close examination must be made for leaks and necessary repairs made to reduce leakage to a minimum.

When brake system is charged to standard pressure, a 15-lb. service reduction must be made, after which a second examination of the train must be made to determine:

(a) Brake pipe leakage.
(b) If brakes will apply in service application.
(c) Piston travel.
(d) That brake rigging does not bind or foul.

Release tests must be then made to determine if brakes release properly.

If, during these tests, the brake pipe leakage as indicated by the brake pipe gage exceeds 8 lb. per min., it should be reduced to 8 lb. (preferably 5 lb.) and if piston travel is less than 6 in. or more than 8 in., it should be adjusted to nominally 7 in.

After a road engine is coupled to a train, the brakes must be tested as prescribed in Rule 31.

27. Before a train leaves an originating point, where brakes have not been tested from yard plant, test must be made as follows:

After air gage on engine indicates within 5 lb. of standard brake pipe pressure, enginemen must, on request or signal, make a service brake pipe reduction of 15 lb., and determine by length and force of brake pipe discharge if there is open communication throughout the brake pipe. After the brake pipe discharge ceases and having noted brake pipe leakage, he must increase reduction to a total of 25 lb. Inspectors, or train crew, must then make certain that brakes have applied, that piston travel is not less than 6 nor more than 8 in., and that brake rigging does not bind or foul; inspectors or member of train crew must then give enginemen proper signal for releasing brakes, and see that all release.

28. A defect discovered during a standing test that cannot be repaired promptly, must be reported by inspector or trainman to foreman inspector or conductor who will decide action to be taken.

When the test is completed the inspector or trainman will so inform the engineman and conductor, and advise them the number of cars having ineffective brakes in the train.

29. Before a train is started from a terminal the inspectors, or train crews, must know that all hand brakes are released and pressure retaining valves and angle cock handles are in proper position.

30. When cars are added to a train, the brakes on such cars must be tested as prescribed in Rule 27, and where practicable they should be charged before coupling them to the train.

31. When engines are changed, or an angle cock has been closed, except for cutting off car or cars from rear of train, an application and release test must be made from the engine. Inspector or trainmen will note that rear brakes of train apply and then signal for a release, noting that rear brakes release.

32. A running test of brakes must be made with passenger trains as soon as speed of train permits after engines or engine crews have been changed, after angle cocks have been closed and at a point which will permit train to be stopped by hand brakes, before reaching ends of double track, junctions, railroad crossings at grade, drawbridges, meeting and passing points and before going down heavy grades, and in case the brakes do not hold, at once signal for brakes. Such test should be made by applying the brakes with sufficient force to ascertain whether they are in working order. Steam or power should not be shut off when making the test unless conditions require it.

Movement of Cars with Brake Inoperative

35. Freight trains leaving an originating point must have all brakes in operation unless otherwise authorized. Car next to engine must have brakes operative. Three or more cars with brakes inoperative must not be placed together.

36. The movement of a car with brakes inoperative in passenger, mail, express or milk trains is restricted as follows:

From leaving originating point of train.
From being placed in train at intermediate terminals.
From being handled next to engine or at rear of train.

37. When brake pipe becomes defective on passenger, mail, express or milk cars enroute, signal pipe may be substituted for it by coupling signal hose at each end of car to brake pipe hose. Engineman must then be notified that one brake has been cut out.

Train Handling

39. Where engines are to be changed on passenger, mail, express or milk trains, the incoming engineman must leave train brakes applied.

40. When making service stops with passenger trains, not less than two applications should be made, except when graduated release is being used. The initial brake pipe reduction of either application should be not less than 8 nor more than 12 lb.

41. When making service stops with passenger trains of 7 or more cars, at low speed, brakes must not be released after final application until train has stopped, except when graduated release is used.

42. To stop a freight train but one application must be made, and initial brake pipe reduction should be from 5 to 7 lb. If steam or power is being used it should not be shut off, and, when conditions permit, engine brake not allowed to apply until stop is completed. After stop has been made, and before attempting to release brakes, total brake pipe reduction should be 20 lb.

43. A release must not be attempted, during brake application, until brake pipe discharge ceases.

44. When backing freight trains and it is desired to make service stop, initial brake pipe reduction should be 5 to 7 lb. and, when conditions permit, driver brake should be kept from applying and steam or power used lightly until train has stopped.

45. To release brakes on a freight train, brake valve handle must not be left in full release position longer than 15 seconds at any one time, except in heavy grade work.

46. Brakes must not be released on trains of 60 or more cars when moving at a speed of 15 or less miles per hour, except in grade work, when retaining valves are used. When releasing brakes on freight trains at higher speed or with shorter trains, the independent or straight air brake must be applied to prevent slack running out.

47. Conductor must notify engineman when braking of trains is not satisfactory.

48. When stopping freight trains of 25 or more cars for water or coal, air brakes must be applied by engineman and engine detached. If on a grade, hand brakes must be applied to hold train. While taking coal or water, engine brake must be held applied.

49. When using sand in making stops, its use should commence before brakes are applied and continued to the stop.

50. Should a train part, engineman must shut off steam or power and place brake valve handle in emergency position.

51. When engines are double headed, brakes must be operated from leading engine. Automatic brake valve on all but leading engine must be cut out, handles of brake valves must be in running position, and air compressors kept running.

52. The automatic and independent or straight air brakes on engines must be cut in. Independent or straight air brake alone should not be used for making stops with a train.

53. Engines or motors should not be reversed while brakes are applied.

Train Handling on Grades

58. In the absence of instructions, an understanding must be had between engineman and trainmen as to the number of retaining valves to be turned up before descending a grade. Retaining valves must be turned up from front to rear and turned down from rear to front of train.

59. Brake pipe pressure must not be permitted to fall below 55 pounds without being in position to safely release brakes and recharge auxiliary reservoirs. Before releasing brakes, speed of train must be reduced to give ample time to recharge auxiliary reservoirs to the maximum pressure.

60. Trainmen should watch carefully for hot wheels on descending grades, and if excessive heating is observed, turn down retaining valve. If this does not give desired results, stop the train, determine and remove cause or cut out the brake.

Emergency Application

62. When necessary to make an emergency application from the engine it must be done by quickly moving brake valve handle to emergency position and leaving it there until train stops. No attempt must be made to start train until brakes are released.

63. Conductors' valves must not be used except in case of emergency or as prescribed in Rules 64 and 67. When necessary to make an emergency application from train, conductor's valve must be opened quickly and kept open until train has stopped.

64. When whistle signal to apply brakes is given, train crew must quickly open conductor's valve and apply hand brakes. Conductor's valve must be kept open until train has stopped.

Conductor's Valve and Back-up Hose

67. If necessary to use conductor's valve for other than emergency application, it must be opened gradually and kept open until train has stopped. Engineman must lap brake valve and shut off steam or power. No attempt to release brakes must be made until train has stopped.

68. When back up hose is used, brake pipe must be fully charged and brake valve carried in running position. A brake test must be made through back up hose before train is moved. When engineman observes application has been made, he must give train crew hand signal, using white light by night.

Air Brake Hose

71. After a train is stopped by a burst hose, brake valve handle must be placed in running position so defective hose may be located.

72. Hose must be uncoupled by hand.

Train Signal Equipment

75. If a car discharge valve becomes defective in service, it must be cut out and conductor notified.

76. If necessary for a train to proceed with train air signal inoperative, train and engine crews must be notified.

Hand Brakes

80. In hump yard service, hand brakes must be known to be operative before cars are dropped over hump.

81. Hand brakes must be applied on cars left on side tracks and, when necessary, the wheels blocked.

Movement of Dead Engines in Trains

85. All engines equipped with side rods must have them applied, when handled dead in trains, suitable washers, or wooden blocks clamped together with bolts being used where necessary on main rod bearings to keep the side rods in place.

86. Engines and tenders must have air brakes cut in and operative on drivers, trailer, engine and tender trucks.

87. Engines and tenders equipped with ET or LT brake must have safety valve on distributing valve or control valve, adjusted to not less than 25 or more than 30 lb.

88. Engines and tenders equipped with automatic and straight air combined must have the safety valve in brake cylinder pipe adjusted to not less than 25 or more than 30 lb.

89. Engines equipped with ET or LT brake must have positive stops applied to handles of automatic and independent valves to secure these handles in running position.

90. Engines and tenders equipped with high speed brakes without the straight air must have high speed reducing valves set to reduce the brake cylinder pressure to not less than 25 or more than 30 lb., or must have a safety valve applied to brake cylinders or brake cylinder pipe set to not less than 25 or more than 30 lb.

91. Engines fitted with power brakes other than air must be equipped with an air train line and connections.

92. Engines equipped with ET or LT brake must have the cut-out cock of dead engine fixture open.

93. The cut-out cock in brake pipe under the automatic brake valve must be closed.

94. Air operated devices, with the exception of distributing or control valves, taking air from main reservoir must have the operating valve securely closed.

95. Not more than four dead engines may be handled in one train. There shall be not less than five cars between the engine hauling train and the first dead engine and between any two of the dead engines.

96. Delivering line will be held responsible for flat spots on driving tires, trailer tires and tender truck wheels.

97. Owners will be responsible for any special application of safety valves as required in Rules 87, 88 and 90, inclusive.

Reports

100. Defects in air brake or train signal equipment must be promptly reported on prescribed forms.

101. If defects develop or brakes are cut out on freight cars enroute, trainmen must apply defective air brake cards indicating defects on backs of cards.

Exhibit 2—Maintenance of Brakes and Signal Equipment on Passenger Cars

150. Brake cylinders, slack adjuster cylinders and high speed reducing valves shall be cleaned, lubricated and tested at least once in twelve months.

151. Triple valves, safety valves, and all portions of control valves, shall be removed from car for cleaning, lubricating and testing on a standard authorized test rack at least once in twelve months.

151. Centrifugal dirt collectors and strainers must be cleaned when the triple valve or control valve is cleaned.

Slack Adjuster, Adjustment

153. The automatic slack adjuster crosshead should be placed in extreme release position when all brake shoes are of maximum thickness. If the piston travel under this condition is less than 6 in. or more than 8 in. the travel should be adjusted to nominally 7 in. from a full service brake application by means of the brake rods and levers.

Shop Inspection and Repairs

156. When passenger cars are in shops for general repairs the entire brake equipment, including the hand brake, must be thoroughly overhauled, renewing or repairing, when necessary, missing or worn brake rods, levers, pins, hangers, supports and brake shoes.

157. The brake pipe and signal pipe should be thoroughly inspected and hammer tested, particularly at such places on the car as are not readily accessible to inspection and repairs when cars are in service, renewing, in each case, pipe that is found to be badly rusted or shows signs of weakness during the hammer test. The brake pipe and signal pipe shall be thoroughly blown out with air pressure after the hammer test is made and the dirt collector thoroughly cleaned. Pipe clamps and supports must be replaced where missing, and tightened where loose.

158. The brake cylinder shall be cleaned as prescribed in Rules 217 and 227 for freight cars.

159. The brake cylinder shall be tested for leakage after cleaning, with an air gage attached to the triple valve or control valve exhaust, or to the vent port in the brake cylinder cut-out cock. The leakage should not exceed 5 lb. per minute, from an initial pressure of 50 lb. and piston travel adjusted to nominally 7 in.

160. The retaining valve shall be cleaned and tested. If accessible it may be cleaned without removal from the car.

161. Triple valves, high speed reducing valves and compensating valves should be cleaned and lubricated as prescribed in Rules No. 240 to 257 for freight cars. High speed reducing valves and compensating valves should be adjusted to close at 60 lb. cylinder pressure.

162. In cleaning the control valve of the universal type, clean all internal parts with gasoline, or a suitable oil, except rubber seats and gaskets. After cleaning, all parts must be blown off thoroughly with air pressure and wiped dry with a cloth, after which, seats, faces of all slide valves, slide valve graduating valves and upper portions of bushings where the slide valve spring bears, must be lubricated with dry graphite in the same manner as outlined for triple valves.

163. The equalizing piston and its cylinders, both ends of the release piston and the emergency piston and its cylinder, slide and graduating valve and bushings should be lubricated the same as the triple valve piston, cylinder, slide and graduating valve and bushings.

164. Before replacing the charging valve and graduated release piston in their bushings, apply one drop of anti-friction oil to each of the bushings, distributing the oil over the surface with the finger, making sure that the valve and piston move freely in their bushings.

165. Check valves in the equalizing or emergency portions should not be lubricated, but wiped clean. Before replacing the intercepting valve, protection valve, high pressure and cut off valve, apply one drop of anti-friction oil to each of their bushings, distributing the oil with the finger.

166. The intercepting valve bushing is a slip bushing. The outer surface and the bore in the valve body should be wiped clean and a light coating of dry graphite applied.

167. The quick action piston does not require lubrication; but the piston and bushing should be wiped clean and dry.

168. The safety and cut off valves should be thoroughly cleaned and the seat of the latter examined, and renewed if found defective. Adjust the safety valve to open and close between 58 and 62 lb. brake cylinder pressure.

169. No hard metals should be used to remove gum or dirt or to loosen the piston packing rings in their grooves. Unless necessary to apply new packing rings they must not be removed from groove or distorted in any manner. This applies to all packing rings in triple valves and control valves.

170. All pipe joints, including those in the signal system, hose, release valve, angle and cut out cocks should be tested under a pressure of not less than 90 lb., using soapsuds for this test when weather conditions permit, reducing all leakage to a minimum.

171. With the brake system charged to standard pressure, make a 20 lb. service reduction, after which make an examination of the brake to determine:

(a) Brake pipe leakage.
(b) If brakes will apply in service application.
(c) Piston travel.
(d) Brake cylinder leakage.
(e) That brake rigging does not bind or foul.

Release test must then be made to determine if brakes release properly.

172. If during this test, the brake pipe leakage as indicated by the brake pipe gage, exceeds 5 lb. per minute, it must be reduced to 5 lb. and if piston travel is less than 6 in. or more than 8 in., it must be adjusted to nominally 7 in.

173. The retaining valve and its pipe must be tested and made to hold the brake applied at least 3 minutes following a release from a full service application.

174. Conductor's valve, car discharge valve, platform, or "back up valves" and whistles should be tested under pressure and known to be in proper working order.

175. All defects found must be repaired and all stencil marks scraped off and painted over, and the brake restenciled in accordance with the railroad company's drawing or instructions.

Terminal Yard Inspection and Repairs

179. Passenger cars in terminal yards should have the air brake and train air signal equipment tested as follows, at periods to be specified by road involved:

180. Where facilities are provided, charge the cars from a yard air plant, to not less than 90 lb. for the brake system and not less than 40 lb. for the signal system.

181. While the train is being charged, make an examination for leaks from the brake and signal system and reduce the leakage to a minimum. Make a visual inspection of stencil date, brake rigging, hose, position of angle and stop cocks, retaining valves, retaining valve piping, hand brakes, attachment of reservoirs and cylinders to their supports and the supports to the car. Any hose leaking around fitting or otherwise defective, and cocks found leaking at top of key should be replaced. Brake shoes should be renewed when necessary.

182. When the brake system is charged to standard pressure, make a 20 lb. service reduction, after which make a second examination of train to determine the five conditions from (a) to (e) listed in Rule 171.

Release test must then be made to determine if brakes release properly.

183. If, during this test, the brake pipe leakage as indicated by the brake pipe gage exceeds 5 lb. per minute, it should be reduced to 5 lb. or less. If piston travel is less than 6 in., or more than 8 in., it should be adjusted to nominally 7 in., with slack adjuster cross heads in proper position. The air signal must operate properly from front and rear cars. All defects found shall be repaired.

Exhibit 3—Maintenance of Freight Brakes, Rules and Instructions

[In general, these rules have been clarified but without important changes and with few additions. In the table showing the types of retaining valves a 10- to 20-lb. double pressure spring type valve has been added.—Editor.]

Discussion

There was no discussion of this report.

(A motion to accept the report and submit it to letter ballot was made, seconded and carried.)

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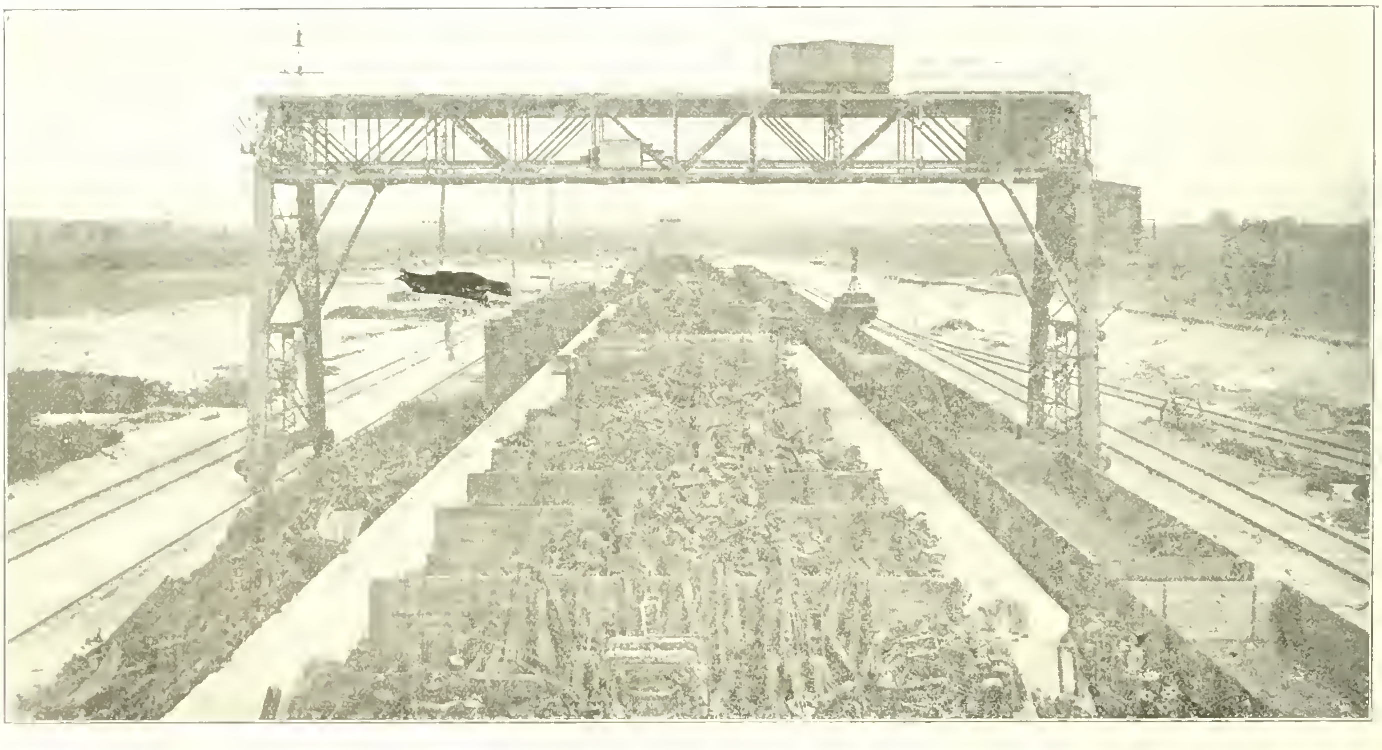


Report on Locomotive and Car Lighting

Trial of New Cab Lamps Suggested—Bushings of Two Inside Diameters Proposed for Axle Pulleys

The following subjects have been considered by the committee during the year: Locomotive headlight lamps, locomotive cab lamps, axle generator pulley bushings, axle generator belt drive, and car lamps.

Locomotive Headlight Lamps

The committee has kept in touch with lamp improvements that have been developed during the year. The suggestion has been made to the lamp manufacturers that it would be very desirable to obtain a definite mechanical difference in the headlight lamps for the primary purpose of identification. A possible change from the present G type of bulb to the PS type of bulb is reported. This will very likely permit maintaining a separate sized bulb for each size of lamp required and will also permit of improved focusing of the light.

Locomotive Cab Lamps

The 15-watt, 33-volt S-17 lamp now in general use for locomotive cab lighting in gage lamps, etc., has been reported by some member lines as unnecessarily large and a smaller lamp has been called for. A 15-watt, 33-volt S-14 lamp is available and the committee requests that member lines try out the new lamp during the coming year and give the committee a record of the service obtained.

Axle Generator Pulley Bushings

The association has a standard practice that leaves to the user the determination of the actual length of the bushing and its internal diameters, the latter being dependent upon the size of axle and position on the axle at which it is used.

The corrugated steel type of split bushing is today most widely used for this purpose. Due to the lack of established dimensions for these bushings an investigation has developed that a very large number of sizes are in use. For the 5-in. by 9-in. axle alone, over 12 sizes of bushings have been found which are used to a considerable extent. From a study of this subject it has been found that two sizes of bushings for each size of axle will take care of practically all pulley positions in general use today. In this study consideration has been given only to bushings for application to the taper section of the axles. The internal diameters shown for the bushings are based on the assumption that the axles are turned to the actual dimensions given as A. R. A. standard. The lengths for the bushings have been selected to permit using the same bushing either with or without bushing clamp. A long bushing is also desirable, as it provides for a greater range for shifting the bushing along the axle to correct for variations in the actual diameters of the axles along the section where the bushing is applied. Different lengths for the two bushings for the same size axle have been selected to facilitate ready identification due to the small differences in the internal diameters for these two bushings.

The proposed dimensions for axle pulley bushings are given in the table.

Table I—Axle Pulley Bushing Dimensions

A. R. A. axle journal in.	Bushing designation	Location of center line of busbing from center line of axle, in.	Bushing dimensions, in.			
				Diameters		
				Inside		
			Length	Large end	Small end	Outside
4¼ by 8	B-1	13	13	5 11/32	4 29/32	7½
	B-2	7½	12	5⅛	4¾	7½
5 by 9	C-1	13	13	6 1/16	5 9/16	7½
	C-2	7½	12	5⅞	5⅜	7½
5½ by 10	D-1	13	13	6⅝	6 1/32	7½
	D-2	9	12	6 13/32	5⅞	7½
6 by 11	E-1	12	13	7 3/32	6 17/32	7½
	E-2	9	12	6 31/32	6 7/16	7½

With the type of axle pulley in general use having a hub 6¼ in. long and using a bushing without clamps, the range of pulley locations possible for the above bushings when the latter are placed on the axle at locations designated in Table I is shown in Table II.

For axle generator drives where it is desired to have the center line of the belt coincide with the center line of the car it is necessary either to use wide face axle pulleys having two separate hubs or else employing bushings of special design if single hub pulleys are used.

The committee suggests the adopting by letter ballot as recommended practice, the axle pulley bushing and the range of pulley location on the axle as indicated in Tables I and II.

Axle Generator Belt Drive

In view of the importance of the subject of the drive for axle generators your committee has considered it desirable to report on new developments or improvements that are of general interest. During the past year there has been developed the so-called wide face axle pulley, two general designs having thus far been brought out. One design is known as the barrel type of pulley and as first developed was 18½ in. in diameter, 33½ in. over all, having a 1-in. flange. In the later design the length has been decreased to 28½ in. This design of pulley has been used entirely with free speed type of generators with the belt located along the center line of the car. There are at present about 450 of these pulleys in service.

Table II—Range of Pulley Locations

Bushing designation	Location of center line of pulley from center line of axle, in.	
	Max.	Min.
B-1	16⅜	9⅝
B-2	10⅜	4⅝
C-1	16⅜	9⅝
C-2	10⅜	4⅝
D-1	16⅜	9⅝
D-2	11⅞	6⅛
E-1	15⅜	8⅝
E-2	11⅞	6⅛

The other design is 18 in. diameter, 24 in. straight face with 2-in. flaring flange. This pulley has so far been used only with the controlled speed type of axle generator, the belt being located approximately 5 in. from the center line of the car. Approximately 100 of these pulleys are in service on one railroad and 50 on another.

These types of pulleys have not yet been in service long enough to permit accumulating sufficient data for a reliable comparison of belt performance with standard pulleys. It has been definitely established, though, that they will prevent belts from running off the pulleys with body hung generators where cars are operated over extremely short radius curves, under which conditions the majority of standard drives for body hung generators will frequently throw off the belts.

There has also been developed and is being tried out in service a universal axle pulley of such construction that it will rotate in a vertical plane so that the pulley remains in line with the belt when the car is running on curves. The pulley was put in service May, 1922, using a 4-in. 5-ply rubber belt with special flexible belt fastener which was reported as still in service on June 1, 1923.

Car Lamps

There is an increased use of the 25-watt 30-34-volt gas filled lamp which the manufacturers are furnishing in the PS-16 type and size and which a member road recommended to be of the PS-18 type and size. It has been suggested that this lamp and the 100-watt, 30-34-volt, PS-25 C lamp be added to the list of recommended sizes for train lighting. The committee believes that in anticipation of a rather radical change in the dimensions and type of bulb used in train lighting it is not advisable to do so at this time.

The members of the committee are W. E. Dunham, chairman, C. & N.; W. H. Flynn, superintendent motive power, M. C.; E. W. Jansen, I. C.; J. L. Minick, Pennsylvania; J. J. Tatum, superintendent car department, B. & O., and E. Wanamaker, C. R. I. & F

Discussion

W. E. Dunham (C. & N. W.): The committee is looking into the matter of a proper dimensioning of the glass reflectors for headlights. There seems to be a difference of opinion among manufacturers. In giving the figures for his reflector one manufacturer will use the inside depth of the reflector and the inside diameter at the large end; whereas other manufacturers will use the outside dimensions, and this is rather confusing. That particular feature is being checked over and we anticipate having a report on that subject next year.

E. B. Katte (N. Y. C.): May I direct your attention to what appeared to be an omission on the part of the commitee, that might save some money to some of the member companies. While there are some radical changes to be made in car lighting lamps within the next year or so, I do not know of any specific change which will affect the PS-18 lamp. This is a large lamp, gives a little better diffusion and a considerably better appearance, in the existing lamp shade, and it will make a difference in the price, I am told, of some three to four cents a lamp. On one road that might make a saving during the coming year of $4,000 or $5,000 in the purchase of lamps. We would appreciate it if your committee, or if this convention might add this lamp as one of the approved lamps at this time.

(A motion that the report be accepted and submitted to letter ballot was then made, seconded and carried.)

Importance of Modern Repair Track Facilities

Present Facilities Generally Inadequate—Able Foremen Needed—Prompt Switching Essential

Not overmuch attention has been given to repair track facilities in the past. The question is growing in importance as labor becomes more scarce and wages higher. This discussion, therefore, possesses a special value at this time.

By T. H. Goodnow

Supt. of Car Dept., Chicago & Northwestern

It should be recognized that the repair track is an important factor in the operation of a railroad, as maintenance of equipment is one of the most important problems confronting railroad managements. Bad order cars represent capital tied up, with loss of revenue when the cars are out of service.

Modern Repair Track Facilities

In considering a modern repair track and facilities, several things must be borne in mind, the most important of which is the efficient and economical handling of the work. This involves the location of storage, classification and repair tracks, the nature of repairs to be handled, power, machinery, buildings, etc.

Repair tracks are usually located in close proximity to railway terminals from which empty and loaded cars are to be received, and storage tracks should be located and laid out to provide for the classification of bad order cars into different classes. Repair tracks should be located so that the work may be handled to the best advantage and cars repaired and returned to service with the greatest possible dispatch and with a minimum amount of switching.

Car repair work naturally divides itself into two classes; namely, repairs to wood cars, and to steel cars. While the general facilities required for the proper handling of the work are applicable to both, yet each requires facilities peculiar to itself.

The transportation and handling of materials to and from shops, material sheds, platforms and cars is an important item and has a direct bearing on the efficiency of the plant. It is best accomplished by means of auxiliary, or industrial tracks, arranged in such a manner as will expedite this part of the work with the least possible interference with other operations. The relative position of material storage sheds, racks, platforms and oil house should be such as to insure the material necessary for the various operations on cars undergoing repairs being readily obtained and distributed with the least amount of labor and in the shortest possible space of time.

Equipment for Repairing Steel Cars

With the advent of the steel car came the demand for increased facilities on the repair track properly to handle this phase of the work. These demands necessitated the introduction of pneumatic riveting hammers, rivet cutters, drills, heating torches, rivet heaters, welding and cutting torches, jacking frames for straightening and squaring steel cars, etc. In the repair and overhauling of steel cars, there is a large accumulation of sheets, plates, bars, shapes, etc., that have a reclamation value. These plates must be straightened, repaired and re-used on the car, or placed in stock for subsequent use on other cars. The necessity for the installation of heavy machinery, hoists, cranes, etc., soon became apparent and the facilities on the modern repair track now include such items as power shears and punches, straightening and bending rolls, flangers, blast furnaces, straightening frames and tables, drill presses and emery grinders; also overhead and jib cranes for the transportation and handling of heavy material.

Provision should be made in connection with repairs to steel equipment for the storage of a reasonable quantity of sheets, plates, bars and other metal parts, in close proximity to the machine tool area and in such a way as to enable this material to be unloaded and handled to storage racks and cars by the cranes. Deterioration caused by rust and exposure, should be guarded against.

Where the volume of work to be handled warrants, a gas generator and necessary system of pipes, with outlets at proper distances, should also be installed to facilitate the work of welding and cutting. Such an arrangement not only permits of handling this important feature of the work advantageously but also materially reduces the cost.

A centralized station should be established for the storage, care and distribution of small hand tools, jacks, etc. This will not only insure proper distribution of necessary tools, but will provide opportunity for better inspection, and in a large measure, place the responsibility for proper care and usage upon the individual employee using such equipment. This will also in a large measure reduce the required investment in this class of equipment.

Adequate Lockers Needed; First Aid

For efficient operation of a repair track, provision must be made for the proper housing of the men employed, with adequate and convenient toilet and washroom facilities, a clean, light, sanitary place for them to eat, and good lockers in which to keep their clothing and personal tools. Where the number of men is great enough to warrant, permanent facilities should be arranged to care for injured employees and if permanent facilities are not possible, some arrangement should be made so that early attention may be given to all injuries, serious or minor. This will save suffering and loss of time on the part of the men, as well as loss of services and payment of claims by the railroad.

Able Foremen and Gang Foremen Vital

I have left to the last, the one item that to my mind is the most important; that is, the foremen and gang foremen. These individuals are the ones who are directly handling the expenditure of the millions of dollars annually in repairs to freight equipment. Of the two, give me the active, energetic, interested foremen in preference to modern repair tracks and shops. These men are the ones who are controlling the conservative use of materials in marking up repairs necessary on equipment. They are also the contact between the workmen and the company, and their efforts in interesting the workmen in the output speak either for efficiency, or the contrary. The success of car repair work lies largely with the supervision, either on the modern repair track or those not so modern.

By T. W. Demarest

G. S. M. P., P. R. R., Northwestern Region

Mr. Goodnow has given us a very able paper in connection with the details of the freight car repair track. Perhaps to some of the operating officers, however, there are other essential features. If you will think back with me the length of your experience and compare how many men worked on a car to get it out when you first went on the railroad and how many days it took as against how many men you are now working on a car and how many days it takes, from my general observation, there has been no material improvement made in speeding up repair work on freight cars. Is it not true, that whenever you were faced with the contingency of additional car work, you went out and bought more property, laid down more tracks and increased your capital investment?

From the management's viewpoint the poor despised freight car takes just as large, if not a larger proportion, of the railroad's income for maintenance as locomotives do. Everybody watches the locomotive and is following the cost of its operation and maintenance, but on the other hand, freight car repair work, which costs at least as much, is either neglected entirely, or its importance is underestimated.

There are some things that Mr. Goodnow might have mentioned, but in the limits of his paper probably could not, and one of the first is this: In the maintenance of freight car equipment you must divide maintenance into two kinds, light or running repairs, and heavy maintenance or rebuilding work. To get economical maintenance on rebuilding work you must segregate it from the light classes of repairs and do it in shops which are equipped for this work.

The next question is: How long are you going to keep the rebuilt cars in the shop? Are you going to keep them in there from four to six days? Are you going to work one or two men on them just as you did 30 years ago, or are you going to develop some working plan that will give you the effectiveness of locomotive repair shops? If we tried to repair locomotives the way we do freight cars there wouldn't be enough shops in the country to take care of them.

The contract shop uses a method that you have been very slow to adopt, and that is the so-called progressive system, dividing the work into sections, crowding men on each particular kind of work, forcing it through and cutting down the dead time of the cars from six days to two or three days. The method of operation is essentially as important as facilities. The two must go together.

Other Discussion

C. J. Bodemer (L. & N.): There is one feature that it might be well to bring out in connection with this matter which I do not think has been touched upon, and that is the necessity for prompt attention on the part of the transportation department to the switching of bad order cars. You all know that you must have a certain amount of track space to set in a certain number of cars for repair purposes at one time, and as your men go up and down the line of repair tracks finishing one track at a time, it is necessary either to have prompt switching facilities afforded at that time or else a great number of other shop tracks on which dead cars are placed for repairs. Otherwise the men will be out of work while waiting for the next line of cars. I think that prompt switching is a very important matter.

Mr. McCall: Would it not be well to give a great deal more attention to the cleaning and painting of steel freight car equipment? The only way that we will get any relief is by the sand blast system, but there are freight cars in service today that are positively dangerous, simply due to rust. We had a few days ago on our part of the line a fatal accident due to a man actually jumping through the bottom of a steel car that was apparently all right. The man was instantly killed. The bottom of the car was eaten out with rust, and I am afraid that few of the carriers are giving serious enough consideration to protecting the steel equipment from being eaten up by rust.

C. F. Giles (L. & N.): It is important that something be done not only by the individual railroads but by the railroads as a whole to keep this steel equipment in repair. The introduction of steel equipment has not by any means solved the freight problem.

Handling of Material to Car Repair Tracks

Discussion Developed the Need of Adequate Trucking System and Personnel to Handle Material

This discussion was the last one scheduled on the program and owing to the lateness of the hour there was time to hear from only two members of the association, R. H. Dyer (N. & W.) and J. C. Fritts (D. L. & W.).

By R. H. Dyer

General Car Inspector, Norfolk & Western

Handling material to car repair tracks is one feature in connection with repairs to cars that in my opinion has never been given the study it deserves. In the laying out of repair yards, convenience in handling of material stands second only to the convenience in getting the cars on and off the tracks. In a great many cases it requires more time for the workman to assemble the material, than it requires for him to perform the work on the car. This condition increases with the track length, as it would be impracticable to scatter material from one end of the tracks to the other.

Proper consideration of the subject at hand should begin as follows:

First: In laying out a repair yard, the tracks should not be over 1,000 ft. long, providing room for twenty cars spaced so that the work necessary on each car can be performed.

Second: On account of the increase in weight of the different parts used in car maintenance, such as couplers, draft gears, etc., it is essential that some means of hauling such material should be provided.

Repair tracks should be spaced with room for a standard gage service or pushcar track between the 1st and 2nd, 3rd and 4th, 5th and 6th tracks and so on. On these tracks wheels can be moved back and forth and pushcars should be provided for the hauling of heavy material. Where width of space will not permit, a narrow gage track 30 in. wide may be used with small hand trucks to fit. This small truck can be constructed so that a pair of wheels can be easily loaded, transported and unloaded at the proper place. There are also many kinds of small motor trucks on the market that have been found to be economical for hauling materials to repair tracks where tracks are so located that the trucks can be used to advantage.

Third: In order to save time in transporting material to the cars, storage should be located as near the center of repair tracks as possible, with the exception that it has been found advantageous and economical to locate small bins conveniently spaced along shop tracks in which a small supply of bolts, nuts, washers, cotter keys, rivets, etc., may be kept. This saves a great amount of time for the reason that a workman would otherwise walk possibly 500 ft. and return to get a nut or a cotter key, consuming four or five times as much time to secure the article as to apply it.

Fourth: At a small point where a small force of carmen are employed, the foreman in charge is easily able to look after the material and keep up the supplies, but where a force of 25 or more car men are employed, a good experienced car man should be put in charge of material in order that he may keep up supplies, know what he has on hand and be able to tell the workmen where to find what they want. Such a man in order to properly make out his requisition on the storekeeper should be able to read a blue print.

Fifth: It is also essential that an intelligent car repairer of long experience be placed in charge of delivering material to the workmen. This man should be provided with a sufficient number of laborers to keep the workmen supplied with the proper material.

If the right man is selected for this job, one who knows the dimensions and kind of material needed for certain jobs, he will be able to collect the material and deliver it to the workmen at the car and save more time than any other man around the shops. He would also in the absence of certain material know when a substitute could be used that would often prevent a considerable delay to cars.

By F. J. Fritts

Master Car Builder; D., L. & W.

Local conditions throughout the country vary to such an extent that it is quite difficult to suggest in detail, methods that would fully cover such varied conditions, but there are certain practices or fundamentals that it would seem could be generally followed.

Repair tracks should be supplied with adequate planking, laid on a substantial and solid foundation; the planking to be level with the top of rails, which would not only facilitate handling of material, but repairs as well. Storehouse or supply buildings should be as nearly centrally located as possible, and properly equipped for the storing of material. Saw mills and fabricating steel shops (where installed) should be situated so that right angle turns will be eliminated in handling long materials from the manufacturing shop to cars.

On heavy repair tracks, cars should be taken to stripping tracks and all material that will not be used in making repairs should be removed and disposed of at that point.

Dolly tracks, either standard or narrow gage, should be installed between all tracks. Preference will be governed by spacing of tracks. Standard gage requires greater spacing than the narrow gage. Available space and value of land naturally will govern in such cases.

It has been proven that much time and expense can be saved by keeping the scrap removed from cars separate from new material placed for making repairs. To do this alternate track spacing should be used exclusively for the removal of scrap material.

Foreman must check the cars and make a list of parts required sufficiently in advance of repairs that material may be delivered in time to avoid waiting or shifting of men to other cars.

The use of electric trucks where proper planking has been installed, can be used to a very good advantage, saving considerable labor and time in delivering material with the exception of wheels and lumber. There has not been an electric truck as yet designed that will handle the items above referred to but it does seem that trailers may be arranged that would meet these requirements. If such an arrangement can be perfected, dolly tracks could be eliminated entirely, but as a general proposition, where required, all things considered, the narrow gage would be preferable because of the extra land required, increased cost of installation and maintenance, and the necessity of operating considerably heavier trucks with practically no increase in material handled where standard gage is installed.

Supplying material on repair tracks should be in charge of a competent labor foreman who will supervise the work, seeing that material is delivered to cars in the order to which repairs will be made, likewise the prompt removal of all scrap material. The installation of these things should very materially reduce the cost of handling material on repair tracks.

Discussion

Secy. Hawthorne: When Mr. Fritts handed me this paper he told me on his way out here he did see an electric truck built especially for the handling of lumber which would be very suitable for that work in railroad shops, and that he had no doubt at all but that one could be designed for the handling of wheels.

The Baltimore & Ohio announces that the Capitol Limited, its new express train between Washington and Chicago, has been taken through on time on every trip since it was put in service, a month ago; a mileage of 47,184 train miles and never a minute late. This train which, westbound, leaves Baltimore at 2 p. m. and Washington at 3 p. m. has a sleeping car which starts from New York at 8:30 a. m. Thus passengers by this route may go through from New York to Chicago by way of Washington in 25 hours, 30 minutes, arrival at Chicago being 9 a. m. Central time.

* * *

Bird's Eye View of Eddystone Plant, Baldwin Locomotive Works

Report on Prices for Labor and Materials

Prices Changed to Meet Conditions—Reduction in Allowances for Cars Destroyed

The committee submitted the following report under A. R. A. Interchange Rules 101, 107, 111 and 112 of the freight car code and Rules 21 and 22 of the passenger car code:

Prices for Materials—Rule 101

The material prices recommended are the same as those now in force under Rule 101, except for adjustments to meet changed market conditions.

Items No. 1 to 65a, inclusive (covering air brake equipment and pipe fittings) represent latest quotations plus a predetermined percentage to cover store room expense, store room overhead, stock investment and transportation charges.

Items 103 to 214, inclusive (covering miscellaneaus car materials), are based on studies conducted during January and February of this year and include transportation charges, store room expenses, etc., as heretofore.

However, the committee feels that, due to the unsettled market conditions, before the issuance of the 1923 A. R. A. Interchange Rules these prices will be investigated and if sufficient increase or decrease develops necessary collections will be made.

Prices for Labor—Rules 107 and 111

The labor rates recommended under Items 172, 442 and 433, Rule 107, are based on the weighted average hourly rate paid repairmen on a number of large representative roads, plus an overhead expense of 62 per cent.

The following are recommended in Rule 107:

Second paragraph changed to read: The labor charges of *.95 per hour* (Item 172, Rule 101, and Item 442, Rule 107, and *$1.15 per hour,* Item 443, Rule 107), in addition to including the actual labor cost of performing the work, include the following items of indirect expense:

Item 58 changed to read: Brake Hanger, R & R or R. (Also to be charged if renewed or repaired when brake beam is R & R or R at same time.)

Item 93: Show 3 hr. opposite this item for both columns, leaving both columns blank opposite Item 92.

Item 136: Change the words "or opposite end" to read "on opposite end."

Item 149 changed to read: Door cap (wooden or metal) R & R or R, includes filler, blocks or castings. Ordinary cars—2 hr.

Item 204-a changed to read: Flooring boards (nailed and bolted or nailed and riveted, or riveted or bolted only) including slope or cove decking on gondola and hopper cars, per sq. ft.

Item 212 changed to read: Hand Rail Rod, side or end, R & R or R per section. Ordinary cars 0.8 hr.

Item 213 changed to read: Hand Rail Pipe, side or end, R & R or R, charge on pipe connection basis.

Item 214 changed to read: Hand rail post, R & R or R, charge on bolt, nut or rivet basis. Excludes R & R or R of hand rail or pipes.

Item 234 changed to read: Lining, under sills or over flooring, per sq. ft. Note: This charge also to be made when sills are renewed or spliced.

Item 248a changed to read: Post, side or end, excluding R & R or R of sheathing, lining and fixtures, renewed, each. Ordinary car, 1.7 hr.; refrigerator cars, 4.2 hr.

Item 249 changed to read: Post, corner, excluding R & R or R of sheathing, lining and fixtures, renewed, each. Ordinary cars, 2 hr.; refrigerator cars, 5 hr.

Item 250 changed to read: Post, corner, renewed, when associated with renewal of side sill, inside end sill, side or end plate, each. Ordinary cars, 1.5 hr.; refrigerator cars, 2.5 hr.

Item 250b changed to read: Post, side or end, renewed, when associated with removal of side sill, inside end sill, side or end plate, each. Ordinary cars, 1 hr.; refrigerator cars, 2 hr.

Item 254 changed to read: Release lever, coupler, R & R or R, includes any or all connections to coupler lock (whether or not in connection with R & R or R of coupler) excludes brackets or castings, each. Ordinary cars, 0.2 hr.; refrigerator cars, 0.2 hr.

Item 257 changed to read: Release lever bracket, coupler, R & R or R, charge on bolt, nut, lag or rivet basis.

Item 278b changed to read: Running board, tank car, end or side, R & R or R, charge on bolt basis.

Item 417a changed as follows: Underframe, steel (all kinds) or continuous metal center sills to which are secured metal body bolsters or metal or wood cross ties, first application or R & R, includes R & R of underframe or continuous metal center sills for renewal or repairs to top gusset plates over cross ties, center girders, bolster stiffeners, or other parts of underframe (excludes R & R or R of flooring, rivets removed and renewed in connection with R & R of underframe and rivets used in repairs to underframe). (Add jacking of car when necessary.)

Note: This item not to be charged in connection with sill renewals.

Item 439: First rivet on car any size, applied, net—present, $0.55; proposed, $0.48.

Item 440: All other rivets on car after first rivet, applied, net, each:

¼-in. diameter	.08	.07
⅜-in. or ½-in. diameter	.14	.12
⅝-in. or over diameter	.29	.25

Item 442: Change rate from $1.10 to $0.95.

Item 443: Change rate from $1.35 to $1.15.

Rule 111—Item 19 changed to read: Dirt collector, R & R or R, per connection.

Destroyed or Damaged Cars—Rule 112

The changes under this rule are based on cars built during 1922 on data furnished by the Presidents' Conference Committee for freight train cars. The reproduction cost on such cars that were not included in the report (evidently due to the fact that no class D, E, and F cars were built during 1922) were determined by maintaining the same percentage of differential in the proposed prices as existing in the present rules.

Passenger Car Interchange—Rules 21 and 22

Rule 21—The labor rate under Items 19 and 20 was determined in the same manner as under Freight Car Rule 107.

New Item: 5-a—Belt, charge 0.5 hr. generator on electric lighted equipment, R & R or R each.

[The committee proposes a change in the charges for labor on lubrication from $0.85 to $0.75 per hour and on repairs from $1.20 to $1.05 per hour.]

Rule 22—Several changes in the prices for materials are proposed for a number of items.

The report is signed by A. E. Calkins (chairman), N. Y. C.; Ira Everett, Lehigh Valley; J. H. Milton, C. R. I. & P.; J. K. Watson, A. T. & S. F.; T. J. Boring, Penn. System; E. H. Weigman, L. & N.; M. Ring, Can. Nat.; H. G. Griffin, Morris & Co., and A. E. Smith, Union Tank Car Company.

Discussion

In the absence of Mr. Calkins, the above report was read by T. J. Boring (Penn. System). Your committee wishes to withdraw its recommendation for changes under Rule 112 covering settlement prices for cars destroyed. As mentioned in the report, the changes suggested were based on costs of cars built during 1922 on data furnished by the Presidents' Conference Committee for freight train cars.

The owners of private refrigerator cars have objected to the decrease in the price per pound proposed by your committee for refrigerator cars, claiming that reduction is not warranted as exemplified by their costs and that the data from the Presidents' Conference Committee did not include a sufficient number of refrigerator cars. Your committee met with the private car owners in open meeting in the secretary's rooms the 19th inst. and as a result of the arguments presented it was decided to withdraw the recommendations under Rule 112 in order to consider further the prices for refrigerator cars, at least.

Your committee will request the private car owners to submit their costs, which will be considered along with data from Presidents' Conference Committee in establishing the prices that will be included in the next issue of the Interchange Rules. The prices for all cars will receive due consideration at the same time.

Chairman Coleman: You have heard the report. A resolution or a motion that the report be approved, recommending that the changes be incorporated in the Rules of Interchange, will be in order.

J. J. Tatum (B. & O.): *I will make a motion to that effect.* *(The motion was duly seconded and carried.)*

Economy From Modern Shop Machinery

Comparison of Modern and 40-Year-Old Machine Tools as Regards Productive Capacity

The subject of economy from modern shop machinery was brought up near the close of the session and the only discussion was that of Mr. Mullinix, presented in writing.

By S. W. Mullinix

Shop Supt., Chicago, Rock Island and Pacific

This is a very interesting subject and one that inspires the real progressive shop man to get out of the stagnant pool into the current where things are moving. Understand that in the shops referred to locomotives are either built or overhauled. In answering the question, we might view it from different angles. For instance, let us go back forty years to the time when we built a shop to take care of what was then the modern locomotive. We installed in this shop what was then modern, up-to-date machinery, capable of taking care of any work that might accrue. What I wish to do is to draw a comparison showing what was necessary then in relation to requirements at the present time, all brought about by the increased size of the locomotive and need for economical production. The former shop would be equipped with a power plant and equipped with three or four tubular boilers, fire and feed-water pumps and possibly an air compressor, which gave us 400 or 500 ft. of air per minute; that was all.

A High Speed (?) Tool

We then go to the machine shop and install the *monster* 72-in. wheel lathe with the crank pin turning and boring attachment; belt driven; angle irons bolted to face plate extending between spokes of wheels for driving; eight to ten hours required for turning a pair of drivers; speed 10 ft. per min., 1/32-in. feed.

We would next install a planer that would be belt driven; one speed; one head on the cross-rail and no side head; cross-rail raised and lowered by hand; the bedways narrow with abrupt angle, so that oil could get away quickly from where it was needed.

All the lathes, slotters, milling machines, drill presses and bolt-threading machines (sometimes two-spindle but oftener single) would be belt driven. If at night, or on holidays or Sundays, the entire line shaft had to run and probably in addition to this an auxiliary line in order to run one machine to turn a bolt, or take a light cut off a shoe or wedge.

All feed changing on the lathe was done by changing gears. Single geared machines did not cause much lost time, but when compounded, to an inexperienced operator, the necessary changes would be confusing. Bolt threading machines (single-spindle) gave us from four to six hundred bolts a day; two-spindle from 600 to 1000 bolts, lubrication of the dies being by a spoon or dripper. Our boiler shop, as well as the forge shop, had but few machines—a punch and shear in the boiler shop but little machinery outside of steam hammers in the blacksmith shops.

Modern Tools Have Many Advantages

Such machinery as we had in our shop forty years ago would render us very poor service today. Let us compare this old shop of long ago with the modern equipped shop of today, starting out with a power house and such equipment as is necessary to do the work which is expected of it. We install the modern, up-to-date 96-in. wheel lathe; motor drive; controls convenient to the operator, either in front or back of machine; variable speed; pneumatic for loosening tail stock fastenings; and motor to move tail stock to and from the work. With wheel lathes properly designed and handled we are able to run 13 ft. per min. with ½-in. feed which will enable us to get an average of one pair of drivers every 90 minutes, at least. If not, don't blame it on the machine, as you will not find the trouble there, but with the operator, who needs coaching. If he is one of those fellows who tries to make believe he knows it all and will not accept coaching in the proper spirit, change operators.

We next install special locomotive rod milling machines with rod holding fixtures; quick setting of work; all operating levers in front of the operator; micrometer dial indicating depth of cut; feeds and speed as desired; from 100 to 200 per cent more efficient than the old type machine. Next comes the locomotive rod boring machine; two-spindle heavy duty; one operator; doing the work that two men have done; one setting; quick and accurate; easy handling and clamping. Heavy cuts and fast feeds make it at least 200 per cent more efficient than the old-time single-spindle drill press.

The modern vertical rod milling machine requires only one setting of the rod; eliminates drilling and sawing; also slotting. Any desired feed or speed can be obtained and fast traverse of the work table is provided in three directions.

Planers have variable speeds, motor drive, electric control and are capable of taking heavy cuts, governed by the material being machined. Centralized control, rail setting and locking from the operating position, the provision of not less than three heads increases production at least 100 per cent. Guide grinding machines are 200 per cent more efficient than planers and will not only take care of guides, but any other plain surfaces. Turret lathes are today 300 to 400 per cent more economical than the old engine lathe; the work is quickly set up with rapid and accurate production.

Can Old Machines Profitably Be Replaced?

Now I have named a very few machines, there are hundreds of others which will afford a like saving by their use. When we are replacing old machinery in our shop by new, we should be in a position to say whether or not we were losing money by keeping the old machine in commission. I have in mind a 42-in. lathe that has given 18 years' service, and I am quite sure the machine has produced more the past ten months than any twelve-month period before. What has made this possible? The operator is interested and takes great pride in producing. He turns cylinder bushings 22-in. to 30-in. in 2½ hrs., using 7/16-in. feed, running 40 ft. per min. on the roughing cut; ¾-in. feed for the finishing cut. Machines are not built that are going to do any better. The class of work done on this machine does not require unreasonable time in set-ups. It is a motor-driven, heavy-duty machine. A few days ago the operator of a 42-in. vertical mill, placed on this machine a gray iron packing pot to cut up into cylinder rings, 27-in. diameter by ⅜-in. thick, 1-in. deep, getting 30 rings, finishing from floor to floor in 4¼ hrs. This was done on practically a new machine, strictly modern. On one of our old tools we could not have made more than 15 rings in the same length of time. I mentioned thread cutting machines, the modern three-spindle threading machines which have the unit system of lubrication will thread 3000 bolts, ½-in. to 1-in., in eight hours.

I have not mentioned economy in modern, up-to-date pneumatic tools as well as electrical. That is really a revelation and to enumerate the uses and advantages of these tools would take quite a book.

The Southampton Street 36 Stall Enginehouse at Boston is of the Rectangular Type

Report on Shops and Engine Terminals

The Work of Previous Committees Has Been Condensed and Co-ordinated in This Report

Exhibit A—Engine Terminals

The following is a summary of the data gathered in 1922 by the American Railway Association committee on Design and Operation of Engine Terminals, plus a certain amount of information published by the American Railway Engineering Association on this subject:

General Layout of Terminal

Terminals are all more or less of a compromise. There are so many circumscribed elements affecting each point that no matter whether the terminal is built by gradual expansion or is constructed new, the final arrangement will generally reveal some undesirable features. A good labor market will often overbalance the selection of a site which would have been of greater strategic value. The site selected should be such that soil water will not drain into the house or turntable pit. Enough land should be acquired to allow for 100 per cent expansion in the future. Many variable factors enter into the best selection of a site; proximity of transportation yards, cost and availability of land, distance from passenger station, necessity for smoke abatement, street car or other transportation, etc.

Studies along broad lines should be made before a terminal layout best suited to meet present conditions and future demands can be adopted. Investigation will frequently reveal the fact that a reduction in delay at modernized terminals will be equivalent to adding power to the division. The typical engine terminal is considered as a division clearing house and it is assumed that it literally controls the amount of freight and passenger-service that can be furnished by the transportation department.

A sub-committee of the American Railway Engineering Association, collaborating with a committee of the Mechanical Division, American Railway Association, submitted a typical terminal layout plan at the 1922 convention of the American Railway Engineering Association. This plan shows a large terminal with provision for two houses and separate sets of facilities for handling fuel, water, coal, sand, ashes, etc.

Here follows a quotation from the report devoted to general considerations of engine terminal layout.

Summarizing, engine terminals must be laid out so that one operation will not interfere with another. The importance of this cannot be over-emphasized. If one operation depends upon another for its success, unless that one is a success, the other will be a failure. Each facility should be independent to an extent that if any one unit or operation should fail it would not have the effect of stopping or retarding the operation of the terminal. Few operations can be conducted efficiently for any length of time if the facilities are strained to the limit. To this end each facility should be designed to perform double the work ordinarily required and at important terminals duplicate facilities should be provided. A single track lead to an engine house is inexcusable. With three or more tracks available a majority should be assigned to incoming engines. Sufficient leads, switches, and crossovers must be provided to avoid delays at coaling station, ash pit, inspection pit, or other facility. As a general rule a number of short leads are preferable to a single long lead as this enables one engine to move independently of others. Where number of leads is restricted frequent crossover switches should be provided to prevent blocking any locomotive. Lead track to turntable should line up with corresponding tracks in engine house for convenience in placing dead engines in the house.

Enginehouse Design—General Features

Modern enginehouses divide themselves into three classes; a brick wall with wood frame and roof, reinforced concrete frame and roof, and a combination of steel frame and reinforced concrete. The first mentioned type is cheapest and most generally used, but the trend has been toward reinforced concrete. All enginehouses should be of fire-proof construction as far as possible. In designing an enginehouse provision should be made for doubling the capacity needed. It is first necessary to determine the class of repairs to be made to power and the extent of such repairs. This involves a study of the capacity for doing such work at other terminals to which the engines run. Also the proximity of a back shop largely determines the extent of repairs necessary in the enginehouse. It is desirable to locate the house some distance from a city in order to get cheaper land, but in leaving the city care should be taken not to get too far away from an adequate labor market. The number of stalls to be provided is a function of the engines to be handled and the expected detention. If 100 engines are to be cared for and each may occupy a pit 12 hours, then 50 pits will be needed. If the average detention is only 8 hours a day then 34 stalls will be ample. Quality of water, as affecting boilers, and amount of local switching may also exert considerable influence upon the number of stalls necessary.

Enginehouses are made in various cross sections to suit local conditions, facilities, funds and taste. The modern house for a large terminal may have an overhead crane with down draft system, boiler washing plant, drop pits for driving, engine truck and tender wheels, jib cranes at frequent intervals and many other up-to-date facilities. Practically all of the later designed enginehouses have increased head room to improve ventilation and lighting. The continuous monitor type of house, single or double, is now being more generally adopted. The depth of the house, over all length of section, has now increased to 132 ft. on several large roads. The rear walls of the house (outer circle walls) should be practically all windows if good lighting is desired. Window sills should be about four feet from the floor.

In some localities the shape of the property makes a rectangular house fit better than a round house. For large stations a transfer table may be located between two transverse rectangular enginehouses and some rectangular layouts will require both a transfer table and a turntable. A transverse rectangular house is preferable to a longitudinal arrangement. The rectangular house, owing to its parallel spacing of pits, is much easier and cheaper to build than a round house. One particular advantage of the rectangular house with a wye is the saving in space permitted inside the building on account of the parallel track arrangement. Also the building may be designed so that it may be increased by adding multiples as desired. Leads and wye tracks cost less to maintain than turntables. The vulnerability of the turntable to accident is pointed out as a reason for the wye arrangement.

Enginehouses should be designed so that both engine and tender trucks can be removed at the same time, with tender cut loose, if desired. The distance from the engine pilot to the outer wall varies from 8 to 15 ft. and from tender to inside doors, 5 to 10 ft.; distance from engine to side walls from 5 to 10 ft. Doors vary from 12 to 14 ft. wide and from 14 to 18 ft. high. Doors are made of wood or steel frame, swinging, and rolling wood or steel slats. Columns may be omitted in the drop pit section and trusses substituted. This provides a clear passage for moving wheels from pits to rear of house. Outer row of columns should be made strong enough to support jib cranes, which may then be installed at any time desired.

In January, 1921, a committee of the American Railway Engineering Association collaborating with a committee of the Mechanical Division, American Railway Association sent out a questionnaire covering the principal features of enginehouse design. Here follows a short quotation from the 1922 report of this committee.

The Mechanical Division committee recommends a permanent floor, preferably wood block or brick on a concrete foundation for the outer half of the house where most trucking is done. Concrete is satisfactory for the remainder of the floor. The floor should slope from the line of columns between pits to drain into pits, about ⅛ in. per ft. The committee considers the ideal floor to be of creosoted wood block (12 lb. per cu. ft.), laid direct on a six-in. concrete base with a bituminous cushion and filler. Such a floor is easy to truck over and work on and does not damage engine parts and tools dropped on it. The floor will be waterproof. Floor between pits can be made cheaper than in the outside circle where most trucking is done. The roof structure recommended is to be fire proof and is a combination of reinforced concrete and tile. Non-fire-proof roof to be wood of slow burning construction.

Replies to the questionnaire indicated a marked preference for swinging wood doors. Rolling lift doors are not as satisfactory on account of the liability of getting out of order and the difficulty in repairing damage done by engines. The committee recommends the wood swinging door as satisfactory and easy to keep in repair. Door openings should not be less than 17 ft. in clear height and 13 ft. in clear width. The replies to questionnaire developed the general opinion that there is no satisfactory smoke jack. Cast iron is the first choice, asbestos second, and wood third. Wood, fire-proofed appears to be as satisfactory as any other type. The smoke jack hood recommended is 42 to 48 in. wide and at least 10 ft. and preferably 12 ft. long with a flue opening of at least 7 sq. ft. All piping, etc., should as far as possible be maintained outside the path an engine would take in passing through the outer wall of the house, account of accident.

Turntable, Tractor and Pit

Turntables are now generally 100 to 110 ft. long and 120 ft. is being used for Mallet engines. All turntables should be equipped with a suitable tractor or tractors. A Mechanical Division Committee of the American Railway Association at a meeting December 15, 1920, concluded that one turntable was ordinarily sufficient for a 50-stall enginehouse. A 50-stall house would provide for dispatching 100 engines per day if, for example, each engine was detained in the house (average) 12 hours a day. This would mean 200 moves of the table daily if each dispatchment required two moves, one in and one out, and all engines were dispatched. In other words, the table must turn once every 7.2 minutes. If a peak load period occurs in which 25 per cent of the movements are made in four hours this would require the table to turn once in every 4.8 minutes, which is about as fast as dependable operation will justify. Another consideration is the delay on account of failure of power or table which in some cases may justify one table for enginehouses with less than 50 stalls.

The size of the turntable has a considerable bearing upon the number of stalls in the house and longer tables permit more approaches without having frogs in the track at edge of table. Generally, the longer the table the less waste floor space at outer circle of house, this results from reducing the angle of stalls. The turntable deck should be wide enough to provide a walk each side with handrail protection. The turntable pit should be paved and drained. The turntable should be long enough to balance the engine when tender is empty. A deck turntable with plate girders below in pit is preferable to a through plate type with shallow pit, when the cost of construction is not greater and when drainage will permit.

There are two recognized types of turntables:

1. Balanced.
2. Three point support.
   (a) continuous—through beams.
   (b) non-continuous—bolted or riveted beams.

The minimum length of balanced turntable should be such that no part of the engine or tender will project beyond the edge of the table when the engine with tender empty is balanced on the table. With an adequate three-point support table no part of the engine or tender will ever project beyond the ends of the table as the balancing feature is not necessary with this type.

Cranes, Tractors and Hoists

Where heavy repairs are contemplated, an enginehouse may be equipped with overhead cranes. When the house is not equipped with a down draft exhaust system, the crane may only extend from the smoke jack to the tender but with the down draft system the crane may be extended to the outer circle wall of the house. This emphasizes one particular advantage resulting from down draft methods. Portable cranes are always useful and should be generally employed. Jib cranes are recommended, even when an overhead crane is provided, if quick material movement is desired. Without an overhead crane, jib cranes of two- or three-ton capacity, swinging on outer circle columns between working pits, are very desirable. Jib cranes at drop pits are best located on the nearest column to the pits. Tractors, where floors are suitable and specially provided, will greatly expedite the movement of material. Many commonly removed parts of modern engines have now outgrown the hand operated truck.

A joint committee of the American Railway Engineering Association and American Railway Association made a report in 1922 in part as follows: "Replies received from forty-two roads regarding cranes showed that twenty-one roads used no mechanical devices at all, seven used traveling cranes, eight used some jib cranes, eight used monorails and chain hoists and five used tractors. Six roads contemplated using traveling cranes. In general, the crane equipment is dependent upon the nature of repairs to be made, proximity of back shop, etc. A terminal handling 75 or more locomotives per day should have overhead cranes or be well supplied with jib cranes. The general feeling regarding the use of unwheeling hoists in engine houses seems to be that they will prove economical where all drivers are to be dropped and work done on them, but where no work is to be done on the wheels or on a few pairs only, the drop pits are more economical. The same remarks apply to the drop table in this case as to the unwheeling hoists."

Engine Pits and Drop Pits

A Mechanical Division committee of the American Railway Association concluded that the following characteristics of engine pits were desirable.

Distance from inner face of outer wall of engine house to inner face of pit wall	13 ft.
Distance inner circle columns to pit wall	10 ft.
Clear width of pit	4 ft.
Clear depth of pit below top of rail	2½ ft.

Jack timbers should run the full length of the pit. Pits should be crowned at the center with a gutter on each side. Drainage should be toward the turntable with a sewer grate at the extreme end of the pit. The slope for drainage should be at least 6 in. total.

The majority of roads recommend drop pits to take care of main trailer, engine truck and tender truck wheels. Pits for the engine wheels are especially desirable. Installation of pits for removing tender wheels would raise the standard of maintenance. Where Mallet engines are handled a double drop pit is recommended. Drop tables are favorably mentioned for enginehouses. A hydraulic jack is favored for drop pit work although several roads prefer air jacks since the telescoping feature requires less depth of it. There is reference to a special compressed air telescoping jack which gives reliable service. Drop pits should be located near the machine shop so that wheels can easily run in, if desired. Drop pits or drop tables are necessary in every house and the installation of a hoist does not do away with need for a drop pit when a pair of wheels must be removed.

Shops and Tool Equipments

The extent of the shop facilities will depend upon the location of the house with reference to the back shop. The machine shop should be in an annex, or adjacent to the enginehouse and generally contain only such machinery as is necessary for light or running repairs. It is not good practice to install machinery in the circle or enginehouse proper. The boiler, smith and tin shops may be located in the machine shop for small terminals, or adjacent to it for larger houses.

The following machines and facilities have been recommended by previous committees for enginehouses operating independently of back shops:

1—36-in. by 36-in. by 8 ft. planer
1—36-in. drill press
1—30-in. radial drill press
1—20-in. drill press
1—44-in. boring mill
1—lathe for largest piston head
1—24-in. by 16-ft. engine lathe
1—16-in. by 6-ft. portable lathe
2—16-in. by 6-ft. stationary latbe
1—28-in. D. H. crank shaper
2—double grinders
1—grindstone
1—50-ton press
1—4-inch pipe threader
1—1½ in. bolt cutter
1—double punch and shear 24-in. by 36-in. metal up to 1½-in. tbick
1—flanging clamp, 10-ft.
1—800-lb. steam hammer
1—set tin shop tools
2—1 man electric welders
1—acetylene torch outfit
Blacksmith forges and an annealing furnace

It is well to locate the machine shop as far away as practicable from enginehouse gases. The American Railway Engineering Association typical terminal layout shows the machine shop extending out from the circle of the house with one enginehouse track passing through it. The blacksmith shop, foreman's office and toolroom, also storeroom, are shown in the machine shop or adjacent to it. Another alternative plan shows the engine and drop pits in the machine shop and two enginehouse tracks entering the machine shop but not passing through it. The boiler and smith shops are in the machine shop with the office and storehouse building adjacent. The boiler, tin and pipe, flue and smith shops in large terminals are best located in separate rooms or buildings adjacent to the machine shop.

Boiler Washing System

The majority of roads questioned by the committee favored equipping all enginehouse stalls with hot water wash-out and refilling facilities. A few roads prefer only one-half of the enginehouse so equipped. The general opinion is that washing boilers with hot water is at all times desirable from the standpoint of saving in time, fuel and water and reduction in fire box and flue repairs. When a house is not equipped with a washing system the blow-off steam from boilers should discharge outside the house. All hot water and steam pipes should be lagged.

A committee of the American Railway Engineering Association considered it good practice to place a set of blow-off boxes not far from the cinder pit so that locomotive boilers may be blown off a little before entering the enginehouse. This arrangement reduces the chances of clogging the blow-off line in the enginehouse, and where boiler washing plants are installed gives cleaner water for washing out and less sediment to dispose of.

Plans have recently been advanced which aim to fill boilers with steam at 100 lb. pressure or over, steam to be obtained direct from power house. It is claimed that this procedure results in much saving of time and is more economical than present practices. Your committee recommend that this matter be investigated further and report made.

Ash Handling Facilities

There is some difference of opinion as to the best location for ash handling facilities. It is generally conceded, particularly in cold climates that ash pits should be located near the enginehouse so that engines can readily enter the house, on their own steam, with fires dumped. Also the time of exposure of firebox sheets to the cold is shortened by this location. The ash pit is unquestionably the governing facility outside of the enginehouse. This is due to the length of time required for this operation. New ash pits should be designed to take care of a peak load of 25 per cent more engines than the ordinary maximum and 50 per cent more would be better.

The kind and type of ash handling facility depends entirely upon local conditions. The length and capacity of pits depends upon the maximum number of engines handled at the terminal in 24 hours. At terminals where a large number of engines must be handled quickly probably the water pit type is the best. At terminals where there is no congestion of engines the bucket conveyor type of ash pit works out satisfactorily. Water pits do not function as well in cold weather account of steam rising from the water and tendency for loaded wet ashes to freeze solid in cars. In designing water pits, care should be taken to safeguard all approaches so that men will not fall into them. A well-designed water pit will allow from four to six engines to be handled at one time and the pit capacity should be sufficient to hold ashes for several days, if necessary, account of damages to crane or lack of car supply. Water pits require a minimum number of men for the service rendered and the force may be easily adjusted to the demand. The capacity of pits may be increased readily by lengthening at either end. Length of each pit handling two engines per track should be from 1½ to 1¾ times the length of engine and tender, and length of pit handling 3 engines per track should be from 2½ to 2¾ times length of engine and tender. The type of engine selected should reflect future operating needs.

A sub-committee of the American Railway Engineering Association made a very exhaustive report on ash pits to the 1922 convention. Several paragraphs abstracted from this report are here inserted.

A new type of ash pit having many unusual features has been described recently in technical publications. This pit is located in the roundhouse and runs transversely under each stall. Engines come direct from train to stalls in house. The pit is a sloping trough 14 ft. wide at top in which a stream of water flows constantly. Ashes dropped into this trough are washed down to an outside storage pit from which they are loaded into cars with clam shell buckets. The top of the trough is level with the bottom of engine pit and when not in use is covered with a movable plate to preserve the continuity of the engine pit floor. Your committee suggests that this arrangement be investigated and reported on by a future committee.

Ash pit design obviously depends upon the number of engines handled. A check of over 7,000 fire cleanings showed 1.41 cu. yd. of ashes removed per engine, with a good grade of coal. Your committee recommends from 2 to 3 cu. yd. of ashes per engine for average storage capacity. Where local data has not been secured it is recommended to design pit capacity on basis of engine standing 45 minutes on pit for cleaning operation. This includes two men working 30 minutes.

Coaling Station, Sand Storage and Water Cranes

Coaling stations may be of the modern mechanical type or the older gravity tipple. The type selected usually depends upon the number of engines handled, the number of tracks available for coaling engines and the kind of coal used. Station capacity should be at least 24 hours' supply and better 48 hours, for maximum demand. The coal storage bins should be made self-cleaning as much as possible by proper sloping of forces. Gravity tipple outlet fixtures may be of the under-cut or over-cut type. Preference is shown for the over-cut fixture as it seems to provide more even mixing of coal delivered.

Mechanical coaling stations should be of the transverse type and a station serving several tracks is preferable to the longitudinal type because it facilitates engine movement to and from the station. When it is necessary to deliver coal to two or more tracks it is best to install a mechanical type of station. Loaded coal car tracks should have a down grade toward the track hopper to permit easy feeding of cars. The receiving hopper must be long and wide enough to handle a complete car and provide sufficient room for unloading and handling coal. The hopper should be protected from the weather. It is not good practice to have a steel car chute too close to ash pits on account of fumes from wet ashes corroding the steel. A good many modern mechanical stations are built of concrete, with usual bucket type conveyor. Under certain conditions a belt conveyor has been found satisfactory and economical. A coal measuring or weighing device is recommended for all coaling stations.

A longitudinal coaling station designed recently and described in technical papers shows coal dumped into a pit below the ground level. A clam shell with traveling crane lifts the coal to gravity chutes which deliver direct to tenders. This type of coaling station has a number of new features which may prove superior in operation or economy to other types. Your committee suggests that this arrangement be studied and reported on by a future committee.

Sanding facilities are usually found in common with coal chute so that sanding may be accomplished while taking coal. Also in small terminals the duties of men operating tipple and sand facilities may be combined. Sand should be dumped from road cars into a pit beneath the track or trestle. Storage capacity of green sand should be sufficient for several months' supply; a winter's supply should be provided in cold climates. Modern sanding facilities are recommended for all large terminals. One well-known arrangement provides for dumping wet sand through a hopper to an underground storage pit, from there it is elevated in conveyor buckets to dryers which in turn discharge dry sand by gravity into tanks. These tanks are charged with air which forces dry sand to other tanks high enough to discharge by gravity to engine boxes. Smaller terminals may be equipped with dryers preferably of the stove type, on ground level which discharge dry sifted sand by gravity into underground tanks from which sand is forced by air to overhead gravity tanks similar to mechanical arrangement just described.

The location and number of water cranes or columns depends upon the importance of the terminal and local conditions in the terminal and yard. Water supply for yard engines should be especially considered and water storage tanks should always be of very liberal proportions. No water crane should be located where the overflow will freeze on switches. Suitable sewer gratings should always be furnished to carry away surplus water. Water columns should also be located near the entrance to the terminal and water should be equally available for inbound and outbound engines. Engines taking water should not block the movement of other engines.

Inspection Pits and Washing Platform

A number of roads have found inspection pits to be an important addition to the terminal. In cold climates pits should be covered with a protection shed. Pits should be connected by transverse tunnels with steps up to ground level in the clear. The inspector's office should have a pneumatic tube connection with enginehouse foreman's office to expedite writing up and issuing orders for making repairs necessary. Track space for two times their capacity should be allowed front and rear for power waiting for and leaving the inspection pits. Inspection pits are best made of concrete with floor crowned in the middle for drainage. Sufficient sockets for portable and fixed lights should be provided. The inspection pit is really the entrance or beginning of the terminal. Here the crews are usually released and it is a convenient location for locker, wash and toilet rooms for crews, also the inspector's office.

Buildings and Offices

The location of the wash platform is subject to considerable difference of opinion. In some cases it is thought best to wash engines first on entering the terminal and before inspection. Others prefer to wash last, after engines leave ash pits and just before entering house. Some roads, particularly in cold climates, prefer the washing facilities in the enginehouse and one stall is occupied for this purpose. The wash platform should be arranged so that operators can climb up easily when washing upper parts of engines and tenders.

The officer in charge of enginehouse should have an office adjacent to the house. This building should provide rooms for usual clerks and dispatchers. Suitable locker and wash rooms and toilets should be provided for all enginehouse employees, also an ample supply of drinking water conveniently located. A proper telephone connection for all offices at the terminal is very important. This may be handled through a private branch exchange.

The supply house should be so located that supplies may be taken from incoming engines, checked into house and out again to out-going engines. The location depends upon the general design of the terminal and should be so convenient as to cause no delay to arriving and departing engines. At small terminals the supply house, if large enough, may be used jointly with other houses or offices which may be located nearby.

Light repair sheds are not in general use. A considerable number of engines do not have to go into the house and these may be very readily cared for in the repair shed. Shed should be located near the machine shop. Light repair sheds provide cheap floor space for tightening and testing engines and thus conserve the high-priced floor space in the enginehouse for heavier repairs. It is recommended that more data be obtained relative to the economy and usefulness of this facility.

Storehouse and Oil House

The storehouse and its facilities should be centrally located, preferably close to enginehouse and machine shop. Walls should have plenty of windows and material handling should be expedited by suitable roadways, platforms and racks. The oil and storehouses should be of fireproof construction. Storehouse should be placed so that men will not have to cross enginehouse leads to get materials.

Oil requirements at large terminals necessitate a separate oil house with attendant, located conveniently to enginehouse and machine shop. At a terminal where oil requirements are light the oil house may be made a part of the storehouse but separated from it by fire walls. In any case, the oil house should be adjacent to storehouse.

Exhibit B—Power Houses

The following is a summary of previous reports of the committee on Modernization of Stationary Boiler plants, condensed and brought up to date.

Power House Building

Location

The power plant should be located centrally with respect to distribution of live steam (especially to roundhouse blower lines); exhaust steam for heating; electric current; air and water. If plant is, or may be operated, condensing the location with respect to source of circulating water and disposal of hot well discharge should be considered. Also plant should be readily accessible for switching and storage of fuel and cinder cars.

Construction

Frame. Wood frame and wood roof trusses are desirable for small plants up to 300 hp. or temporary plants. Steel frames and trusses have the advantage of permanency, and structural possibilities, such as furnishing support for coal bins, ash conveyors, traveling cranes and piping.

Walls. Wood or galvanized iron walls are advisable only in small or temporary installations. Brick or reinforced concrete are superior and cost less for maintenance.

Floors. Concrete or similar floors are best. The floors should not be connected to engine foundations and should be provided with suitable drains. Whenever possible a basement should be provided below the engine room floor to accommodate exhaust steam and other pipe lines with sufficient head room for men to work. Often it is desirable to make the basement floor of one concrete slab reinforced about two feet thick for supporting machine foundations.

Roof. It is advisable to have the roof of fireproof construction, especially over boiler room.

Windows. Ample windows to be provided for ventilation and light. Steel sash are preferable.

Doors. The doors should be conveniently located and of sufficient size to move machines in and out the building.

Ventilation. Natural draft or induced draft ventilation should be installed, especially in engine room where electric machinery is in operation, and must be kept cool.

Cranes. It is advisable to install hand-operated traveling cranes over the equipment in the engine room for taking out crank shafts, pistons, etc.

Power House Equipment

Boilers

Type. The following types of boilers are generally employed in railway power plants: (1) Locomotive type. (2) Scotch Marine type. (3) Horizontal return tubular. (4) Water tube.

Locomotive type boilers have an advantage in small railway power plants, as these boilers are often obtained from dismantled locomotives and the cost of installation is small.

Horizontal return tubular boilers are also comparatively less expensive, especially the installation. The advisable limiting size of locomotive and horizontal return tubular boilers is 150 hp., and the highest boiler pressure 150 lb. When more than six locomotives or return tubular boilers are in one installation it is then desirable to consider water tube boilers of larger capacity per unit. For the relative efficiencies of locomotive, return tubular and water tube, see Table 1.

Table 1—Comparative Efficiencies of Locomotive Return Tubular and Watertube Boilers Hand Fired and Stoker Fired

	Lb. of water evaporated per lb. of combustible from and at 212 deg. F.	
	Hand fired	Stoker fired
Locomotive type	4 to 6.5	....
Return tubular type	5.5 to 9	6 to 10
Water tube type	7 to 10.5	8 to 12

Settings. The foundations of boilers should be made firm by proper footings to prevent settling and cracking of the side walls and opening up of pipe joints as well as the deterioration of interior brick wall and distortion of the boiler itself.

The settings of water tube boilers vary with the type and conditions of service and it is recommended to follow setting plans provided by the manufacturer.

Stack. Stacks may be of steel, brick or concrete. The comparative cost for initial installation and per annual maintenance, based on 1922 figures, are shown in Tables II and III respectively.

Table II—Stacks Costs Per Boiler Horse Power

	200 Hp.	400 Hp.	600 Hp.	800 Hp.
Steel	$600	$1,500	$2,100	$2,800
Brick	2,700	2,900	3,100	3,500
Concrete	2,600	2,800	3,200	3,600

Table III—Maintenance and Depreciation Costs of Stacks Per Year

	200 Hp.	400 Hp.	600 Hp.	800 Hp.
Steel	$120	$240	.....	.....
Brick	82	90	$95	$100
Concrete	65	72	80	87

Stokers. With hand firing and hand ash disposal one fireman can efficiently attend 200 boiler horsepower or 500 boiler horsepower if he shovels coal only. With stokers, overhead coal bunkers and mechanical ash conveyors one man can look after 1,000 to 4,000 boiler horsepower. Therefore, with all factors considered, such as reduction in boiler room force, greater capacity of boilers, interest and depreciation on investment, etc., it is believed that plants having 1,000 hp. and over should have stoker feed boilers and under certain conditions profit may be shown with stoker feed boilers in less than 1,000 hp. The type of stoker to be used depends upon fuel available and the method of conveying same in the power plant. Following are the types of stokers in general use:

1. Hand fired and hand operated. These give a more even distribution of the fuel bed but do not eliminate hand firing.
2. Traveling chain grate with natural draft. This type of stoker is best fitted for burning small sizes of free burning bituminous coals, especially coals with high ash content. The capacity of the boiler is limited to the amount of fuel which can be burned on the grate with natural draft afforded.
3. Traveling chain grates with forced draft. This type of stoker was designed especially for burning coals of high fixed carbon such as anthracite, slack and coke breeze and has proven successful in this field. Is now being tried more or less successfully with certain bituminous coals. The forced draft gives this type of stoker greater capacity than the natural draft stoker, also enables it more effectively to take care of sudden fluctuating loads.
4. Over feed step grates. This type of stoker is designed for both natural draft and forced draft and is used mostly with free burning bituminous coals.
5. Underfeed stokers with forced draft. These stokers are best adapted for burning coking bituminous coals of all grades and sizes. The advantage of the forced draft with this stoker is the same as with forced draft chain grate.
6. Pulverized fuel. At present pulverized fuel finds its field in plants exceeding 1,000 developed boiler horsepower. Low grade fuel has been burned and high boiler efficiencies obtained. The process of pulverizing is being perfected and cost reduced. The relative cost of operating pulverized fuel installations and stoker installations depends largely upon local conditions.

Coal and Ash Handling Apparatus. Coal should be placed in a boiler room and on the grates and ashes disposed of at the least cost. This usually means reducing the hand labor by providing mechanical coal and ash handling equipment. The following systems are in general use:

1. A trestle over a coal bin in front of hand fired boilers, the coal being dropped into the bin from dump coal cars.
2. Continuous conveyors such as: Spiral screw, scrapers, aprons and buckets, overlapping pivoting buckets and endless belts.
3. Hoists with car or a skip hoist.
4. Clam shell operated by a locomotive crane.
5. Steam ejector for ashes suitable for small plants.

Feed Water Heaters. It is very advisable to use feed water heaters in plants of all sizes. The feeding of cold water by injector or pumps into the boilers is detrimental to the boilers and also uneconomical. There is a saving of 1 per cent in fuel for each 11 degrees feed water heated before it enters the boilers. To insure efficient heating of the water and reserve storage capacity, the heater should be of ample size. In plants where exhaust steam is used for heating the condensate should be returned to the feed water heater. In such cases it is often advisable to install an auxiliary reservoir or "make up tank" above the heater in order that the heater may not be overflowed when a large quantity of condensate is returned during the short period of time. In large power plants a recording meter on the heater is a convenience in determining the load carried by the boilers. The open type feed water heater is most satisfactory for railway power plants.

Feed water pumps. Feed water pumps should be of ample size and at least two pumps (duplicate units) provided. Many railroads find outside packed plunger type to be the most satisfactory on account of convenience in maintaining the packing.

Engine Room Equipment

Steam Engines. Due to the fact that at the majority of shops and roundhouses, exhaust steam is used for heating buildings and also because steam boilers must be maintained to furnish live steam to the roundhouse steam blower line the prime movers are mostly steam driven. In a few cases it has been found advantageous and economical to install gas or oil engines, but so long as steam locomotives must be operated the steam power plant will likely predominate. The principal classes of steam driven prime movers are as follows:

1. Reciprocating engines of several types.
2. Steam turbines.

The determination of what particular kind of steam engine shall be employed requires careful analysis, as local conditions largely govern; such as floor space available, amount of exhaust steam needed for heat, required size of unit, type of generator and whether plant is to be operated condensing or non-condensing. In general it may be said that in units up to 250 hp. operating with exhaust steam used for heating, reciprocating engines are the most desirable. If during the season when steam heat is not required, and at the same time fuel must be conserved, uniflow engines may be considered. Also if circulating water is available engines may be run condensing. In units above 250 hp., except in special cases, steam turbines are preferable. In order to secure reasonable economy from steam turbines they must be run condensing and it is necessary to take this into consideration.

As to maintenance, this largely depends upon local conditions, but in general steam turbines require less maintenance than reciprocating engines, but when repairs are necessary it generally requires the service of the specialist not always available on railroad organizations. The railway shop machinist is usually capable of making repairs to the reciprocating engines.

Air Compressors. The air compressor equipment for the shop terminal should be of ample capacity. Air tools will not operate efficiently at less than 100 lb. pressure. The intake pipe opening should be at least fifteen feet above the ground and protected so far as possible against dirt, dust and moisture entering the compressor. Ample air reservoir capacity should be provided and air lines should be protected against freezing and accumulation of moisture. In some cases it may be advisable to install after coolers to relieve the air of suspended moisture.

Pumping Units. It is very advisable to have the pumping units accessible to the other engine room equipment, especially if they are to be depended upon for fire protection. Fly wheel pumping engines are very satisfactory units.

POWER HOUSE PIPING

The design and installation of power house piping requires care and the following features demand particular attention: (a) Sizes, (b) Provisions for expansion in steam lines, (c) Provisions for proper drainage to prevent accumulation of water with resulting water hammers and damage, (d) The use of good material both as to pipe, fittings and packing. A failure in the piping due to poor material will cost many times what would be saved by the use of such material, (e) All cutout valves for boilers and steam driven units should be conveniently located and within reach of the power house attendants; if necessary, runways over boilers with shops, etc., should be provided to enable the attendants to reach all valves, (f) Pipes and fittings should be so located that all parts are readily accessible for repairing and renewing; avoiding, so far as possible, all trenches and similar unhandy arrangements.

POWER PLANT EFFICIENCY

Notwithstanding that a power plant may be carefully designed with respect to building arrangement and equipment, it will not accomplish what was expected in output or cost per unit of output unless the equipment is properly operated and maintained and also economies and efficiencies sought after. The operating engineer should be an experienced mechanic capable of repairing and maintaining the equipment under his charge. Cleanliness of machinery, floors, walls, etc., about the engine room and boiler room indicates, as a rule, a careful operating engineer and one who maintains his machinery in the same good order. The maintenance of all equipment is of the utmost importance as a failure may occur which will cripple the roundhouse terminal and perhaps cause a shutdown of the shops.

In addition to the proper maintenance of equipment, an effort should be made to secure the output at as low a cost as possible by locating and correcting the inefficiencies of the plant. The losses occur in both the boiler and engine room and the correction of many of them is not beyond the ability of the usual chief engineer or his immediate supervisor. The following are among the more important causes of:

Boiler Room Losses

Excess of Moisture in the coal caused by too much water to "wet down the coal."

Incomplete Combustion. (a) Due to insufficient grate area or grates being clogged up. (b) Unburned coal escaping through the grates into the ash pit. (c) Insufficient air supply resulting in formation of smoke and unburned gases, such as carbon monoxide. (d) The deterioration of boiler bridge walls or baffles being burned out and boiler gases short circuited.

Excess Air During Combustion. In large plants where efficient help is employed the use of stack temperature recording instruments as well as carbon dioxide recorders are helpful in determining the processes of combustion, also draft gages may be used in determining this and other losses.

Air Leaks in Boiler Settings. Cracks in boiler settings and loose clean cut doors should not be permitted, as air infiltration cuts down furnace efficiency.

Cold Feed Water. Boilers should be fed with pumps instead of injectors and water heated in a feed water heater which should be kept clean and in working order.

Scale on Boiler Tubes. Scale ⅛ inch thick on boiler tubes and shell causes heat losses up to 10 per cent. Also excessive scale deposits cause rapid deterioration of tubes and boilers and make for excessive repairs. It is advisable to treat very hard waters to lessen their content of scale forming salts.

Soot on Boiler Tubes. Soot is an excellent non-conductor of heat and an accumulation of soot quickly cuts down boiler efficiency. Permanent soot blowing apparatus is now usually installed with all water tube boilers and is also finding favor in smaller installations of other types of boilers.

Engine Room Losses

Steam, Air and Water Leaks. Unless steam, air and water leaks are carefully watched they will be the source of great expense. With coal costing $4.00 per ton and water at 8 cents per one thousand gallons the following table shows loss per month by steam, air and water leaks:

COST OF STEAM LEAKS

Size of the leak or sum of the several leaks	Cost of leak per month—steam pressure			
	60 lb.	120 lb.	150 lb.	200 lb.
1/16 in. diameter	$2.98	$5.26	$6.44	$8.24
⅛ in. diameter	11.86	21.02	35.74	33.00
¼ in. diameter	57.46	84.04	102.96	132.02
½ in. diameter	189.90	336.10	411.86	528.08
¾ in. diameter	427.50	756.10	926.50	1,187.96
1 in. diameter	759.62	1,344.44	1,647.44	2,112.34

COST OF AIR LEAKS

Size of the leak or sum of the several leaks	Cost of leak per month—air pressure 100 lb. per sq. in.
1/16 in. diameter	$5.78
⅛ in. diameter	23.18
¼ in. diameter	92.72
½ in. diameter	370.90
¾ in. diameter	835.00
1 in. diameter	1,483.64

COST OF WATER LEAKS

Size of the leak or sum of the several leaks	Cost of leak per month—air pressure 100 lb. per sq. in.
1/16 in. diameter	$12.00
⅛ in. diameter	48.00
¼ in. diameter	192.00
½ in. diameter	768.00
¾ in. diameter	822.00
1 in. diameter	3,072.00

Loss from Radiation. All steam pipes as well as cylinders and valve chests on steam operated machines should be well insulated with suitable coverings of which there are a number on the market. For railway power plants consideration should be given to fireproof coverings reasonably unaffected by moisture and steam, with a composition that will resist an ordinary amount of handling as well as vibration.

Steam Losses in Reciprocating Engines. Due to steam leaking by valves and pistons, these losses are obvious and can be and should be corrected by the operating force.

Steam Losses in Steam Turbines on account of worn blades and nozzles can be corrected by the operating forces or by experts.

Losses in Reciprocating Steam Engines and Air Compressors on account of incorrect valve settings can be corrected by the operating engineer who should be provided with steam engine indicators, etc.

Losses in Pumping Machinery on account of slippage by water pistons and valves can be corrected by the operating engineer.

Power Transmission

Power transmission in railway shops resolves itself into the following classes:

TRANSMISSION BY BELTING AND LINE SHAFTING

This is used in small shops where no electric energy is available, or in group drives in large shops using steam engines in the former and electric motors in the latter. Oak tanned leather belting is preferable; cast iron split pulleys are more desirable than wood split or steel split pulleys; the usual kind of shafting employed is cold rolled steel.

Hangers with roller bearings are in general use and very satisfactory as they reduce friction load. The building roof trusses should be capable of supporting, at least, 1,600 lb. concentrated load at intervals of eight feet for the shafting, etc. Tight and loose pulleys in many cases have been found more desirable than friction clutches on countershafts.

ELECTRIC TRANSMISSION

Electric motors are used on large machines and also on machines which are isolated or cannot be properly driven by belt, or machines which are located in bays served by an overhead traveling crane. Direct current is preferable for operating electric traveling cranes of large capacity, various speed motors on machine tools and reversing motors on metal planers. Alternating current has much the advantage in facility of transmission.

Motor Installations. Where small power plants are involved it is the practice to install wound rotor slip ring type induction motors in sizes 10 hp. and larger, to avoid the disturbance resulting from the starting of the squirrel cage type. Motor wiring should be in rigid iron conduit and safety switches used with automatically protected manual starting equipment is the general rule.

Portable Motor Drives. The use of portable motor driven arc welders and machine tools is increasing rapidly. In enginehouses outlets may be provided at alternate stalls, placing them on the wall of the outer circle. In the shop buildings outlets may be placed as demanded by local conditions. The outlet is a combined safety switch and plugging receptacle so interlocked that the plug cannot be inserted or removed while the switch is closed. A contact is provided in the receptacle for grounding the frame of the motor through the steel armor of the flexible connection. The flexible connection between the plug and motor is kept as short as possible.

Portable Electric Rivet Heaters. These are being introduced and are difficult to handle on a small plant, on account of the fluctuations and comparatively heavy demand. Outlets are provided as demanded by local conditions, the same type of receptacle being used as for portable motors, but wired on a separate circuit, single phase, two wire circuits having proved most economical under present conditions. It is understood that development is progressing on a resistance type heater. Receptacles are available up to 200 amperes, 500 volts a-c, with greater capacities in prospect.

Traveling Cranes. Bare copper trolley wires are used on the smaller sizes, but in recent installations of 250 and 150 ton cranes T-rail contact conductors have been used. Feeders are provided to keep the drop of potential at any point on the runway within such limits that the crane speed will not be materially reduced under maximum operating demands. A rather unusual feature is the guarding of the main contact conductors to prevent accidental shock to men working on the crane runway structure. Isolation by elevation is usually considered a sufficient guard, but we have had several serious accidents, particularly in enginehouses, to window washers and men on top of locomotives.

Compressed Air Transmission

Compressed air is used mostly on portable tools. The average pressure in the air mains is usually 110 lb. per sq. in.

Piping, Lighting and Heating

General Piping

All pipe lines containing steam, air or gas should be placed above ground on support wherever possible. Also suitable runways should be provided inside of buildings for overhead pipes. These runways should consist of suitable steel stringers with grating thereon to prevent accumulation of dust and persons slipping when making repairs to pipe lines.

Cutout valves should be placed on all pipe lines which enter buildings. These to be located not nearer than 20 ft. on the outside of the building and arranged with chain wheels, if overhead, for shutting off the lines in case of fire.

Expansion of pipe lines should be provided for by the use of "U" bends.

For fire protection inside of building, hose reels are usually employed. Where the use of hose reels are required on the outside of building, such as in car repair yards, or transportation yards, a suitable metal hose should be built with the roof well insulated to prevent the heat from deteriorating the rubber hose. Pipe lines serving fire hydrants should not be placed close to buildings and fire hydrants should be situated to give most ready means of protecting buildings.

Natural Lighting

In old shops sufficient attention was not given to securing adequate daylight illumination. This was somewhat difficult on account of the building construction then used; but with the steel frame construction it is now possible to give large wall areas to glass sash which serves for both light and ventilation. Also of late satisfactory skylights such as the "V" shaped skylights have been brought out that give light without glare, ventilation and freedom from condensation and dripping of moisture.

Electric Lighting

General Wiring is installed in rigid iron conduit, with a 30 per cent Para insulation for rubber covered wire.

Enginehouses. Different methods of illuminating enginehouses are used, depending upon the construction of the building, and to a certain extent upon the preference of the local operating people. A system generally used is the installation of roundhouse reflectors, especially designed and marketed for enginehouse use.

These are mounted about eight feet from the floor, three being used per stall, the arrangement depending upon the location of building columns. A white enameled reflector with a plain glass door has proved most satisfactory. Ease of cleaning and reduction of bulb theft and breakage, as well as good distribution of light, result from this installation.

Plugging circuits for portable electric light extensions are placed on the building columns. In connection with the use of these portable extensions particular attention is called to the necessity of properly safeguarding the users by providing a heavy pattern portable lamp guard, with socket recessed in a wood handle, with portable cord and as rapidly as practicable use polarized caps to insure connecting the screw shell of the socket to the grounded wire of the circuit. All drop cord and extensions should be maintained in safe condition.

Shop Buildings. For shop buildings general illumination from overhead enameled steel reflector units, spaced for uniform intensity, supplemented by local illumination where the nature of the work requires local lighting, is preferred.

Turntable, Cinder Pits, Etc. The tendency is to use flood lighting where practicable, though illumination by units suspended from poles or messengers is quite common and usually satisfactory.

Yard Lighting. Shop yard lighting is usually accomplished by units mounted on poles and flood lighting. Have one very satisfactory coach yard flood lighting installation. Caution should be exercised in laying out flood lighting to avoid glare and shadows.

Heating with Stoves

The heating of roundhouses or shops by stoves should not be considered except in very mild climates and where oil or gas is available. Heat from stoves does not fill the entire building and stoves are expensive and dirty to maintain, also constitute a serious fire hazard.

Steam Heat

General. In general heating by steam is the most satisfactory, using exhaust steam wherever possible and supplementing by live steam if necessary. Practically there is about 3.4 per cent as much heat in exhaust steam as there is in live steam. The heat is given out by two systems, direct radiation and indirect radiation.

Direct radiation. In this system the pipe or radiators are placed along walls or in engine pits where the cold air accumulates or passes. The condensed steam wherever possible should be returned to the powerhouse.

Indirect radiation. In this system a current of air is blown over a nest of pipes by means of fan blowers and the hot air distributed throughout the building by ducts, the ducts discharging the hot air where it will meet the incoming cold air.

Exhibit C—Car Shops

A tentative shop layout embodying general features in such detail as was deemed immediately essential, together with general observations on the subject, were submitted to the Association in Circular S-111-132 at the 1920 Annual Meeting. A shop of four units A—B—C and D was presented; also certain other fundamentals were recommended, such as track spacing, crane capacity, standard gage industrial track and the height under girder beam of crane, etc. This plan was worked out with the idea of consolidating facilities at large interchange centers, however it is beyond the average requirements of most any of the railroads with the possible exception of the very largest. Each unit submitted provides for a capacity of 25 cars per day and the expansion program so mapped out to facilitate expansion until the ultimate capacity of 100 cars per day is reached. No definite conclusions have been drawn as to the construction of the buildings, this being in a large measure dependent upon the location, the different type of construction varying for certain localities to such an extent as not to permit of any recommended practice.

The consensus of opinion denotes a preference of the more or less square type of building in lieu of the longitudinal shape since it permits less congestion, particularly where the progressive system of repairs cannot be followed entirely. In scheduling equipment through shops, not very much can be accomplished in mine run of cars, but must be selected in series, or practically the same class of equipment. The cost of moving and the damage created in getting cars to the shops should also be given serious consideration.

Steel car shops should be located where the cars accumulate, or at the unloading point, or at the point where they are to be loaded. At the Great Lakes where most of the steel cars are used, the shop should be provided near the unloading points on the lake. On roads that have no ore, in the reverse movement, the shops should be located in the mine districts, or on a division leading to the mine. Wood car shops should be located where the bad orders accumulate. It does not pay to haul a wood car the entire length of the road for a roof or end, some side sheathing or floor. For that reason a railroad with 20,000 to 40,000 cars should not need more than two first class shops. Cars going to these shops would be cars requiring extremely heavy repairs.

The question of machine tools as reflected in the report referred to above is more a suggestion than a recommendation and the committee feels that this subject be given careful consideration in the near future, particularly the method of heating rivets, whether electrically, oil or coke and the method of removing rivets, whether arc, gas or busters.

Exhibit D—Locomotive Shops

The committee finds that very little data has been collected on the design of locomotive shops by previous committees and about the only information available is found in technical publications.

The committee feels that the time available to collect data and submit a comprehensive report is too short and they recommend that this important subject be given consideration by future committees.

Power House Equipment

In general this part of the report is identical with Exhibit B, except for the following additions:

BOILERS

Oil and Gas Fuels. The use of oil and gas as a fuel is increasing, particularly in the vicinity of oil and gas fields. Also the use of oil has extended beyond the limits of fields of production to territories where (1) a suitable grade of coal does not exist, (2) where coal is comparatively higher in price than oil, or (3) where lack of coal storage facilities, inadequate supply, or other local conditions influence. The relative economy of a coal and oil burning installation depends upon the heating values of the coal and oil to be burned; cost of same laid down at the plant and local conditions as to boiler settings, etc. In determining the advisability of burning oil the following factors are taken into consideration in addition to comparative costs:

1. Reduction in boiler room labor.
2. Elimination of coal and ash handling.
3. Cleanliness about the plant.
4. Close regulation of firing.

In general, the oil burning installation consists of the following:

Storage. The oil is delivered in tank cars which are drained into an unloading trough, or direct by pipe connection to a storage reservoir; if gravity is not sufficient to drain, pumping must be resorted to. The reservoir may have capacity of from 10,000 gal. to 50,000 bbls. or more. The oil flows by gravity through pipe lines suitably placed and heated from the main reservoir to an auxiliary reservoir outside the power plant.

Pumps. Oil is fed to burners by means of steam operated pumps operating on governors usually set at from 20 lbs to 60 lbs. oil pressure. The pumps should be of the Duplex type and provided with air chambers so that the oil flow will be steady.

Burners. Several types of burners are employed: (a) "Outside mix"—from which the oil flows out of burner on to a jet of steam which conveys it into the combustion chamber. This type of burner is particularly adapted to very heavy oils; (b) "Inside mix" or atomizing. The oil and steam are intimately mixed inside of this type of burner by means of baffles or spirals which very finely atomize the oil and reduce it to a vapor. This burner is especially adapted to light grades of oil; (c) "Mechanical mix burner." The oil is atomized in this type of burner by various imposed mechanisms which break up the oil which is supplied at a very high pressure. Such burners require special draft conditions.

Settings. As a rule oil burning boiler settings deteriorate much reservoir: if gravity is not sufficient to drain-pumping must be exercised in placing the settings and in selecting the materials. It is necessary that sufficient combustion chamber space be provided otherwise the combustion chamber will take on the character of a retort and quickly melt down the settings and injure the boiler. The kind of settings varies with the type of boilers employed.

Regulation and economy. To get the best results from oil burners they must be regulated to give a clear fire and without too little or too much air. There are automatic regulators on the market which have been successfully used.

ENGINE ROOM EQUIPMENT

Reciprocating engines of several types. The determination of what particular kind of steam engine shall be employed requires careful analysis as local conditions largely govern; such as floor space available, amount of exhaust steam needed for heat, required sizes of unit type of generator and whether plant is to be operated condensing or non-condensing. In general it may be said that in units up to 250 hp. operating with exhaust steam used for heating, reciprocating engines are the most desirable. If during the season when steam heat is not required and at the same time fuel must be conserved uniflow engines may be considered. Also if circulating water is available engines may be run condensing.

Steam turbines. In units of about 250 hp. except in special cases steam turbines are preferable. It will be noted from the table that in order to secure reasonable economy from steam turbines they must be run condensing and it is necessary to take this into consideration.

As to maintenance, this largely depends upon local conditions, but in general steam turbines require less maintenance than reciprocating engines, but when repairs are necessary it generally requires the service of the specialist not always available in railroad organizations. The railway shop machinist is usually capable of making repairs to the reciprocating engines.

POWER HOUSE PIPING

Insulation should be placed on pipes and fittings carrying steam, the type of insulation and amount varying with the temperature and construction employed. All covering should be protected from weather and damage and on outside pipe lines the joints in the lagging should be "buttered" and a metal jacket applied which should be kept well painted.

GENERAL PIPING

For fire protection inside of building, hose reels are usually employed. Where the use of hose reels are required on the outside of building, such as, in car repair yards, or transportation yards, a suitable metal hose house should be built with the roof well insulated to prevent the heat from deteriorating the rubber hose. Pipe lines serving fire hydrants should not be placed close to buildings, and fire hydrants should be situated to give most ready means of protecting buildings.

HEATING

Hot Water Circulating System. In this system the exhaust steam (supplemented by live steam if necessary) heats water in a specially designed heater in the power house and is circulated through the shops by circulating pumps. The heat may be supplied to the buildings through direct or indirect radiation as in the case of steam heat. It is claimed that this system offers a superior regulation of the heat supply.

The report is signed by A. R. Ayers (Chairman) N. Y., C. & St. L.; F. W. Hawkins, Pennsylvania System; I. S. Downing, C. C. C. & St. L.; B. P. Phelps, A. T. & S. F.; and Henry Gardner, B. & O.

REPRESENTATIVES of the federated shopcrafts in the New York Central, having asked for a general increase in pay, are holding protracted conferences in New York City with officers of the road.

New Burlington Locomotive Shop at Denver

$2,500,000 Project Will Employ 750 Men—Will Turn Out 200 Classified and 50 Running Repairs a Year

By A. H. Ostberg

Mechanical Engineer, Valuation Department, C. B. & Q.

After a thorough investigation, taking into consideration the present shop facilities for handling heavy locomotive repairs as a whole, the large increase in number of locomotives acquired during recent years, locomotives on order and an increase in business requiring the intense use of the locomotives from a service standpoint, it was decided to build a locomotive repair shop capable at the outset of taking care of 200 classified repairs and 50 running repairs per year.

The next important step considered was the geographical location of this shop. About 63 per cent of the total locomotives are assigned on the lines east of the Missouri River. Our locomotive repair facilities on this side of the river were materially strengthened when in 1917 we built at West Burlington, Iowa, a new machine and erecting shop and other improvements capable of an ultimate output of 50 locomotives a month.

On the lines west of the Missouri River, about 37 per cent of the total number of locomotives are assigned. In 1910, extensive locomotive repair shops were constructed at Havelock, Nebr., and no other important locomotive shop improvements have been installed since then, notwithstanding the fact that the percentage of increase in locomotives assigned to the lines west has been the same as the increase on the lines east. It was, therefore, concluded that the new shop facilities should be placed somewhere on the lines west.

A location was desirable which would facilitate the movement of locomotives to be shopped with the least possible average haul, taking into consideration the fact that some engines would have to be towed in both directions while others might be able to go under steam. The number of coal and oil-burning engines to be repaired and their relative division assignments were also important factors in deciding on the location. Accessibility to the labor and material markets, climatic as well as living conditions, and water conditions were also taken into consideration.

Denver, Colo., at the extreme western end of the railroad, was finally selected. The shop site covers 280 acres, and is located about 2½ miles north of the Union Station. It has an ideal location and can easily be reached from the city by electric cars, and is easily accessible both from the Burlington and Colorado & Southern.

The improvements consist of the following:

Machine and erecting shop	240 ft. by 506 ft.
Boiler shop	130 ft. by 306 ft.
Blacksmith shop	88 ft. by 198 ft.
Power house	89 ft. by 128 ft.
Storehouse and office (3 story)	80 ft. by 160 ft.
Oil house	25 ft. by 40 ft.
Oxweld generator house	20 ft. by 50 ft.
Yard Crane Runway	100 ft. by 577 ft.
Casting platform with crane	84 ft. by 272 ft.

Lye vat, deep wells, stand pipe, electric substations, etc.

In planning the relative locations of the buildings, the importance of minimum handling of materials to and from shops was carefully considered. The shop and storehouse yard cranes overlap, allowing for interchange of material. Necessary concrete runways and ramps are provided for easy and quick handling of motor trucks. The buildings are located and built so that ample future enlargements can easily be made without interfering with the operation and, while at present the facilities are only to be used for locomotive repairs, ample space is allowed for possible freight and passenger car repair facilities.

In a facility of this kind the proper selection and location of tools and machinery is of great importance. In placing the machinery, a careful study should be made of the major operations to be performed on each individual tool. With this information at hand, the tools may be placed in groups or departments so that the work may be done with the least possible back movement in routing through the shop.

Machine and Erecting Shop

The machine and erecting shop is 240 ft. wide by 506 ft. long, divided into three bays. The erecting shop in the center is 100 ft. wide and the machine shop on each side is 70 ft. wide.

The building frame is all structural steel, supported on heavy concrete piers with a concrete curtain wall up to the windows and tile above. It has concrete floors throughout. The windows are wired glass in steel sash, which together with the monitor sash, give perfect light to all parts of the shop. The shop is heated by the blast system from fan rooms located in buildings adjacent to the center of the east and west walls through underground concrete ducts to registers located at alternate columns. Adequate toilet and locker room facilities are also provided in the building on the west wall. It is lighted by high-powered Mazda lamps suspended from the ceiling, sufficient for night work when necessary.

A system of crane signals is installed throughout the shops facilitating the movement of the cranes.

The shop is of the longitudinal type with three pit tracks 30 ft. from center to center, extending the full length of the erecting shop. These tracks will accommodate about 35 locomotives at one time. The erecting shop is served by two 125-ton cranes on the upper crane runway, and one 15-ton crane on the lower runway. The large cranes are provided with 15-ton auxiliary hoists.

The distance from the erecting shop floor to the roof trusses is 50 ft.

The east machine bay will be used for heavy work and is served by two 15-ton traveling cranes and 25 wall jib cranes. Some of the jib cranes will be equipped with fast electric hoists and others with high speed Triplex hoists.

In this bay are located the following departments, with a brief description of the machinery located therein, as well as a brief description of the major operation on each tool:

Wheel Work

90-in. Driving Wheel Lathe.—For turning driving wheel tires.

Combined Journal Turning and Quartering Machine.—To be used for turning crank pins, turning all journals, facing hub liners and quartering wheels.

54-in. Tire Turning Lathe.—To be used for turning tires on trailer wheels, engine truck wheels, and tank truck wheels, and turning narrow gage drivers. Can also be used for coach wheels when required.

32-in. by 18-ft. Engine Lathe.—For driving trailer, engine truck and tank truck axles, shafting, steam hammer pistons, turning old axles for bar stock, etc.

30-in. by 14-ft. Engine Lathe.—For crank pins, heavy knuckle pins, crosshead wrist pins and miscellaneous heavy work.

96-in. Boring Mill.—For boring tires, turning wheel centers, front end rings, large piston heads and bull rings and large gears and pulleys.

600-Ton Wheel Press.—Pressing on and off driving, trailer, engine and tank truck wheels. Pressing out crank pins, etc.

Tire Heating Furnace and Blower.—Heating tires for applying on wheel centers.

Two—1½ in. by 12 in. Double Bench Grinders. General Tool Grinding.

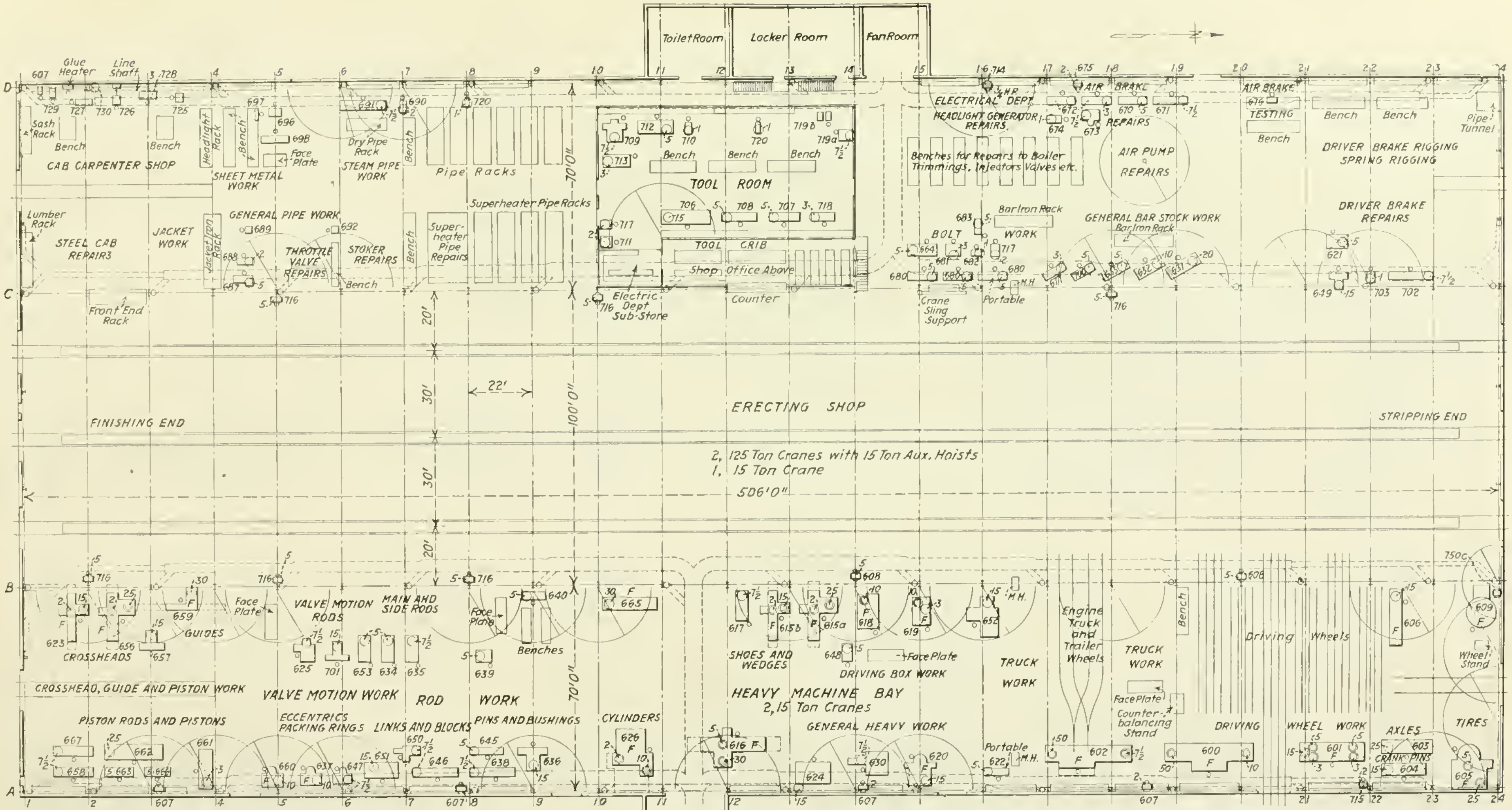
Counter-balancing Stand.—For counter-balancing driving wheels.

Driving Box Work

48-in. by 48-in. by 19-ft. Planer.—For driving and trailer boxes.

36-in. by 36-in. by 19-ft. Planer.—For new shoes and wedges, old driving and trailing boxes and equalizers.

32-in. Shaper.—For planing old shoes and wedges, engine truck



ITEM	DESCRIPTION	DEPT.	ITEM	DESCRIPTION	DEPT.
600	90" Driving Wheel Lathe	Wheel	621	100 Ton Vert. Hydro. Press	Brake Rig
601	Comb. Journal Turning and		622	18"x8 ft. Engine Lathe	Portable
	Quartering Machine	Wheel	623	36"x36"x10' Planer	Piston
602	54" Tire Turning Lathe	Wheel	624	Plain Milling Machine	G. H. W.
603	32"x18 ft. Engine Lathe	Wheel	625	48" Radial Drill	Valve
604	30"x14 ft. Engine Lathe	Wheel	626	60" Draw Cut Cyl. Planer (C.& S.)	G. H. W.
605	96" Boring Mill	Wheel	630	3½" Horiz. Boring Machine	G. H. W.
606	600 Ton Wheel Press	Wheel	631	7½"x26" Turret Lathe	Bolt
607	3"x30" Grindstone	Cab	632	3½"x18" Turret Lathe	Bolt
607	(4) 1½"x12" Double Bench Grinders	G.H.W.-Wh. Rod-Pist.	633	3¼"x20" Turret Lathe	Bolt
608	2, 3"x18" Double Grinders	Erect.	634	28" Shaper	Rod
609	Tire Heating Furnace	Wheel	635	32" Shaper	Rod
615a	48"x48"x10' Planer	Dr. Box	636	5" Drill	Rod
615b	36"x36"x10' Planer	Dr. Box	637	36" Boring Mill	Valve
616	60"x60"x14' Planer (C. & S.)	G. H. W.	638	24"x14 ft. Engine Lathe	Rod
617	32" Shaper	Dr. Box	639	100 Ton Vert. Hydro Press	Rod
618	18" Slotter	Dr. Box	640	18"x8 ft. Engine Lathe	Rod
619	15" Slotter	Dr. Box	645	18"x10 ft. Engine Lathe	Valve
620	54" Boring Mill	G. H. W.	646	24"x14 ft. Engine Lathe	Valve

ITEM	DESCRIPTION	DEPT.
647	24" Boring Mill	Rod
648	50 Ton Vert. Power Press	Dr. Box
649	3" Drill	Brake Rig.
650	Vert. Link Grinder	Valve
651	12"x36" Plain Grinder	Valve
652	72" Radial Drill	Dr. Box
653	28" Shaper	Valve
656	48"x48"x10' Planer	Piston
657	4" Drill	Piston
658	24"x12 ft. Engine Lathe	Piston
659	84" Guide Grinder	Piston
660	36" Boring Mill	Piston
661	100 Ton Horiz. Hydro. Press	Piston
662	36"x20 ft Engine Lathe	Piston

ITEM	DESCRIPTION	DEPT.	ITEM	DESCRIPTION	DEPT.
663	18"x8 ft Engine Lathe	Piston	689	Pipe Bending Machine	Pipe
664	3" Single Head Bolt Cutter	Bolt	690	24" Drill	Pipe
665	48"x20 ft. Engine Lathe	G. H. W.	691	24"x14 ft Engine Lathe	Pipe
666	3¼"-14"x36" Turret Lathe	Piston	692	Brazing Furnace	Pipe
667	24"x10 ft. Engine Lathe	Piston	696	36" Squaring Shear	Tin
670	18"x8 ft. Engine Lathe	Air Brake	697	42" Bending Roll	Tin
671	24"x10 ft. Engine Lathe	Air Brake	700	3¼"x28" Turret Lathe	Bolt
672	2, 20" Brass Turret Lathes	Air Brake	701	4" Drill	Valve
673	24" Boring Mill	Air Brake	702	24"x12 ft Engine Lathe	Brake Rig.
674	20" Drill	Air Brake	703	20" Drill	Brake Rig.
675	1½"x12" Double Bench Grinder	Air Brake	706	27"x16 ft. Engine Lathe	Tool
676	Triple Valve Test Rack	Air Brake	707	18"x8 ft. Engine Lathe	Tool
677	1½"x24" Turret Lathe	Air Brake	708	18"x10 ft Engine Lathe	Tool
680	3, 18"x8 ft. Engine Lathes	Bolt	709	Universal Milling Machine	Tool
681	1½" Double Head Bolt Cutter	Bolt	710	20" Drill	Tool
682	Centering Machine	Bolt	711	4" Twist Drill Grinder	Tool
683	Bar Shear	Bolt	712	13"x40" Universal Grinder	Tool
687	8" Pipe Threading Machine	Pipe	713	24" Shaper	Tool
688	2" Pipe Threading Machine	Pipe	714	½"x6" Double Bench Grinder	Elect.

ITEM	DESCRIPTION	DEPT.
715	1½"x12" Double Bench Grinder	Wheel
716	5, 3"x18" Double Grinders	Erect
716	3"x18" Double Grinder	Erect
717	2½"x20" Wet Grinder	Tool
717	2½"x20" Wet Grinder	Bolt
718	1½" Turret Screw Machine	Tool
719a	200 Lb. Power Hammer	Tool
719b	Electric Furnace	Tool
725	36" Band Saw	Cab
726	Single Spindle Shaper	Cab
727	16" Jointer	Cab
728	18" Swing Cut-Off Saw	Cab
729	1½" Mortiser	Cab
730	15 H.P. Group Drive Motor	Cab
750c	Blower, 300 CFH @ 12 oz	Wheel
698	8 ft. Cornice Brake	Tin
720	2, 6"x6" Power Hack Saws	Pipe, Tool

○ = A.C. Motor H.P. ∘ = Operator
◎ = D.C. Motor H.P. F = Special Foundation

Arrangement of Machine Tools in the Machine and Erecting Shop of the Burlington at Denver hub plates, driving box cellars, driving wheel keys, and eccentric keys.

18-in. Slotter.—Driving boxes, rods, frames, etc.

15-in. Slotter.—Small rods, valve motion work, driving box shells, chafe irons, carrying gear work, etc.

18-in. by 8-ft. Engine Lathe.—Brass driving box plugs, extra large equalizer pins, plugs for wheel centers and miscellaneous driving box and truck work.

50-Ton Vertical Power Press.—Driving box brasses.

72-in. Radial Drill.—Driving boxes, wheel centers, bolted engine wheels, tank wheels, crank pins, and miscellaneous work.

GENERAL HEAVY WORK

60-in. by 60-in. by 14-ft. Planer.—Frames, equalizers, and other heavy work.

54-in. Boring Mill.—Driving boxes, boring engine truck tires, tank truck tires and centers and piston heads.

Plain Milling Machine.—Milling keyways in piston rods, milling for valve motion work, machinery and tool work such as gears, jigs, and die work.

60-in. Draw Cut Cylinder Planer.—Planing cylinders and other heavy work.

3½-in. Horizontal Boring Machine.—Keyways in driving axles, rocker boxes, tumbling-shaft boxes, boring trailer brasses, boring air pump cylinders and general tool work.

48-in. by 20-ft. Engine Lathe.—Cylinder bushings and tumbling shafts.

1½-in. by 12-in. Double Bench Grinder.

ROD WORK

28-in. Shaper.—Rod brasses and keys.

32-in. Shaper.—Rod Brasses and keys.

5-in. Drill.—Boring, drilling and reaming rods.

24-in. by 14-in. Engine Lathe.—Knuckle pins and bushings.

100-Ton Vertical Hydraulic Press.—Straightening rods and pressing bushings in and out.

18-in. by 8-ft. Engine Lathe.—Rod studs and bolts, small knuckle pins, etc., turning ends on rod keys, steel oil cups.

24-in. Boring Mill.—Rod bushings.

1½-in. by 12-in. Double Bench Grinder.

VALVE MOTION WORK

48-in. Radial Drill.—Drilling and reaming large holes and general work.

36-in. Boring Mill.—Eccentrics and straps, slip rings, and general valve motion work.

18-in. by 10-ft. Engine Lathe.—Valve motion pins and bushings, link saddles, etc.

24-in. by 14-ft. Engine Lathe.—Valve yokes, valve stems, valve rods, eccentric arm pins, etc.

Vertical Link Grinder.—Grinding links and link blocks, and miscellaneous internal grinding.

12-in. by 36-in. Plain Grinder.—All valve motion pins, link saddles, etc., air pump piston rods and valve stems.

28-in. Shaper.—All valve motion planing.

4-in. Drill.—Valve motion work and part of the rod work.

CROSSHEAD, GUIDE AND PISTON WORK

36-in. by 36-in. by 10-ft. Planer.—Crossheads, etc.

48-in. by 48-in. by 10-ft. Planer.—Crossheads and miscellaneous work.

4-in. Drill.—Crossheads, piston heads and general work.

24-in. by 12-ft. Engine Lathe.—Crosshead pins, washers, nuts, etc., some small piston rods, stoker pistons and general engine work.

84-in. Guide Grinder.—Grinding guides and miscellaneous surface grinding work.

36-in. Boring Mill.—Pistons, and piston packing and boring crossheads.

100-Ton Horizontal Hydraulic Press.—Pressing pistons on and off.

36-in. by 20-ft. Engine Lathe.—Piston rods.

18-in. by 8-ft. Engine Lathe.—Bolt work, facing nuts and washers, and general work.

3¼-in. by 14-in. by 36-in. Turret Lathe.—Piston and valve stem packing and glands.

24-in. by 10-ft. Engine Lathe.—Crosshead pins, etc.

1½-in. by 12-in. Double Bench Grinder.

The west machine bay will be used for handling lighter work and is served by 11 wall bracket jib cranes with high speed chain hoists. The bay has a runway prepared for the future installation of 15-ton traveling cranes. The following departments, with a brief description of machinery, are located in this bay:

AIR BRAKE AND BRASS WORK

18-in. by 8-ft. Engine Lathe.—General air brake work.

24-in. by 10-ft. Engine Lathe.—General air brake work.

Two 20-in. Brass Turret Lathes.—Brass trimmings.

24-in. Boring Mill.—Air pump pistons and packing rings, brake cylinder piston heads, etc.

20-in. Drill. General air brake work.

1½-in. by 12-in. Double Bench Grinder.

Triple Valve Test Rack.

Test Rack.—Signal valves, governors, engineers' valve, feed valve, air pumps, etc.

BOLT WORK

3-in. Single Head Bolt Cutter.—Pedestal bolts, piston rod nuts and driving brake rods.

Three 18-in. by 8-ft. Engine Lathes.—Turning bolts.

1½-in. Double Head Bolt Cutter.—Threading bolts.

Centering Machine.—Centering bar iron for bolts.

Bar Shear.—Shearing bar iron for bolts.

2½-in. by 20-in. Wet Grinder.—Tool grinding.

GENERAL BAR STOCK WORK

7½-in. by 26-in. Turret Lathe.—Knuckle joint pins, crank pins, crosshead pins and eccentric crank pins.

3½-in. by 18-in. Turret Lathe.—All carrying gear pins, driving brake pins, small knuckle pins, etc.

3½-in. by 20-in. Turret Lathe.—Valve motion pins, etc.

1½-in. by 24 in. Turret Lathe.—Valve stems, boiler trimmings, hand brake work, etc.

3¼-in. by 28-in. Turret Lathe.—Drive brake pins, etc.

ELECTRICAL DEPARTMENT

½-in. by 6-in. Double Bench Grinder.—General grinding.

DRY PIPE AND PIPE GANG

8-in. Pipe Threading Machine.—Threading 2½-in. to 8-in. pipe.

2-in. Pipe Threading Machine.—Threading ¼-in. to 2-in. pipe.

Pipe Bending Machine.—Bending various locomotive pipes to shape.

24-in. Drill.—Miscellaneous drilling.

24-in. by 14-ft. Engine Lathe.—Dry pipe sleeves, throttle valves, etc.

Brazing Furnaces.—Brazing copper pipes, etc.

6-in. by 6-in. Power Hack Saw.

DRIVER BRAKE WORK

100-Ton Vertical Hydraulic Press.—Pressing bushings in and out.

3-in. Drill.—Carrying gear bushings, and general driver brake work.

24-in. by 12-ft. Engine Lathe.—Driver brake and carrying gear bushings, pins, etc.

20-in. Drill.—Drilling pins, etc.

TOOL ROOM

The tool room is located in the center of the light machine bay, with the general foreman's office above a portion of it. This department occupies a space 60-ft. by 88-ft. and contains the following tools:

27-in. by 16-ft. Engine Lathe.—General machinery and tool repair work.

18-in. by 8-ft. Engine Lathe.—Tool room work.

18-in. by 10-ft. Engine Lathe.—Tool room work.

Universal Milling Machine.—Tool room work.

20-in Drill.—Tool room work.

4-in. Twist Drill Grinder.—Grinding twist drills.

13-in. by 40-in. Universal Grinder.—Tool room work.

24-in. Shaper.—Tool room work.

3-in. by 18-in. Double Grinder.

2½-in. by 20-in. Wet Grinder.

1½-in. Turret Screw Machine.—Punches and general tool room work.

200-lb. Power Hammer and Two Electric Heat Treating Furnaces.—Tool tempering and hardening.

6-in. by 6-in. Power Hack Saw.

TINSMITH SHOP

36-in. Squaring Shear.—Shearing sheet metal up to No. 16. gage

42-in. Bending Roll.—Rolling sheet metal up to No. 16.

8-ft. Cornice Brake.

CAB SHOP

8-in. by 48-in. Grindstone.

36-in. Band Saw.

Single Spindle Shaper.

16-in. Jointer.

18-in. Swing Cut-off Saw.

1½-in. Mortiser.

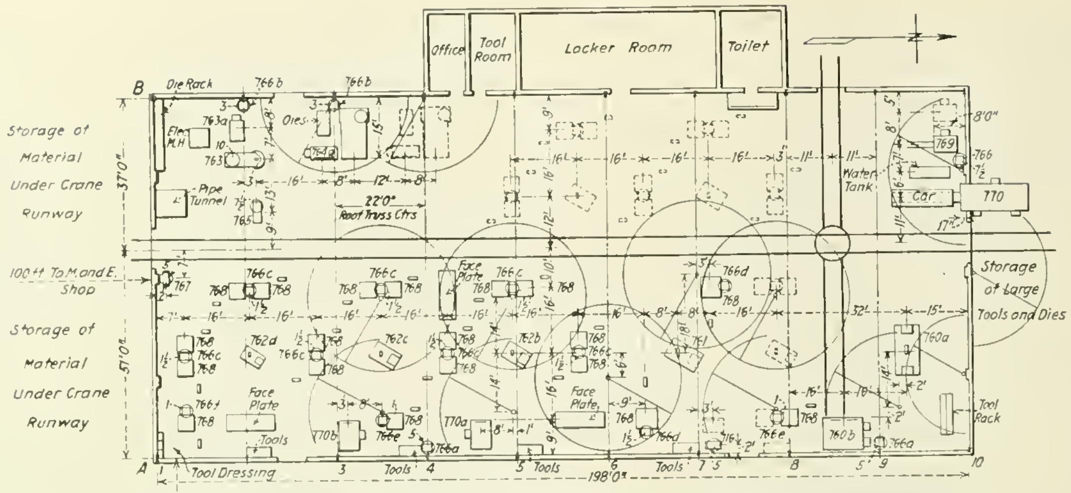
15-h.p. Group Drive Motor.

Glue Pot Heater.

ERECTING SHOP

Eight 3-in. by 18-in. Double Grinders.—General Grinding.

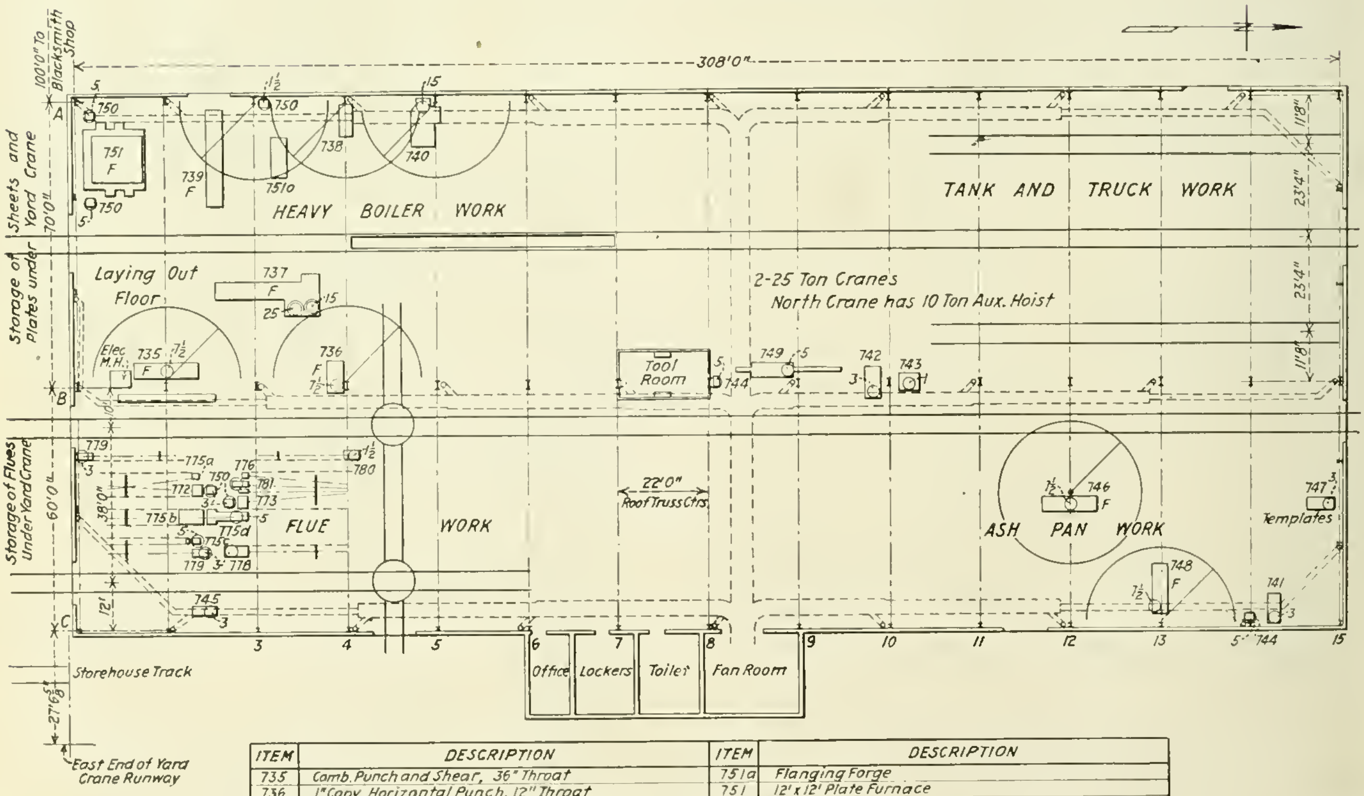
All machine tools in the shop except wood-working machin-



ITEM	DESCRIPTION	ITEM	DESCRIPTION
760 a	5500 Lb Double Steam Hammer (From C.&S. Shops)	766 b	2-Pressure Blowers for Furnaces 763a and 764a
760 b	Double Door Forging Furnace, 5'0"x7'6"	766 c	7-Pressure Blowers for Double Forges
761	2,000 Lb Frame Steam Hammer	766 d	2-Pressure Blowers for Frame Forges
762 b	1,500 Lb Steam Hammer	766 e	2-Pressure Blowers for Single Forges
762 c	1,500 Lb Steam Hammer	766 f	Pressure Blower for Tool Dresser's Forge
762 d	800 Lb Steam Hammer	767	3"x18" Double Grinder
763	500 Lb Bradley Upright Hammer	768	Forges
763 a	19½"x42½" Forging Furnace	769	28½"x52½" Case Hardening Furnace
764	2½" Ajax Forging Machine	770	4'0"x14'0" Car Bottom Annealing Furnace
764 a	16"x52" Forging Furnace	770 a	3'0"x5'0" Hammer Furnace
765	2¼" Bar Iron Shear	770 b	3'0"x5'0" Hammer Furnace
766	Pressure Blower for Furnaces 769 and 770	716	3"x18" Double Grinder
766 a	2-Pressure Blowers for Furnaces 770a&b and 760b		

○ = A.C. Electric Motor with H.P. noted ▭ = Anvil Dotted Lines Indicate Future Equipment

Arrangement of Shop Equipment in the Blacksmith Shop



ITEM	DESCRIPTION	ITEM	DESCRIPTION
735	Comb. Punch and Shear, 36" Throat	751a	Flanging Forge
736	1" Capy. Horizontal Punch, 12" Throat	751	12'x12' Plate Furnace
737	12 Foot Bending Roll, ¾" Capy (From C. and S. Shops)	772	2¼" Flue Furnace
738	¾" Pneumatic Flanger	773	6" Flue Furnace
739	16 Foot Pneumatic Flanging Clamp	775a	Pneumatic Tube Swedging Machine, Capy 2" to 4½"
740	6 Foot Radial Drill	775b	Electric Tube Welder, Capy. 2" to 2¼"
741	36" Drill	776	Pneumatic Tube Swedging Machine, Capy. 2" to 6"
742	1½" Double Staybolt Cutter	777	Tube Testing Machine, 10 to 20 ft. Capy.
743	Double Spindle Staybolt Drill	778	Flue Cutter, Capy 1½" to 6"
744	3"x18" Double Grinders (2)	779	Flue Cutters, 2½" (2)
745	Safe End Machine	780	Flue Cutter, 6" (From C. and S. Shops)
746	Comb. Punch and Shear, 36" Throat	774	Flue Cleaner
747	⅜" Sheet Metal Cutter, 36" Throat	775c	Tube Polisher
748	6 ft. Bending Roll, Capy. 5/16"	775d	Tube Roller
749	2¼"-20"x36" Turret Lathe	781	Flue Welder, 6" (From C. and S. Shops
750	5-Blowers		

● - D.C. Electric Motor with H.P. noted ○ = A.C. Electric Motor with H.P. noted F = Special Foundation

Arrangement of Shop Equipment in the Boiler Shop ery are equipped with individual motor drives and automatic push button control stations. The operator is thus enabled to start and stop motor and tool with the least possible effort, thereby reducing to a minimum the idle time. From a safety standpoint this is also most important. The tools are all of modern construction with all latest improvements. The machines have been placed so as to permit of installing more machines in the future.

The entire shop is equipped with steam, water, air and electricity. The current used is 440-volt, 60-cycle, three-phase, and 110-volt, single phase, as well as 220-volt direct current for crane service and variable speed motors. The entire shop is provided with Oxweld service for acetylene welding, and with electric welding receptacles for electric welding.

Necessary gangways have been allowed for the use of the motor trucks in hauling material throughout the whole length of the shop.

Boiler Shop

The boiler shop is 130 ft. wide by 308 ft. long. It is constructed of steel, concrete and tile, with a concrete floor, and is served by two through tracks. It is heated by the blast system through underground concrete ducts, and has adequate toilet and locker room facilities as well as a separate office for the foreman.

The west bay, designed for heavy boiler and tank work, is 70 ft. wide and 33 ft. high under the roof trusses, and is served by two 25-ton electric traveling cranes. The one over the tank department has a 10-ton auxiliary hoist. Heavy boiler plate tools and furnaces of the most up-to-date design are located in this bay and are served by wall bracket jib cranes in addition to the overhead cranes.

In the east bay, which is 60 ft. wide by 20 ft. under the trusses, are located the flue and ashpan departments. Adjacent to this bay on the west, is the flue rattler, separately housed. The flue department is equipped with an electric flue welder and other modern flue machinery which greatly increases the efficiency of the welding operation. The whole shop is equipped with electric welding receptacles and Oxweld outlets.

Boilers, flues, ashpans, etc., will be carried from the machine and erecting shop to the boiler shop by means of a 50-ton yard crane.

Blacksmith Shop

The blacksmith shop is 88 ft. wide by 190 ft. long. It has a steel frame on concrete foundations, with brick walls. The lower chords of the roof trusses are 22 ft. above the floor and, with the large, full length monitor in the roof, the ventilation is well provided for. The shop is served by a through track running under the yard crane runway. This shop has a cinder floor. The building is provided with wall radiators and is equipped with shower baths and adequate locker and toilet facilities for the comfort of the men.

This shop is equipped with a 15-ft. car floor annealing furnace and a case hardening furnace with recording pyrometers for proper heat treating, steam hammers from 800-lb. to 5,500-lb., and with forges, furnaces, and other machinery for repairing all classes of locomotive forgings.

All forges and furnaces, both in the blacksmith and boiler shops, are equipped with individual motor driven blower units, which make independent operation possible. It also does away with expensive underground or overhead air ducts which are difficult to maintain, resulting, at times, in a considerable loss of air through leakage. It will also reduce the current consumption for supplying blast to a minimum. Each blower unit can be designed to suit the particular pressure required. For hand forges, the blast requirements are different from those of frame fires or oil furnaces.

Furthermore, no difficulty will be experienced later when additional equipment is added, while with a system of air ducts, it is generally found that some re-arrangement is necessary. The shop is equipped with electric welding receptacles and Oxweld outlets.

To preserve the timbers used for all steam hammer foundations, creosoted oak timber is used. Sufficient wall jib and post jib cranes, equipped with electric and high-speed chain hoists, are installed for proper and easy handling of material.

Frames, rods, and other material to be repaired will be carried from the machine and erecting shop to the blacksmith shop by a 50-ton yard crane.

Power House

The power house is of brick and steel construction 89 ft. wide and 128 ft. long; with a basement. It has a concrete chimney 12 ft. in diameter inside by 250 ft. high.

The boiler room is 78 ft. by 86 ft. and houses four 400-hp. horizontal water tube boilers equipped with superheaters, and natural draft, chain grates, with room for a 100 per cent increase. This room is built high enough to include the overhead coal storage bunkers of 50 tons' capacity, automatically filled by bucket conveyors from a pit under cars on an adjoining track. The ashes are also automatically conveyed from the ashpits to an overhead ash hopper which is conveniently located over the coal and ash track.

In the boiler room are also located the feed water pumps and heater, and other auxiliaries, including the 1,500-gal. per minute fire pump which supplies a separate system of firelines around the shops.

In the compressor room, which is 40 ft. by 86 ft. and is served by a 10-ton hand traveling crane, are located the two 3,400-cu. ft. steam driven, air compressors with additional space for a future unit. Owing to the sandy condition of the ground around the buildings and surrounding country, the intake to these compressors is protected by the latest improved type of air filter.

Three-phase electric current will be purchased at 13,200 volts, 60 cycles, and will be transformed down to 440 volts at the outdoor transformer station adjacent to the power house. Direct current will be furnished by two 200-kw., 250-volt motor generator sets located in the compressor room. Here is also located a 13-panel switchboard of the most modern type, controlling all electric circuits.

Throughout the power plant, means are provided for measuring, weighing and testing, so that proper records and high efficiency may be maintained.

Store House and Office

The store house and office is a reinforced, concrete structure, two stories in height with basement, 80 ft. wide by 160 ft. long. It will only serve the facilities described, and, will not at present, be used as a system distributing store. The general office of the shop superintendent and storekeeper is located on the scond floor and the shop surgeon will have his office on the first floor. Electric elevator service is provided for.

The store house will be equipped with steel skeleton material racks and a shop delivery system will be put in effect by which the store department will deliver material direct to the point where it is to be used. Motor trucks and trailers will be used in this service.

Between the store house and machine and erecting shop is the casting platform and loading track served by a 10-ton electric traveling crane equipped with a magnet. To the south of the store house is an elevated concrete receiving platform, 100 ft. by 104 ft. Material will be delivered to the basement direct from cars through outside chutes.

Other Facilities

A 25-ft. by 40-ft. oil house is built of re-inforced concrete, providing a fireproof storage and distribution center for all oil for shop use. A 12-ft. platform is provided on three sides with ramps for inter-communication by tractor with the store house and with the shop. A complete Bowser system of oil storage is also installed.

A yard crane runway, 100 ft. wide by 577 ft. long, is traversed by a 50-ton electric traveling crane with two 25-ton trolleys. It serves the machine and erecting shop, the boiler shop, and the blacksmith shop, located on each side of it, and the lye vat at the west end. The lye vat has two compartments 12 ft. wide and 25 ft. long, one compartment 4 ft. deep, and the other 8 ft. deep, with a drip platform 25 ft. by 25 ft.

The water supply is furnished by two deep wells with two cisterns for supplying drinking water and service water. Additional storage and pressure will be obtained from a 500,000 gallon standpipe.

These improvements will cost approximately $2,500,000, and will give employment to about 750 men. The entire project, both architectural and mechanical, has been designed and supervised by the railroad company.

Shop Management Problems Are Discussed

Supervision Frequently Entirely Inadequate—Importance of Human Factor Emphasized

Although scheduled near the end of a heavy convention program—and in intense heat—the discussion on "Shop Management Problems of Today" proved to be exceptionally constructive and interesting.

By H. T. Bentley

Gen. Supt. of Motive Power, Chicago & Northwestern

Generally speaking, the subject can be discussed under the following headings: Men, management, materials, manufacturing, machinery, money and miscellaneous. Some of the problems in each group are comparatively easy to solve, whereas others are so interwoven with financial and similar matters that they require a careful analysis from various angles before definite action can be taken.

Men and Management

Labor turnover is one of our greatest problems today, serious disorganization results from men coming and going, particularly in industrial centers where the demand for labor is great, and whatever price is paid by manufacturers to secure needed help is added to the cost of their product, and in that way transmitted to the purchaser. With a railroad, having rates that cannot quickly be raised to furnish greater income, the employees look at outside rates paid on jobs, many of which are of a somewhat temporary character, and wonder why the railroad cannot pay the same rates. As a result there is a feeling of resentment, especially among the younger element who have little seniority to consider and who will lose nothing by making a change.

Stability of employment is something we should aim at, but due to fluctuations in business it is necessary to keep close watch of the income and expenditures to see that there is enough money to pay all expenses as they come due, which frequently results in a reduction in the payrolls with the disorganization due to men being laid off. This is a problem that unfortunately has frequently affected us all very seriously. When an organization has been built up after weeks or months of hard work getting it into shape, it is a serious blow to have it disrupted, and the loss cannot very well be put in dollars and cents. Where the railroad income or that of an individual does not net enough to put some away for a time of depression, the expenses must be reduced to meet the requirements.

The apprentice question is a problem that is very difficult of solution. At one time apprenticeships in railroad shops were sought by young men, and it was nothing unusual for the sons of a mechanic and their sons to take service with the same railroad as apprentices. Under present conditions the question of getting apprentices (who will be a credit to themselves and their families), especially for the boilermaking and blacksmith trades, is quite a serious one. In large cities no inducements appear to be sufficient to get young men to take a position that is honorable though dirty, but from the ranks of which a large number of men have graduated to some of the highest positions in the railroad world.

An efficient and wide-awake shop management is absolutely necessary to get results, and some of its problems are so interwoven with other things mentioned in this paper that its efforts can easily be offset by reason of shortage of material, use of machinery and tools that have long ago outlived their usefulness, and with little or no money available for their replacement.

The question of keeping shops clean and clear of scrap material is one that must be answered in one way or another, and where this work can be handled by a force of men under a competent foreman after the shops are closed, there is no interference with the men during working hours.

Don't Make Your Foreman into Clerks

It is most important but frequently difficult to know where men are working; whether they are on hand at the proper time for starting work; who is absent, and why? With some of the usual timekeeping methods, the foreman is greatly handicapped in trying to keep track of his men, and I take the position that a foreman's place is out among his men and not doing timekeeping or clerical work in his office. As a result of findings by a committee belonging to all departments interested, a method of keeping time has been developed so that a foreman can quickly tell whether his men are on hand or absent, and the distribution of time made to the different accounts or engines worked on without the necessity of men or foremen doing any clerical work. This is a problem that has been solved with more general satisfaction than is usual in such cases.

The proper selection and training of men for positions of responsibility is still one of the real problems, particularly so for the reason that many mechanics do not appear to be anxious to accept promotion and added responsibility.

Handling Materials

One of the largest problems to deal with is the prompt furnishing and handling of material. The output of a shop can be boosted or seriously set back by the stores department. I am afraid that some of us do not give enough consideration to the proper handling of this important subject, and rather expect the stores department to be mind-readers as to changes in standards that the mechanical department may make. This in some cases necessitates the carrying of a new kind of material in large or small quantities or else there is a sudden heavy use of a stock material which formerly moved slowly, or the discontinuance of parts either due to a change in design or the disposing of equipment that formerly used such material.

One of the big problems of today is to get the material needed from the storehouse into the hands of the men who are actually going to use it, and at the least expense. In some cases the storehouse main building is so far from the place where material is to be used that considerable delay occurs, this being particularly true of standard material that is used daily, and in such a case small storerooms should be located at convenient places in or adjacent to the various shops so as to require little effort and time to get such material.

The handling of heavy material to and from the storehouse to the shops and to cars for shipment out on the road is a great problem. Whereas shop motor cars and overhead cranes facilitate movements, a locomotive crane for handling such material that cannot be conveniently reached by other means is a great asset around a busy shop yard.

Materials and Manufacturing

Too much usable material finds its way into the scrap pile and this necessitates a second handling. All material that can be reclaimed should be kept separated from scrap, and again, scrap material should be subdivided so that when it gets to the scrap dock for shipment and sale it does not have to be sorted again.

A few years ago with conditions and rates of pay then in effect, it was the practice among the larger railroads to manufacture practically everything needed for repairing and maintaining locomotives; among these parts being axles and all kinds of forgings, safety valves, injectors, and a hundred other things which according to the bookkeeping records used, indicated that a very large saving was effected as compared with prices submitted by the manufacturers of such articles. Under present-day conditions and rates of pay, it is questionable whether it is actually costing less to make articles in the comparatively small quantities used than to buy them from specialists who are obliged to cut costs in every direction so as to compete with firms who are handling the same lines. As one of our foremen aptly remarked when discussing this subject, "We do not know of any automobile user making the essential repair parts of a standard automobile, nor do we hear of a safety razor owner making the blades, although both of them might be in the machinery business."

To enable manufacturing to be carried on in an economical manner either by outside firms or in railroad shops, a great degree of standardization is necessary in nuts, taps, dies and attachments to various devices furnished by outside firms so that it will pay manufacturers to specialize in certain parts and carry them in stock or distribute them to dealers in a manner similar to that adopted in the handling of automobile accessories.

Regularity of purchases will enable a manufacturer to keep a stock of standard parts and enable him to balance his work so that he will not have to make a set-up of a machine to handle a few pieces as is often done in railroad shops, and which of course adds to the cost per piece of the article being made.

Depreciation

The question of purchasing new machinery and tools is a pressing one, and because of financial conditions during the past few years has not had the attention that its importance warrants.

With the tremendous strides that have been made during the last two decades in high speed steel manufacture, with the resultant necessity of making the machines of sufficient strength to stand up under the speeds and feeds that the modern steels permit, it can be readily seen that machines designed and put into use 25 to 30 years ago cannot give the output that modern machines properly designed for present-day conditions will give. The result, in a number of cases, is that the work is not done as efficiently as it would be if up-to-date machines and methods were used.

With an investment of, say, $1,000,000 worth of machinery that is depreciating and new machinery that is being improved to cut down costs, there certainly should be a fixed amount, say 5 to 8 per cent of the total investment, set aside each year for the replacement of those tools that are obsolete because of age, etc., but new machines costing thousands of dollars should not be bought unless it is known that there is sufficient work to be done at such a reduction in cost that, considering the first cost of the machine, depreciation, etc., it will pay a reasonable return on the investment.

We should not get rid of all tools or machines simply because they are not 100 per cent efficient under maximum requirements, but where new tools are purchased, the old shop tools should be assigned to suit the intermittent work in a roundhouse, if this can be satisfactorily arranged. If not they should be scrapped.

Money

In our efforts to solve the problems that confront us, we are sometimes able to see a way out of a certain difficulty if we can get an appropriation that may be used for new tools, machinery, cranes or other facilities for handling heavy material, and it is certainly very discouraging to be told that the money cannot be furnished, as the increased charges for material, labor, taxes, etc., have practically wiped out the amount needed by the mechanical department, and therefore the improvements so much needed cannot be provided.

Where it is possible to do so, I believe a fund should be set apart so that when small tools or machines are required to take care of some special condition that arises and for which no provision has been made in the budget, the superintendent of shops or master mechanic in charge should be able to get what is necessary, subject of course to the personal approval of the head of the department and properly accounted for at a cost of not to exceed say $3,000. Nothing causes quite so much discouragement to an organization as to be in need of some small tool ranging in price from $150 to perhaps $1,000, and have to wait for a year to get it on the budget and perhaps longer than that before it is actually approved.

Miscellaneous

Where the size of a plant will permit, a shop doing the repair work should be independent of a roundhouse at the same point. In other words, where possible the roundhouse should, as a general proposition, have a machine shop so that ordinary machine work can be done without having to call on the back shop. It is very discouraging to the foreman trying to get material out for engines in the shop to have his work disorganized by having a hurry-up call from the roundhouse, which necessitates the removal of work from a machine so as to take care of the job needed for the roundhouse.

Much valuable time is lost in some shops due to lack of facilities for intercommunication, and as the expense of installing automatic telephones between departments is not great this difficulty can be more readily taken care of than some other things involving large expenditures.

I have given you an outline of a few of the railroad problems, all of which we are trying, each in his own particular way, to correct or improve, and as the conditions vary in different parts of the country no hard and fast rules that can be laid down will be applicable to the various problems and others that confront us.

By D. J. Mullen

Superintendent of Motive Power, C. C. C. & St. L.

The shop management problems of today are too involved and too many to enumerate or describe fully, yet the successful solution of each is measured only by what it contributes to increased output or decreased costs, or a combination of both.

With this idea in mind this paper is not addressed to any of the specific problems of shop management which might involve a mechanical description or a statistical enumeration of performance or cost, but is directed to that broader question of shop management, which today is not developed in the railroad as in the industrial field.

The management of the industrial plant may anticipate for a long period in advance the nature and quantity of work that will be performed on any given unit. The locomotive repair shop differs materially on this point. It does not receive its raw material as does the industrial plant, for its raw material is a locomotive coming in for repairs, which in a greater or less degree furnishes its own material. Even this cannot be anticipated until the locomotive has actually arrived in the shop and entered upon its period of repairs. The condition is still further complicated because of the uncertain repairs to be given the various engines —in terms of labor and material.

Cost Accounting

Regardless of the effort that has been put forth in the development of new means and methods of performing work, or in the layout and arrangement of repair shops, it is a fundamental fact that no problem of management can be considered as successfully solved until it can be definitely established, by an accurate and comprehensive cost and product system that will stand analysis from every angle, that either the cost has been reduced because of a direct reduction in itself, or that it has been reduced because output has been increased.

In considering what is at hand in the way of shop cost accounting systems, one is impressed by the prevailing tendency of such systems to follow along and be productive of those reports required by federal regulations and corporate accounting rather than those that would be developed for purely mechanical analytical purposes by men fundamentally trained in mechanical administrations and not in that of accounting. How many railroad shops are there in the country where the management calling for the cost of manufacturing driving boxes for a certain type of engine can find these figures immediately available?

Such reports are not intended for analysis as to shop product or cost. They represent more what has been done than what is being done because of the consolidation of a large number of elements of cost into the general accounts. The segregation of the details making up these measured costs is not handled from the viewpoint of reflecting information as a barometer of cost and product. What is needed to remedy this condition is the introduction into the mechanical departments of what might be termed "engineering accounting," the purpose of which would be formulating and carrying on cost keeping representing the combination of auditing and engineering experience dictated primarily by those essentials necessary to the proper analysis of the current performance of the shop. This would mean not only keeping costs but using the data for analysis and engineering development for reducing costs.

Wages and Working Conditions

Intimately connected with the cost product system is the matter of wages and working conditions, and regardless of all the cost accounting methods that may be inaugurated or anticipated, the cost of performing any one unit of work can never be controlled until it can be pre-determined what the wages will be for performing that particular operation. It is in this one point alone that the successful solution of many problems of railroad shop management are now held in indefinite suspense because the railroads are not supported by those agencies whose support is desirable in installing the methods of compensation and working conditions in which the cost performance of any one operation may be definitely established.

It has too long been the practice to view the operation of a locomotive shop as an expense. Were it viewed from the viewpoint of operation for profit as are all other industrial plants, the problem of railroad shop management of today would be backed up by a cost and product system, the equal of which could not be found in private industry. The problem of formulating such a system is far more complicated in railroad shop operation than it is in an industrial plant. The industrial plant is making a new product of a uniform nature, whether it is hairpins or automobiles; the point being that the first unit that goes out in the morning is no different from the last unit going out at night.

There are a large number of units of work performed in railroad shops which are identical, and with proper shop management would cost no more in one case than in another, providing the element of labor cost is so handled and developed that at least this large proportion of the total cost is a pre-determined fact before the work is commenced.

Constructive Analysis of Shop Operation

The constructive analysis of any cost accounting system would be along five general lines:

Retirement, replacement, or changes in machinery.
Development and installing new methods of performing work.
Personnel organization.
Methods of payment.
Rules and working conditions.

In the final analysis of any problem coming under the five groups enumerated above it will eventually be a balance between the cost as it is, compared to the cost as it will be when the anticipated change is made.

Assuming the ideal condition is reached and the cost system developed, it would be necessary to consider to what unit of product this system would be compared; that is, will the accurate cost system be combined with the unit of output measuring a physical quantity of work, or expressed in a numerical unit of mechanical equipment, or as is commonly in vogue in this country, upon the product of the engine in the number of miles it has made before the engine is repaired.

It would seem that since shop operation is not responsible for miles that an engine makes, that it is not a problem of shop management. While it is true that the quality of work performed in a shop upon an engine to a great extent establishes the length of time the engine will remain in service, it must be recognized that the shop in repairing and sending an engine out to perform service, does not control the territory in which it operates, nor the facilities nor methods by which it is maintained while in service, and these are elements that should be taken into consideration in measuring shop output on a mileage basis.

Again the capacity or efficiency of a shop cannot be measured in its output by number of engines turned out. It may require in one month twice the work to turn out 25 engines that it does to turn out 50 in another month. A shop may be engaged in repairing engines requiring exceedingly heavy work, at which time its product in engines will be low, yet its efficiency may be just as great, if not greater, than when repairing a large number of engines with light miscellaneous repairs.

Establishing a Production Unit

There is a method by which miscellaneous output in the number of engines receiving various classes of repairs can all be equated to a common unit. Such a unit should fill the following conditions:

1. It should express in terms of the lightest repairs the amount of work required on a locomotive receiving the heaviest repairs.
2. The units so determined should be arrived at and expressed in terms of man-hours of labor.
3. The man-hours allowed should be established under conditions where the compensation or time for performing a given item of work is pre-determined.

In developing such a system it is essential that engines be repaired, subject to a classification of repairs of such specification that in alloting an engine to a certain class of repair a comprehensive description of the work is definitely determined by the class of repair assigned. The next step is that of determining the number of man-hours required to perform the lowest class repairs. With this average man-hours required to complete the lowest class repair as a factor, the average man-hour required to complete the next highest class repairs is determined. The computation is made and the result of this determines the number of units that are to be assigned to the next highest class repairs.

For example: If a Class 5 repair requires 200 man-hours, it would be considered as one unit. If a Class 4 repair required 600 man-hours, it would be considered as three units, and so on up to the heaviest class repairs.

With such a system of analysis the number of man-hours per unit is directly indicative of the efficiency of the shop, in that as the man-hours per unit go up, the shop is less efficient than when man-hours go down.

In consideration of the quantity per unit depending upon how comprehensive the class of repairs may be, there will be a uniformity in the cost of repairs per unit, comparable with the fluctuation of the man-hours per unit. There will be reflected in increased and decreased cost per unit those economical conditions which require an increase or decrease in the wage scale. As shop facilities are changed for the better, it will again be reflected in the reduction in man-hours per unit. The application of such a system over a period of years may be traced in an increase or decrease in the man-hours per unit, the gain and loss in efficiency, due to the various conditions under which the shop is operated. There can be traced the average amount of work required to repair an engine as expressed in units per engine, and lastly, it is evidently an expression of the capacity of the shop as reflected by the number of units turned out per month.

It is through the presentation of such facts as would be derived from the accurate system of cost accounting and the application of a system of measuring output, that the management of the railroads could be induced to adopt those comprehensive policies of betterment and improvement in repair facilities which are so essential in keeping pace with the increased demand for repair shop output and reduction in cost of operation.

By T. W. Demarest

(Gen. S. M. P., Pennsylvania (Northwestern Region.)

It is with a very considerable amount of hesitation that I am endeavoring to carry on this discussion, particularly after the very able paper you have just listened to from Mr. Bentley. My hesitation is based also on the fact that the problems in shop management today are as large as the plant; they comprise your plant, your management, your supervision, your personnel and every item of your operation.

The entire situation can be divided possibly into two heads. One is the human factor and the other is the physical factor Under the human factor I would place management, supervision, labor force and its maintenance, and the establishment of harmonious relations between the employees and the management. Under the physical factor I would place the plant, the machine tools, material, routing of work, and items of that kind.

The physical factor to me is the easiest part of the situation to meet because it can be met, as a rule, through the expenditure of capital, and as brought out by Mr. Markham, who addressed us the other day, our managing officers are realizing more clearly, that in order to get the benefit from the equipment and reinforce a failing labor supply the physical portion of the plant has got to be brought up to date.

Importance of Human Factor

The human side of your plant, however, is another situation entirely. In looking through one of the railway publications of recent date I notice the plans of a new shop which has just been built, and naturally I assume that in the construction of the plant —as it is a new plant—all of the labor-saving devices, all of the methods for shortening steps and saving dead labor, all of the machine tools and everything necessary to establish economical operation, had been incorporated. Reading through the article I noticed that the expected output from that shop was limited to one engine a pit a month. Now that struck me very forcibly, because with old plants with which I have been connected if I can't get two engines a pit a month, or sometimes two and one-half, I think there is something wrong in the shop operation.

I was curious as to why with a brand new plant only one engine a pit a month was expected; I could not reach any other conclusion but that the human factor was responsible To me the human factor is the important item, and I am going to try to give you a few thoughts concerning it from my own experience.

There are three radically different methods of handling labor. My first experience was with an absolutely open shop where the management could be just as arbitrary as it chose in the handling of its employees.

My next experience, which was not so long ago, by the way, was in the direct reverse, where it was the most arbitrary kind of a closed shop and where the men could tell the management what the management should do.

Under our present situation we are trying to develop a different method from either, and that method is neither an open nor a closed shop, but it is a plan under which the employees in the shops have with the management an equal voice in all matters pertaining to their welfare—I will touch on that later.

The Question of Supervision

The first essential in your human factor problem is your supervision. In the plan which I have just referred to, I found that we had sold the plan to the men but I was not at all sure we had sold it to the supervision, and in many cases we hadn't. In analyzing the situation I knew it was very evident we hadn't sold it to the supervision and we hadn't tried to; we hadn't taken the supervision into our confidence and we had not interpreted the policy of the management and did not put the men in the management where they could carry back to the men what the management was trying to do.

The most essential man in your shop today is your supervisor and according to the extent to which you have educated and trained your supervisor, so you may expect the men in the shop to react. Your contact man, who is your supervisor, represents to your workmen the attitude of the management. And you can't expect to have good relationship unless you have a good contact. That is your responsibility.

Another thing, your supervisor should be placed in a position where he feels he is an officer of the company and not a workman. He wants to be placed in a position where he is proud of his position and not simply perhaps feel that he is taking a job and increased responsibility with no adequate return.

Fifteen Men to a Foreman

He does not want to be overloaded with men, and one of the hardest things that we have to convince our management, as a rule, is the necessity for increased supervision. It is the cheapest investment I know of.

Not very long ago a president of a railroad who operates a very large car shop said to our vice-president that in the maintenance of their freight cars they had established an economy which could not be met in a contract shop and they were very proud of the performance. Our vice-president got me. He wanted to know what we were doing, and he said: "Investigate the situation and let me know what you find." We sent some men to study the plant. The first thing we found was that they were working on a piece-work or bonus system. The next thing we found was that the average number of workmen to a supervisor was 50. The next thing we found was that the supervisor was expected to keep the time, allocate the piece-work earnings, and allocate the use of the material, so they could keep an individual car record—and, gentlemen, he could not do it. The result was that insofar as they are concerned I told our vice-president that there was not a record at that particular plant that was worth the paper it was written on, and it was not the fault of the supervisors.

Our experience is that when men have to be educated—and they do—the education is a continual process; that where the work has to be kept up to the workmen, if you want results you have got to limit the number of men under a supervisor, and in my own experience that is about 15. That may sound rather low, but under your present labor situation, and you have all got it just as well as we have, under a situation when there is a decrease in rate of labor supply, a decreasing efficiency of labor, there is just one thing we have got to do: We have got to decrease the number of men reporting to a supervisor so that he can adequately follow their work, follow up the material, and their operations.

Keep in Touch With Foremen

After you have your supervisor educated the job is not done; you have got to have somebody whose business it is to keep in touch with your supervisory force; keep in touch with their mental attitude and their mental processes. I do not know of any better way of doing this than perhaps the establishment of foremen's clubs,—where the foremen can meet one another, become mutually acquainted, exchange ideas, and meet their superior officers, and get from their superior officers direct the policy of the management. It has an enormous effect.

At one of our shops employing possibly 2,200 men, after the organization of the foremen's club, even although there were only about 65 men in the club, we found there were men in it who had worked in the same shop for years who did not know one another. I brought these men together. They had an opportunity of meeting socially with their families, an opportunity of exchanging ideas, and the co-ordination of the work between the departments was most materially improved just through the mutual acquaintanceship of the men.

Getting Down to Brass Tacks

To get down to the brass tacks of the situation—and that is the man on the floor of the shop, or the men operating the machines—it is certain that you can't expect good shop results if your men are limited or guided by men outside of your employ.

You can only expect results where your men, as employees without reference to outside influences, are willing to meet you and discuss their problems and yours across the table and do their bit in assisting the management to produce economical operation, just as they expect the management to do its bit in producing a fair return to the men.

I don't believe in the best day-work shop you ever saw you can expect the same economy in production, or the same output rate per unit, as you can in a shop where the more skillful men have the opportunity for making for themselves a higher rate of wages than the straight day-work provides. The necessity for conserving the labor supply, the necessity for building it up, absolutely compels some method of operation which will permit a man who desires to turn out a day's work.

The question of your labor supply is a vital one and its reinforcement and maintenance have got to be met in different ways. None of us can go out today and build up a plant "off the bat" by hiring skilled labor. The best way, of course, as far as it is practicable, is to relieve hand labor by machine labor, labor-saving appliances, relocation of machine tools, relocation of facilities to reduce the foot work to a minimum and produce economical results. You have got to resort to Mr. Purcell's method with which he has been very successful and the building up of your force through training of apprentices, but in my opinion that is not enough to maintain your departments.

There are at least three departments that no boy wants to enter as an apprentice. Those are the blacksmith shop, the boiler shop and the freight car shop. In these three departments it is not desirable to have a boy enter as an apprentice because the work is of a character which requires a mature man. Therefore you have got to have some other way of building up those three shops; the helper-apprentice system doesn't help you; a freight car shop on a four-year apprentice system is nonsense. Our men agree with us on that. It is pretty hard to tell a man freight car repairing is not a trade and if you can't make a freight car repairman in three to six months, you don't want the man around your plant; but your regulation don't permit you to do it.

Stabilizing Employment

Now back of this is something else that is vital and that is out of your control except as you may be able to inform your executive managing offices—that is a budget which will permit you to operate your plant on a uniform basis. There isn't anything that so hampers production as the necessity for relieving men that you have spent money in training, who go out of the shop because the management tells you the road isn't making money and you will have to reduce expenses. There is another phase of the problem. When business is good the equipment is behind and when it is poor you can't repair it. If you can convince your management as to the economy and advisability of operating your shop on an even number of hours throughout the year without respect to the business, you will do a great deal in accomplishing all these results we are talking about; if you can't do it you will not get the results you are after.

Other Discussion

Mr. Davis (Wabash): We were asked about six months ago to find the cost of overhauling a certain number of locomotives.

If we had been assigned a force of 50 men to do this work and the time of year had been favorable, it would have been an easy matter. In the average shop, however, there is so little in the way of excess capacity to go on that it is impossible to do extra work without an additional force. We analyzed the situation and found that there were a great many discrepancies between the output of different railroad shops. We found a common difference of output of 2½ times per man-hour unit between shops where piecework was used as compared to day-work.

Nine Vital Factors

We analyzed the different factors involved in output, and I will touch on them lightly: Timekeeping, cost-keeping, specialization, routing work through shop, incentives, standardization, improved shop processes and practices, industrial relations.

Nearly all these have been covered in what has been said here with the exception of timekeeping and a little bit on cost-keeping. Timekeeping should set out how much the man should be paid for the time which he puts in. In efficient shop management and the employment of labor the primary essential is a time keeping system. There are a good many ways of doing this, from accepting a man's own word, to an elaborate time-keeping system where a man is checked by some clock process for every operation which he performs. The first is terrifically expensive, and the second just as expensive. There is a happy medium between these two methods by which through some mechanical process—whether it be a time clock or not—a check can be had on the man every noon, every afternoon, and every night at least, and in addition you can have the opportunity of seeing him.

The measurement of a man's time can easily be done by putting in some mechanical process—either a clock or some other mechanical process.

The next factor is to see that the company is repaid in work for the money which has been expended. This function of timekeeping gathers together a group of men who are commonly called non-essential in a shop, or non-productive labor, and gives us the facts, the very thing we must have to go on further with cost-keeping. That is usually neglected.

Now, under that system, in checking men to find out what they did do, it is necessary to have some sort of a form. On that form you should first of all divide the shops into classes, and finally divide it down to a point where the next element of timekeeping—or cost-keeping—can be injected.

In order to have a good cost-keeping system, the first thing is to report the basic facts; the second is to analyze those basic facts, classify them, and have them prepared to use in your future work.

Now, the simple inexpensive way of doing this thing is the best, just as it is when you get into the simple and effective way of timekeeping. Cost-keeping runs hand in hand. In a cost-keeping system you find out what each item costs you and you are able to judge whether or not you can improve on the process.

The railroad wants to know what each thing costs so it can buy properly. Second, so it can tie it in with the R. E. accounts; and third so it can improve its shop processes.

I have mentioned incentive. A man does in proportion to what his incentive is, and without that incentive the maximum effort is not going to be made. The very best incentive that I know of is more wages. Now, whether it is a piece-work plan or a bonus plan does not make any difference, but whenever you have arrived at that incentive, whatever it is going to be, make it adequate, make it certain; let it be so that the man can see it directly in front of him, and let its method be simple and not an elaborate system in which the man will have to guess at what he is going to get.

When we know just when, just how and just where everything was done and what it cost us, then we will have an answer for that political—well, what shall I call him?—that uses the railroad for a football.

The Gainesville & Northwestern Railroad of Georgia, the track of which, according to inspections made by the State Public Service Commission, is in bad condition, was ordered by the commission on June 14 to discontinue passenger train service for 30 days, and within that time to make needed repairs to track and roadbed.

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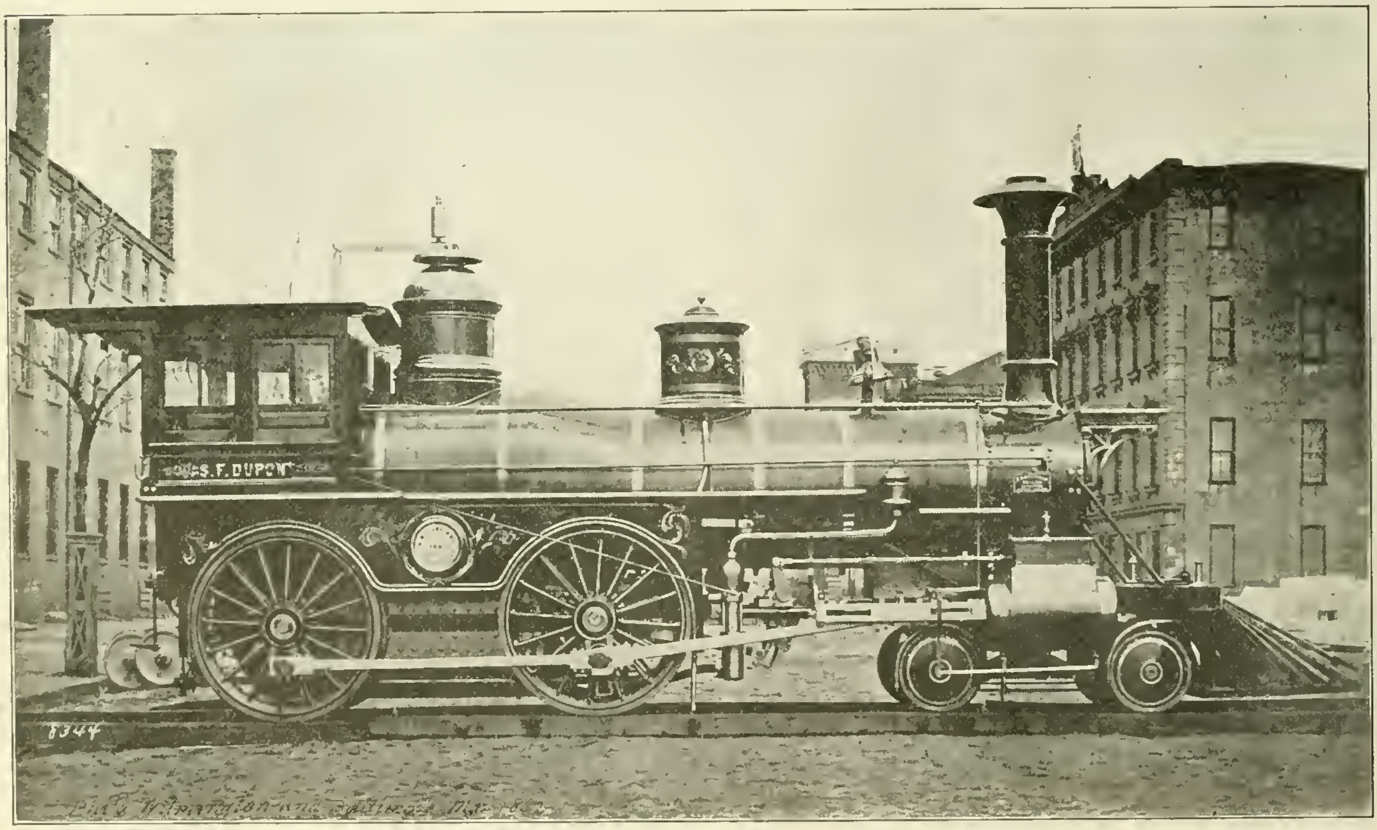

The Latest Word in Freight and Passenger Power on the Philadelphia, Wilmington & Baltimore (Pennsylvania) in 1862

Railroads Are Giving a Remarkable Service

Additional Big Demand to Come This Summer—Co-operation Needed from Every Employee

By R. H. Aishton

President, American Railway Association

IT IS A VERY GREAT PLEASURE to meet you all here today, the Fourth Annual Meeting of the Mechanical Division; and, believe me, for a four-year old you are a mighty lusty lot. However, when we consider that while you are only four years old as a division of the American Railway Association, this meeting represents the fifty-sixth annual meeting of the Master Car Builders' Association and the fifty-fifth of the Master Mechanics', then after all if age gives wisdom you are to be congratulated. You have mighty good reason to be proud of what your two constituent associations, now merged, have accomplished in the more than half-century of their existence in bringing about

Standardization
Interchange Rules
Loading Rules
Development of Better Methods
Dissemination of Information as to Better Practices

And through it all there has not only been the greatest co-ordination as between the railroads, but it is also peculiar to the railroad business, as in no other business, that there has been the most complete co-ordination and co-operation with equipment builders and governmental authorities, some of the results of which are going to be shown to you at this meeting—from a locomotive standpoint by Mr. Vauclain, and from the equipment standpoint by Mr. Carry.

R. H. Aishton

While the record is one of which you railway officers and equipment builders may justly be proud, and the development has been one in which you have had a very large part, there is still a direct obligation before you all in furthering development both of machines and of methods whereby the railroads may be enabled to function more economically and efficiently. There is as much room for the exercise of initiative today as there was in the days of the "Stourbridge Lion" and you gentlemen of the railroads and of the manufacturers are the people to whom the American people are looking and to whom the government is looking to develop and bring about improved methods.

The importance of this meeting at this time is great. There never has been a period when the people were so interested in what the railroads are doing to better conditions than now; neither was there ever a time when the people as a whole understood the problems of the railways more thoroughly. Every officer of a railroad here I hope will feel that he has a personal interest in this subject and if he has any ideas—whether they correspond with what the committees in their wisdom have developed or not—he will not hesitate to get on this floor and express them, because when a committee has thrashed over one of these subjects and when you have agreed that that is the proper thing to do, it ought to be about the last word as to whether it is a correct thing to do or not; and another thing, when you have once made up your mind and voted that it is the thing to do don't go home and forget all about it; tell your people why you think as you do and why it is a good thing; in other words, sell yourself and your proposition and do not hide it under a bushel, or trust to Hawthorne or me to sell it for you.

There has been criticism about meetings taking up men's time and that after all the findings are not mandatory and they don't become standard to as great a degree as they ought to. Why not? You have got the answer right in your hands—it is up to you.

A Remarkable Achievement

Now a word about the general situation in which you are all individually very much interested. Standing on the side lines as I have in the past year there is full opportunity to observe matters. I want to make the statement, without any hesitation, that the railways of the United States during the last year have individually and collectively made the finest record of efficient operation that has ever been made in their history or the history of any railway systems in the world. Railway management, ever since private operation was resumed three years ago, has been subjected to constant and bitter criticism and attack from various sources and upon various grounds. The best answer to these criticisms that can possibly be made is the record of achievement which the railways have put to their credit within the last 12 months.

Just one year ago at this time the country was in the midst of a strike of miners in the coal fields, which had entirely stopped the production of anthracite coal and had practically stopped the production of bituminous coal, except in a comparatively small territory. It was threatened, on account of this strike, with a serious coal shortage. As if that was not to disarrange the business of the country, almost exactly a year ago the employees in the shops of the railroads throughout the country went on a strike against a reduction in their wages ordered by the United States Railroad Labor Board. At that time there already had begun a revival of the general business activity and one of the largest sudden increases in railway traffic in the country's history.

As a result of these two conditions, and when the coal strike terminated about September 1 last year, the demand for the movement and transportation of coal suddenly became abnormally large and at the same time the demands for transportation of other commodities assumed abnormal proportions, creating probably the most difficult transportation problem in the history of any system of railways in the world. In a few weeks a large freight car surplus suddenly became a car shortage, which in October reached the record-breaking figure of 179,000 cars. At that time, owing to the shop employees' strike and other conditions, the railway had about 16,000 or approximately 25 per cent of their locomotives in bad order, and almost 300,000, or about 13 per cent, of their freight cars in bad order.

The first problem the railways had to contend with was to prevent a serious coal shortage and consequent intense suffering during the winter months. Although coal mining had been largely suspended for almost six months, and although, owing to the increase in general business activity there was a large increase in the demand for coal, they handled the output of the mines so there were only temporary and sporadic shortages of coal. During the first 130 working days of the present year they moved over 231,000,000 tons of bituminous coal, which was the largest amount ever transported in the same part of any year, except the war year of 1918, and until the demand for coal began to slacken as spring advanced they were moving more coal than even in 1918.

In addition to the movement of this coal during the last nine months, the railroads have handled a larger total freight business than in the corresponding months of any previous period in history. From January 1 to June 2 they loaded and moved 2,147,000 more carloads of freight, or over 12 per cent, than in the same period of any previous year. The largest freight movement usually comes in October, but in the week ended May 26 the total cars loaded exceeded 1,014,000 cars, which has been exceeded in only two weeks in the fall of previous years.

I have just received by wire figures for the revenue loading for the week ended June 9, which show a loading of 1,013,249 cars of revenue freight, which is an increase of 176,621 cars over the corresponding week of 1922.

Although handling the largest business in history, they have steadily reduced the "car shortage" until in the week ended May 31 there was actually a small surplus.

Getting Ready for Future Demands

So much for what has been done. What is the job that lays ahead of you? As you know, there is always in periods of active business a very large demand in the summer months for box car to move the crops of the western states. In spite of the record-breaking traffic thus far this year, rapid and satisfactory progress has been made in moving empty box cars from the eastern to the western roads for the movement of crops. This movement of box cars westward was begun early in the spring and is still in progress and it is confidently believed that sufficient cars will be available in the western agricultural sections to meet all the demands that will be made this summer and fall. There are actually today on hand sufficient grain cars stored to handle the crops.

From April 16 to June 8 more than 46,000 empty box cars were delivered in Chicago and St. Louis to western roads by eastern and southern lines. This movement to the west was made at the same time that a very heavy movement was being made from the states to Canada of box cars of states ownership and the return of Canadian-owned cars in anticipation of the Canadian grain movement. The number of cars sent westward through Chicago and St. Louis to be ready for the grain movement has been close to 1,000 daily. Ample cars have been provided for moving the peach crop from Georgia and cantaloupes from California.

What other provisions have been made in anticipation of further increases in traffic? In order to handle the increased freight traffic anticipated this year, the railroads from January 1 to June 1 put in service 65,660 new freight cars and during the same months put in service 1,697 new locomotives. In addition, on June 1 the railroads had on order 107,079 new freight cars and 2,041 new locomotives. Both the equipment manufacturers and the railroads are making every effort within their power to secure the earliest possible delivery.

At a meeting in New York early in April the railroad executives adopted a comprehensive program for providing the country with adequate transportation service. You are familiar through your individual managements with its requirements. It provides for reducing the number of cars awaiting repairs to 5 per cent by October 1 and for reducing the locomotives awaiting repairs to 15 per cent by that date. It also provides for the better loading of cars, for better movement of cars, for storing coal, and for all the various things which you are fully acquainted with which will enable the meeting of the peak load of the country's transportation.

Substantial progress has been made on the fulfillment of this program. The number of freight cars awaiting repairs had been reduced on May 15, as against August 1 last year, by 135,000, and while possibly 50,000 of these may be attributable to retirements, nevertheless it does show material progress. Locomotives in bad order between September 1, 1922 and May 15, 1923, have been reduced by 4,400.

The record of efficiency already made in the face of the great difficulties of the past year is the best answer that can be offered to the criticisms that have been made of the railways and to the demands for radical legislation that are being made on the ground that such legislation is needed in the public interest. It is my firm belief that an even better record will be made during the rest of the year in serving the public and that as a consequence thereof the public will be firm in the belief that it is to its best interest to give the railway managements a chance to serve it efficiently rather than to hamper them by restrictive legislation.

One thing, however, I do want to impress upon you in relation to this program. You have about four months left in which to meet its requirements. You, no doubt, have your instructions from the individual managements of each individual railway as to your own individual treatment of the program. Whatever your instructions may be, see that those instructions are thoroughly understood by every employee and officer that has any part to take in the fulfillment thereof, because the complete fulfillment of this program and the service that the railways are consequently able to give the public can only be accomplished through a complete understanding of the officers and employees directly charged with carrying out the work, of its importance and its effect in meeting the demands for transportation to the full satisfaction of the American people, whose servants you are and on whose final judgment, which will be largely influenced by the measure of service afforded, the future of these great transportation organizations rests.

An Appreciation

Now, gentlemen, in conclusion I want to express on behalf of the board of directors the great appreciation of the executives, individually and collectively as an association, for the untiring efforts that have been put forth by the Mechanical Division to meet these various problems.

There never has been a time that we have had to appear before the Interstate Commerce Commission or before a congressional committee or before anybody else about some phase of this question—and the times have been mighty frequent in the last twelve months—that questions to your chairman, Mr. Coleman, have not brought an instant response—the formation of a committee. Those committees have gone to Washington at the expense of fatigue, and annoyance, and time, and thought and all that kind of thing, and those special committees, your regular committees, your general committee, your secretary, Mr. Hawthorne, and your chairman Mr. Coleman, have done a wonderful work on behalf of your association this year. I would feel remiss in my duty if I did not express to all of you gentlemen the appreciation of the executives for the good work you have done.

Training Mechanical Department Apprentices

Shop and School Instruction Essential—200 Santa Fe Graduates Filling Supervisory Positions

By John Purcell
Assistant to Vice-President, A. T. & S. F.

The growth in industry and the great and rapid increase in demand for its products has made a corresponding increase in demand for skilled workmen, the class of workmen which only a well-defined apprenticeship can supply. There are not enough skilled mechanics to supply the demand today, nor have there been for the past 20 years. This is why some of the railroads have found it necessary to devise a modern, progressive plan for educating and training apprentices in their shops. The older method of employing a boy and turning him over to a busy foreman, whose primary duties were immediate output, affording him little time to care for a green, bashful boy, was very unsatisfactory and failed to accomplish needed results. Being left to their own resources with no one definitely responsible for their training, only a few of the more ambitious and resourceful boys survived and became good men; the majority fell by the wayside. It is evident since we specialize with various elements of a shop—a separate tool room for making and caring for tools, and central power house to provide power and lights, an accounting and timekeeping department to determine costs—that we should have a specialized plan for taking care of our young help that will provide a trained head and hand for our skilled work.

John Purcell

Today a boy over 16 and under 22 comes to us to learn a trade. We examine him as to his mental alertness, education, character, etc., and endeavor to learn whether he has natural fitness or liking for the trade he wishes to learn. We also have a surgeon examine him to be sure he is free from physical ailment or organic trouble which would make him unable to perform the work of a mechanic. Company, state, and federal rules of inspection, safety appliance laws, rules of interchange, etc., make it necessary that a worker be able to read a blue print intelligently and to interpret these rules with reasonable understanding. Many of the states have compulsory school attendance laws and in these days a boy of 16 years should have a well-grounded training in mathematics.

Shop Training and School Training

An apprentice training system should be composed of two supplementary branches, shop training and school training. The road with which I am connected has for 16 years conducted such a training course for apprentices and while for the first two or three years it was considered as an experiment, it has become a fixed part of our mechanical organization.

We have three general classes of apprentices, known as regular apprentices, helper apprentices and special apprentices. Regular apprentices must be between the ages of 16 and 22, must be physically fit, have a common school education and be capable of working ordinary problems involving common and decimal fractions. Each is regularly indentured to serve four years, the necessary papers being formally signed by his parents or guardian, who obligate themselves to assist the employer in training the boy, by their parental encouragement and care. He is examined by the apprentice instructors as to his mental qualifications and alertness, and his employment completed by local master mechanic or superintendent of shops, with the approval of mechanical superintendent and supervisor of apprentices.

The apprentice is passing through a critical stage of life, from boyhood to young manhood, is easily influenced, habits quickly formed, and it is well that a strong but kindly hand guide his steps and direct his youthful energy and ambition in correct paths. Here is where the shop instructor proves his value. No time is lost by the boy in getting started. He is immediately put on productive work under the training and guidance of the apprentice shop instructor. If a machinist apprentice, he is immediately taken to a machine and the machine explained to him. He is shown how to fasten his work on the machine and what speed and feed to use, patiently and thoroughly instructed as to each machine, its parts, its functions, its care and how it should be operated. He is made familiar with the purpose for which the piece of work is being made and the use to which it is to be put. Similar instructions are given him as to floor and bench work and all other work of his trade. A regular schedule of shop work is provided showing the number of months or weeks he is to be assigned to each class of machines or each class of floor or bench work. Likewise, with apprentices of other trades, each is given instruction and experience on each class of work of his trade.

The apprentice is never considered as a convenience nor assigned to common labor or regularly used as a helper. We make him feel that his chosen trade is the best possible selection he could make. We hold the instructor responsible for the boy's thorough training just as we hold the foreman responsible for the output of the shop.

For every 25 apprentices there should be a regularly assigned shop instructor whose sole duties should be the training of the apprentice. The shop foreman has little time to devote to a young apprentice boy and is prone to leave him on one job or machine. A good shop instructor is a good investment in any shop. Due to his instruction, better work is done by the apprentice, there is very little defective work and an absence of tool breakage. There is a great advantage in being able to keep important machines going when the regular operator is absent, by placing an apprentice on the machine, who with the help of the instructor can successfully operate it. A good shop instructor will study each boy, weeding out the unfit, advancing the bright aggressive boy, and coaching the backward boy.

School Instruction

In connection with his shop training the apprentice should receive some theoretical instruction, so we have provided regular apprentice schools which the apprentices are required to attend four hours a week in two classes of two hours each, a total of 208 hours a year. Here the apprentices are taught mechanical and freehand drawing, shop mathematics, company and federal rules governing the care and maintenance of equipment, the company standards as to materials and practices, is given an opportunity for reading and studying desirable text books on mechanical subjects, and for a detailed study of injectors, lubricators, air brakes, steam heat, stokers, and other special appliances. Regular apprentices are paid their regular rate for time attending school. The company provides drawing boards, instruments, stationery, lesson sheets, models, charts, books, etc., free of charge, each apprentice being provided with a complete outfit for his use while attending this school.

Our apprentice school instructors are in general technically educated men who have also served apprenticeships in our shops. In addition to their duties as instructors they supervise the making of all shop sketches and drawings and look after special and technical work for the master mechanics. Each instructor is supplied with literature on new appliances, with which he must familiarize himself in advance of their application. We print our own lesson sheets in drawing and mathematics, which are bound in loose leaf form and kept constantly up to date. Upon completing this school course, the apprentice is not only able to read blue prints and working drawings readily and understandingly but can also make sketches and finished drawings. In fact, in addition to being a skilled mechanic he is also qualified for work as a mechanical draftsman.

The fate of an apprentice should not be left to any one man so we established what is known as the apprentice board, a body of men composed of the general foreman as chairman, the department or gang foremen under whom the apprentices work, and the apprentice school and shop instructors. These men meet once a month at stated times to pass on the progress of apprentices and discuss matters pertaining to their training. They go into each case carefully and thoroughly, strengthening the weak and encouraging the strong. In spite of all the care that is taken, there are times when we find a boy who is not making the progress he should. In such cases we endeavor to learn the reason; the boy is talked to and urged to greater effort. If it is found that he continues below the standard and does not take the right interest, he is tried on another trade and if he then does not develop he is dropped from the service. These apprentice boards serve a dual purpose, that of learning of the progress and ability of each apprentice and of making each member of the board study his men more closely and keep intimately familiar with the qualifications and progress of each individual under him.

Thorough experience is given all apprentices. Apprentices of the larger back shops are required to serve six months in roundhouse or at smaller outlying points and apprentices at smaller points are sent to larger shops where a more extended opportunity is afforded. Every effort is made to see that each apprentice is given full variety of experience in all the work of his trade so that upon graduation he may be a skilled, all-around mechanic who can execute and lay out any piece of work from any drawing furnished him.

Helper apprentices are selected from young men who have had two years' experience as helpers of the craft. They serve three years and are given the same shop instruction and variety of work given regular apprentices. They are not compelled to attend the apprentice school but are permitted to do so if they so desire. This apprenticeship provides opportunity for advancement of some of the most deserving helpers in our shops.

Special Apprentices

Special apprentices are graduates in mechanical engineering from colleges and universities. They are employed upon a personal interview by supervisor of apprentices and must pass the same medical examination as the regular apprentices. As they have a thorough technical education and generally have had some shop experience, this course is made shorter than that of the regular apprentice. They are formally indentured for three years. Their course in the shop is short and intensive: First year, general machine work; second year, floor and erecting work; third year, work of a varied nature, consisting of four months in the roundhouse, two months in the boiler shop, two months on freight car work, two months inspection and two months with the road foreman of engines. They are required to pursue a course of reading laid out by the management and to write a monthly letter bearing on the work they have been doing. The purpose of this special apprentice course is to supply the practical experience, without which the college man's technical education is of little value in railroad work. We now have some excellent material as special apprentices and are in the market for more of them.

A standard set of shop tools of the trade must be owned by each apprentice of that trade. The company provides an easy method of payment at wholesale prices and furnishes a tool box for their safekeeping. This insures uniformity and places each boy on the same footing.

Apprentices are encouraged to take part in athletics, clean sport and wholesome amusement aiding in the boy's development. Baseball, football, basketball, etc., are played in their regular season. The apprentices also have their musical societies, their social and debating clubs. We aim to make our boys not only first class skilled mechanics, but also good citizens, of moral character and right living.

Upon graduation or completion of apprenticeship, the apprentice is given a handsome diploma certifying that he has served an apprenticeship in the shops of this company, has completed the prescribed course in the apprentice school and has become a competent and skilled mechanic. This diploma is signed by the master mechanic or superintendent shops, the mechanical superintendent, the supervisor of apprentices and the chief mechanical officer of the system. Often the lettering on his diploma is made by the boy himself.

The Results

From 16 years' experience in this course of training, we have satisfied ourselves that this is the only method to pursue to keep our railroad supplied with first class mechanics. We have no industrial territory to draw on for men. Immediately upon inaugurating our present apprentice system we began to enjoy its benefits. It furnished skilled mechanics for our shops. Just prior to the war our largest shop had not employed a mechanic from the outside for two years. We were making mechanics as fast as we needed them. It gave us a flexible body of young men whom we could transfer to any point where men were needed due to any unusual rush of business. It furnished staff officers and inspectors and best of all, gave us an almost unlimited source to draw on for supervisory officers. Today with all the discouraging conditions of the past few years, we have over 200 of our graduate apprentices filling supervisory positions in our shops, from gang foremen to master mechanics, and a large number in important staff positions.

In establishing and properly conducting an apprentice system, there are several essentials for its successful operation:

(1) Some individual who shall have general supervision in the selection of apprentices and their shop and school training.
(2) Ample shop instructors whose sole duties are to train and direct the boys while in the shop.
(3) An efficient school room instruction where the theory of the trade will be taught the apprentices by capable and intelligent instructors.
(4) The backing and support of the management.

The head should prepare necessary rules to insure a standard method of employing, standard lesson sheets for schoolroom work, a regular fixed schedule for shop work to avoid partiality and to insure an equal opportunity to each. He should see that competent instructors are employed and should keep a faithful record of all apprentices while serving their time and an equally complete record of those who have completed the course and have been assigned to regular work and a list of all graduates available for promotion. You must not expect an apprentice training system to go on and give results without some one whom you can depend on to carry out its purpose.

Railroads should make and promote their own men and not depend on other roads to furnish them. The thorough training of apprentices should have the backing and support of the chief mechanical officer, for it insures him of having not only skilled mechanics for the shops but of having men trained and qualified to fill any position of a supervisory nature that may become vacant in his department. As a matter of fact, every officer owes it to his company and to his superior officer to have men trained and qualified to fill any position that may arise. He should have some one under him thoroughly qualified, who is familiar with the property, trained and ready to take his position whenever the necessity arises.

Discussion

G. M. Basford: He who makes something in steel, stone, iron, wood or wire, creates an inanimate thing which may or may not be used as it should be used for the benefit of mankind. He who has an opportunity to help develop a mind, a man, or a power with possibilities far beyond those of the source they come from does more. You do not know what man you may be making. A word, a suggestion, a dynamic thought given to some young man, matures in an instant. Somebody did this to you some years ago, somebody did this to Mr. Purcell. Who was it?

Probably most men have forgotten who put the dynamite under them to wake them out of the ordinary and to compel them to realize what they owe to somebody else. I do not believe there is one man present who does not possess the ability to place the dynamite under his boys, but a good foundation is needed for this force and it is necessary to qualify to produce it.

There is nothing I take more pride in than the success of the plan of the Atchison, Topeka and Santa Fe, and its execution, for helping young men to find themselves and to prepare them for the most useful, honorable work in the world. John Purcell is the center of this scheme and if any one fails to get the spirit that inspired him to do this great work, he will fail to respond to one of the greatest inspirations ever made available to American railroad men.

Why the Santa Fe Plan Succeeded

Why is the Santa Fe scheme a success? The chief executive backed it from the start. When this plan in embryo was presented to E. P. Ripley, of honored memory, Mr. Ripley said, "We will do it." It was done.

Knowing that the cost might sometime be mentioned, Mr. Ripley was asked how he felt about the cost. He said, and he continued to say, "I shall never want any statement as to the cost of training apprentices, feeling that the true value of thoroughly trained and skilled men can never be measured in dollars and cents." Without the support given by Mr. Ripley and by W. B. Storey, which has never wavered, this accomplishment could not be recorded. But, bear in mind that the results have only just begun to appear. This great work pyramids; the best is yet to come. Who knows what any one of these young men may do and what any one of them may become?

Go to the real root of the matter. Get the appeal to the chief executive of the road. Show him that a successful plan is available and get him to act forcibly, quickly and for permanence. Show him that we are soon to hand our duties, our responsibilities and our oportunities over to others and that it is up to us to do this right.

The Spirit Back of It

Then you need a John Purcell with the inspiration that came to him when a workman in the shop. Then he was in position to see the need of the training of men. When first put in charge of men at Fort Madison 23 years ago, he began the training of men. He trained them in the shop. He taught the school himself and provided books and drawing instruments at his own expense. This spirit is needed. Then you need what Frank Thomas and his devoted men have done to make a plan, to carry it out and to educate thousands of young men who became their loyal, intimate friends.

Mr. Purcell plainly states a need and shows how he has met it for 16 years. But this is not all. Mr. Purcell utters a warning which every executive must heed or fail in the most vital thing of official life. What are we doing to compare with graduating 1925 apprentices in 16 years? What are we doing that compares with the production of 239 apprentice graduates holding official positions in one organization? Who else but the Santa Fe won the Ryerson scholarship four times running? This meant that these boys qualified to take college examinations. Who but John Purcell was in position to supply 300 skilled workmen overnight, to support our boys and carry on in the World War?

The author has told us about his recruiting and training plan, but he does not tell us, nor does he need to tell us, how he imbues his organization with such abounding loyalty to him, to the organization and to everything that "Santa Fe" stands for. This, gentlemen, is fundamental. Loyalty to his men and their loyalty to him is the biggest thing of all. No wonder he succeeds.

The future of American railroads depends upon the training of loyal men and their promotion more than it depends upon any one thing. Sixteen years from today somebody else will have your job. What are you doing to prepare him?

College Men as Apprentices

Professor L. E. Endsley (University of Pittsburgh): The work of educating young men, which I have been in most of my life, is a most enviable job. There is nothing more pleasant in the world than to open the eyes of a boy and give him inspiration. We as educators—and all of us in the railway game should be educators in our line—should make the boy love his work. That is all you need for him to be a successful railroader, or a successful man in any walk of life.

During the last few years, boys leaving college have not been attracted by railroad work. Very few boys are entering the railroad departments of our colleges today. I wonder if the railroads realize the benefit that may come from a technically trained boy entering railroad work. Mr. Purcell said in his paper, "We have some very good special apprentices," meaning college graduates, "and we hope to get more." I wonder if the railroads of the United States appreciate what has been done for them by the special apprentices.

Apprentice Training on the New York Central

C. W. Cross (N. Y. C.): On the New York Central Lines, apprenticeship methods are similar to those on the Santa Fe, both plans following closely the suggestions made by George Basford in a paper before the American Railway Master Mechanics' Association in 1905. The system was inaugurated on the New York Central Lines in 1906 and has continued with increasingly beneficial results. Many graduate apprentices are still in the service as workmen or supervisory officers. Officers have declared that preference may well be given to graduate apprentices when selecting men for positions as foremen. Unlike the Santa Fe, the New York Central Lines are located in a densely populated industrial district; therefore certain variations in the plan are necessary.

We also have three grades of apprentices. Regular apprentices are boys 16 to 21 years of age, having a high school education or equivalent, and in good health. Schools are maintained at the shops six mornings a week. Attendance is compulsory and under pay, but the minimum requirements are not severe. Many boys who have not had much early education still have good intentions and respond to a genuine opportunity to improve their condition by attending the schools. The shop instructor supervises the movements of the apprentices in the shops, gives them instruction in the proper methods to follow and arranges for them to be moved in accordance with the schedule established for each trade. The shop instructors do not assign work, but instruct apprentices in the work which the department foreman has assigned to them.

The helper apprentices are young men 21 to 30 years of age, in good health, who have had two or more years continuous experience as helper in the shop from which application is made. They serve a three-year apprenticeship course. Attendance at the school is optional but many of them do attend.

The special apprentices are young men 18 to 26 years of age, who are college graduates in mechanical engineering, in good health. They are placed on the regular work in the shops and assigned to special work on tests, and selected duties as required. These men do not attend the shop schools.

We do not promise anything for the future, but from the fact that many men now occupying good positions in the service are graduate apprentices, it may be said that the railroad service offers as good opportunities for the future as any other line of work.

In making selection of apprentices, the sons of employees are preferred, although others are also taken. This plan results in noticeable good will and helps materially to increase the bond of mutual interest between the company and the employees.

Leaders From the Rank-and-File

It is from the rank-and-file that we always have, and always will, develop leaders. The best policy is to encourage ambition in the large group of men on whom we must rely for superior performance of duty. The spirit of the service should be that everyone is to make his place in the organization in competition with everybody else. This method will develop loyalty and co-operation which will be mutually beneficial and profitable to the company and the employees.

This plan of apprenticeship is not philanthropic, but is a profitable business investment.

Making Railroads Attractive to College Men

J. J. Tatum (B. & O.): Professor Endsley has referred to the attitude of college men towards the railroads. He failed to say, however, that some of the people of our country have failed to encourage the progress of the railroads. In fact, they have done almost everything to tear down the greatest institution that this country has ever had placed in it.

This country has only progressed to the extent that the railroads of this country have progressed. What we want to stop and what every boy who is in college wants to help to stop, what every college professor wants to help to stop, is adverse legislation against railroads. Leave the railroads alone for a while. Let them work out their own problems and there will be more boys in colleges that will aspire to the railroad business. Your son perhaps may be going to college and may have asked you whether there was an opportunity for him on the railroads. Haven't you stopped seriously to think whether you would advise him to go into railroad service because of this adverse legislation? I ask the help of every railroad man, every college man, every professor and every boy today that is going through college to help stamp out this propaganda against the railroads. Leave them alone and they will become institutions that the college boy will aspire to become a part of.

F. W. Brazier (N. Y. C.): There is one element that holds us back from putting in apprentices in our shops. I have been in the service for 47 years. I have been approached time and time again by men to take their boys in and teach them the trade. I am an old-fashioned fellow. That is the way to get men. If you want to get loyal men, train up the men right in the work of the railroads. Make and promote your own men. One of my pleasant relationships with my men is that I have always had a man behind me, near me, a little more competent than I was to take my place.

F. M. Graff (Erie): Mr. Purcell's paper gives all that we need fundamentally to establish and maintain apprentice instruction. The detailed course on the Santa Fe, with which we are very familiar on the Erie, leaves but very little to be desired. We have drawn extensively from the experience and taken advantage of the money that the Santa Fe has spent in the instruction of its apprentices since 1908. There is one thing that those railroads which have not instituted a regular detailed course of apprentice instruction do not understand, and will not understand until they get into it, and that is that the course must be systematic and it must be maintained.

We should include in our apprentice instruction an elementary course of economics. Then, when our young men graduate into the ranks of mechanics they will have that basic knowledge of the common fundamental facts of life and business that are necessary if we are to progress and go along in peace and prosperity.

Chairman Coleman: It seems to me you are developing something now which Mr. Purcell should have included in his paper—that there could be developed through this Mechanical Division men qualified to represent you in Congress. (Laughter).

More About College Men

Professor Rubenkoenig (Purdue University): I am very proud to say that I am a Santa Fe graduate—about 18 years ago. The special apprenticeship system was not thoroughly developed at that time, but I have had occasion since then to be in more or less contact with it.

Following up what the speaker mentioned a while ago about the colleges teaching our students to look after adverse legislation, that has been my purpose throughout all the years that I have had the students at Purdue University. I am only in contact with them, however, for one year, as seniors, but we are sending out this year seven young men who I think have the right attitude towards the railroads. One of these men in particular, I have in mind, has finished the regular apprenticeship course and was a roundhouse foreman before he came to the university; I have no doubt about his future position in the railroad world.

We were criticized more or less in an editorial—I have forgotten the exact words—about the hieroglyphics of railroading, but I wish to say that if that editorial writer could see the contents of our course he would agree that we do teach some of the A B C's of railway mechanical engineering.

Weed Out Unsuitable Boys

W. J. Bohan (Northern Pacific): Many engineering colleges today recognize the necessity of weeding out men that are not fit and that do not have the proper qualifications. It also is recognized in other colleges besides engineering colleges. I think the same thing should be done with apprentices. You may get an apprentice on the railroad and you keep him submerged for four years, and he never will make a mechanic or even an executive on a railroad (laughter).

Now, that may sound like a joke but it is a fact. About the first thing they ought to do with an apprentice is to uncover him and see if he is any good for railroad work. If he is not any good, then in the interest of the railroads, and in the interest of the man that is trying to be an apprentice, take him out of the service; tell him he is unfit for it, and advise him to go back to the farm or some other place to which he is suited.

H. C. Oviatt (New Haven): *I move that a vote of thanks be extended to Mr. Purcell for this most wonderful paper. (The motion was carried.)*

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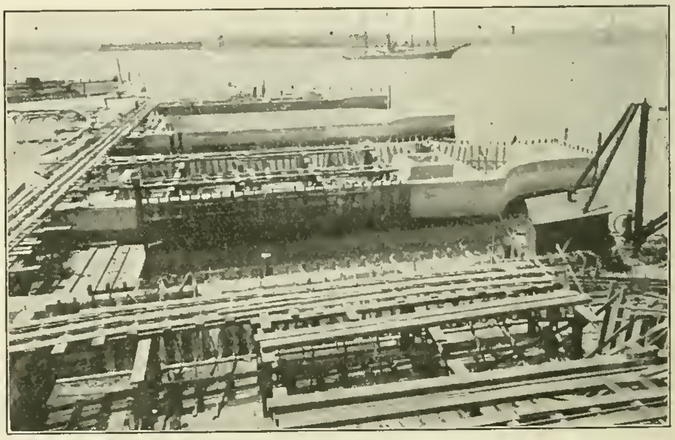

Foundation for Ferry Slips of P. & R. New Terminal at Camden, N. J.

How Employees Can Help With Public Relations

They Have Everything at Stake—An Apt Illustration from the Free Silver Campaign

By C. H. Markham
President, Illinois Central

You have had others here very much better qualified to talk to you about the important matters with which this meeting is concerned. I was very much impressed, for example, with the statements made to you by Mr. Aishton yesterday showing what the railroads have accomplished in the very distressing and difficult times following the coal and shopmens' strikes last year.

It was also illuminating to note his statement of the progress that is now being made in getting ready for the difficult task of handling the peak load of traffic which we are going to be called upon to carry next fall. No one appreciates more than I do the importance of the work of the mechanical men of the railroads of this country.

Provision of Proper Tools

No one appreciates more than I do the importance of providing the men in the mechanical departments of the railroads of the country with the proper tools to work with, and when I use the word "tools" I by no means confine myself to the consideration of the question of the adequacy of the shop tools. I mean more than that—the consideration of all of the elements that enter into the successful operation of our American railroads. It is not only the tools themselves—the shop buildings, the quantity and the quality of the power furnished, but last, and not least, a proper and good relationship with all of the people of this country. This last is necessary in order that the railroads may receive at the hands of those who have to do with creating the conditions under which we operate that which will enable those of us who have to do with financial matters—always involved in that important question of furnishing the necessary tools to work with—to obtain a sufficient return from the operation of these properties to secure from time to time the new money necessary to provide you with the tools which you must have for the operation, if the operation of the railroads of this country is to be successful.

I do not believe there has ever been a time, certainly not within my knowledge in the history of American railroading, when there was as good an understanding on the part of the public of the needs of our railroads as exists today.

How the Employees Can Help

I want to discuss with you for a few moments, if I may, the importance of our all doing everything that can be done to improve upon and promote as best we may a continuation of that good understanding. Out of my personal experience I know what can be accomplished in the matter of car and locomotive movement—miles per day, or loading, or whatever it may be—if the active interest of as nearly 100 per cent as it is possible to obtain of all of the employees who have to do with the handling of cars and locomotives can be obtained; when every man gives to every movement of a car or locomotive, or to every item of the handling, his individual attention to the end that every individual car and every individual locomotive is treated as a unit by itself. I know what can be obtained on a railroad when the management has been successful in obtaining anything like 100 per cent of success in the effort to develop that sort of attention.

Underwood & Underwood

C. H. Markham

Now if that is true when it comes to the matter of dealing with the inanimate cars and locomotives, how much more is it true when it comes to the question of each individual striving as best he may in his contact with other individuals to promote a better understanding of the railroad question. I do not recall the figures as to the number of railroad officers in the employ of the railroads of this country, but I do recall that the last statement of the number of employees showed figures approximating 1,800,000.

Suppose that we could by precept and example—each officer doing what he could to make some contribution towards the development of a better understanding of our railroad problem—get as many of the rank-and-file of the employees interested in doing what they could to make some sort of a desirable contribution toward that effort—think of what it would mean! Many of you here are old enough to remember the Bryan free silver campaign of 1894. You will recall that it was said that if the election had been held two months before the date on which it was held, the chances were more than even that Mr. Bryan would have been elected. But now what happened? Through the dissemination of information as to what the effect of the election of a president of the United States on a free silver platform would have on the individual fortunes of the voters of this country, when election time came an entirely different result was recorded.

I remember that at that time all of my previous experience had been in silver countries—railroading in New Mexico, in Arizona, in Nevada, and later on in California. I memember that one day it dawned on me, at the time when I was advocating this fetish of free coinage of silver in the ratio of 16 to 1, that if that thing ever came to pass, when I went to the pay car and got my money the day after Mr. Bryan was elected the dollar I got would only be worth 50 cents. When that fact did dawn on me I turned out the next day, you can bet your life, and began to work from that day on for the election of Mr. McKinley.

That sort of thing occurred all over the country. There is no reason why it should not occur in this country on this transportation question and no one can make a better and more worth-while contribution to that end than can the railroad officers of this country.

Better, Not Cheaper, Transportation

One of the things that we of the Illinois Central—in our efforts to promote this better understanding as between the railroads and the public—are preaching is that what we want is better transportation and not cheap transportation; that the cheap transportation which does not leave the railroads of the country in a position at all times to take reasonable care of the peak load of traffic offered is in the end the dearest kind of transportation, and that no reduction in rates that would wreck the railroads would be worth-while. On the contrary, it would be one of the worst calamities that could befall the people of this country.

Again, if our rates were reduced, what would happen? When I say "reduced," I mean reduced beyond the point where we could pay operating expenses, render the service that the public wants to have us render, and at the same time get enough out of the operation to make some part of the improvements out of earnings; last, but not least, that we might from time to time be able to secure the new sum of money necessary to carry out programs of continued improvement. Any reduction in rates beyond the point where we can accomplish those things would mean ruin to the railroads of this country and in the end bring about conditions that would be nothing less than a catastrophe to all the people of the country.

What we ought to preach to people on this railroad question is the policy of not dealing with it as they see it today, but always remembering that there must be a stability about railroad rates and railroad practices that does not and cannot obtain in the handling of the affairs of any other industry. When hard times come industrial plants shut down, only leaving a modicum of the expense in the way of overhead. But a railroad can't stop. You can't leave your cars of freight standing on the side track; freight on the platforms; passengers waiting for trains to come. We have got to continue operating in good weather and bad.

It is not possible to adopt with regard to railroad rates the same policies that obtain with regard to the prices of commodities generally. For example, when hard times come, when the railroads can least stand a reduction in rates, that is the time that the great demand for reductions comes. Just now we hear scarcely anything about reduced rates except from certain professional men in public life—I almost started to call them politicians, but I am trying to get away from that habit—whose stock in trade is the creation of antagonism between the people that have and the people that have not.

You don't hear today, for example, from any section of the country, a demand for wholesale reduction in rates. When you talk to shippers today their concern is as to whether or not we are going to be able to take care of their traffic when the peak load offers this fall.

And so I say there is that difference between our situation and that of the other industries. The shipper wants a reduction in rates at a time when we can least afford it. We cannot afford to make reductions when the times are good because if we do, when business falls off later on the rates will not be sufficient to come anyway near meeting our requirements.

An Appeal to Every Employee

I want to close by an appeal to you—each and every individual officer and employee of the railroads of this country—constantly and persistently to do what you can to bring about a better understanding of this railroad question.

Remember that our representatives in Washington are there for the purpose, at least from their point of view, of serving their constituents. Unless there is some great moral question involved where the mob spirit perhaps might rule and where the majority would not be reflective of the real views of the right thinking people of any section of the country, your representative in Congress is nearly always guided by what he conceives to be the consensus of home opinion.

Now, if, through contact, personal or otherwise; through the proper use of the advertising columns of the newspapers; through addresses made at various gatherings throughout the country, we can promote a better understanding of this railroad question at home, is it not reasonable to suppose that in time that message will reach Washington?

Perhaps I can illustrate the point better by telling you a story which I have used on these occasions with some frequence, a story of the old populist days, when it was told that a senator from a western state was talking to a friend in Washington about a letter he had received from his son concerning the growth of populism in his state. He remarked he was going back home and look into the matter.

His friend said to him: "Well, I suppose if you find the conditions as bad as your son reports you are going back there and fight these fellows?"

He said: "Hell no, if they are as strong as my son's letter represents them to be I am going back there and join them." (Laughter)

In a way that story does illustrate the situation. We all go along, broadly speaking, with a consensus of opinion of those in whom we have confidence, and our people in Washington are no different, and so I leave with you the message that if every railroad man in the country will do his part toward promoting this better understanding—and the Lord knows there is enough literature issued on the subject already within the past year to enable us all to post ourselves on any of the questions pertaining to the existing railroad problem—I haven't any doubt but that in the end we can look for fair treatment at the hands of those who have to do with the future of the railroads and that all this threat of government ownership and the evils that go with it will have disappeared.

Mr. Bentley: Before Mr. Markham leaves the hall, I wish to propose a very hearty vote of thanks for the illuminating address that he has given us and I hope that the members will arise so that he may know that we appreciate what he has done. *(A rising vote of thanks was tendered Mr. Markham).*

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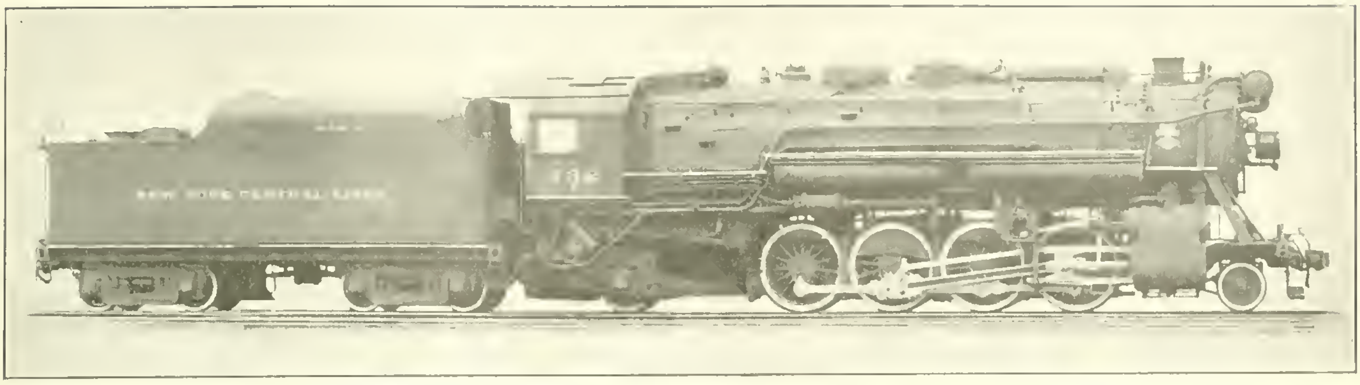
A Gasoline Rail Motor Car on the Kent & East Sussex (England)



Mikado Type Locomotive Used on New York Central Lines, Built by Lima Locomotive Works.

Report on Locomotive Construction

Formulas for Tractive Power, Stokers, Feedwater Heaters, Lubricators and Details of Construction Considered

During the year the committee has given consideration to the following subjects: Tractive powers for mallet locomotives, locomotive rods for heavy power, use of extended piston rods and minimum size of piston on which they shall be applied, hydrostatic and force feed lubrication, means of taking up driving wheel lateral, mechanical stokers, feedwater heaters, exhaust steam injectors, and crosshead connection of piston rods.

The committee will continue its study of standardization of taps and dies and rail stresses under locomotives and make report next year.

Tractive Power of Mallet Locomotives

The formula now in use for a simple locomotive gives only a close approximation of the actual tractive power, because of variation in maximum cut-off, back pressure, internal friction, etc. A uniform formula for the Mallet locomotive also will give only a close approximation of the actual performance.

There are two general types of Mallet locomotives: Four cylinder simple, and four cylinder compound.

The following symbols apply to all formulas given:

C = Diameter of high pressure or simple cylinder in inches.
c = Diameter of low pressure cylinder in inches.
S = Stroke in inches.
P = Boiler pressure in pounds.
D = Diameter of driving wheels in inches.
H = M. E. P. of high pressure or simple cylinder in pounds.
E = M. E. P. of low pressure cylinder in pounds.
R = Ratio of cylinder volumes.
K = A constant—.85 for 90 per cent cut-off locomotives and .75 for 50 per cent cut-off locomotives.
Q = PK = Total M. E. P. in cylinders.
T = Tractive power in pounds.

Of the values of "K" given above, the first has been generally adopted for simple locomotives having approximately 90 per cent cut-off. The second value, that for locomotives having approximately 50 per cent cut-off, is taken from results obtained with the Pennsylvania class I 1s (2-10-0) locomotive. Each piston valve bushing of these locomotives is provided with an auxiliary steam port ⅛ in. by 1½ in. in size and having ¼ in. steam lap. While the steam which passes through the auxiliary ports has an effect on the mean effective pressure, it is believed that the constant .75 may be used for any locomotive having approximately 50 per cent cut-off.

The four cylinder simple is essentially nothing more than two simple locomotives with but one boiler. Therefore, the tractive power of this type of locomotive is double that of the simple locomotive, or

$$T = \frac{2\ K\ P\ C^2\ S}{D}$$

which becomes— $T = \frac{1.7\ P\ C^2\ S}{D}$ for 90 per cent cut-off locomotives, and $T = \frac{1.5\ P\ C^2\ S}{D}$ for 50 per cent cut-off locomotives.

The four cylinder compound is usually equipped with a device by means of which the locomotive can be operated as a simple locomotive at certain times. Under this condition the tractive power of the locomotive would be

$$T = \frac{(H\ C^2 + E\ c^2)\ S}{D}$$

In a properly designed compound locomotive, it is the intent that the piston pressures will be equal. Therefore, we may assume that the mean effective pressures vary inversely as the squares of the cylinder diameters, or

$$\frac{H}{E} = \frac{c^2}{C^2} = R \qquad (1)$$

Now the sum of the mean effective pressures of the high and low pressure cylinders will be equal to the total mean effective pressure, or $H + E = Q$ (2)

Substituting value of H from formula (2) in formula (1), we have

$$\frac{Q - E}{E} = R \qquad (3)$$

From which $E = \frac{Q}{R + 1}$ (4)

The tractive power of the low pressure cylinders is

$$T = \frac{E\,c^2\,S}{D} \qquad (5)$$

Substituting value of E from formula (4) in formula (5), we have

$$T = \frac{Q\,c^2\,S}{(R + 1)\,D} \qquad (6)$$

Since we have assumed equal power for the high and low pressure cylinder, the tractive power of both pairs of cylinders is double that of the low pressure cylinder, or

$$T = \frac{2\,Q\,c^2\,S}{(R+1)\,D} \qquad (7)$$

which becomes—
$$T = \frac{1.7\,P\,c^2\,S}{(R+1)\,D} \qquad (8)$$

for locomotives with approximately 90% maximum cut-off, and

$$T = \frac{1.5\,P\,c^2\,S}{(R+1)\,D} \qquad (9)$$

for locomotives with approximately 50% maximum cut-off.

For comparison, the proposed formulæ are given in connection with other formulæ in general use, all formulæ given being for four cylinder locomotives, except as noted·

	Tractive power	Simple or compound	Approximate maximum cut off, per cent	Cylinder ratios	Authority
1	$T = \frac{1.7\,P\,C^2\,S}{D}$	Simple	90	...	Proposed by sub-committee.
2	$T = \frac{1.5\,P\,C^2\,S}{D}$	Simple	50	...	Proposed by sub-committee.
3	$T = \frac{1.5\,P\,c^2\,S}{(R+1)\,D}$	Compound	90	All	Proposed by sub-committee.
4	$T = \frac{1.5\,P\,c^2\,S}{(R+1)\,D}$	Compound	50	All	Proposed by sub-committee.
5	$T = \frac{1.2\,P\,C^2\,S}{D}$	Compound	90	2.35-2.40	Baldwin Loco. Works.
6	$T = \frac{1.7\,P\,c^2\,S}{(R+1)\,D}$	Compound	90	All	Baldwin Loco. Works.
7	$T = \frac{K\,P\,c^2\,S}{D}$	*Compound	90	*	American Loco. Co.
8	$T = \frac{1.6\,P\,c^2\,S}{(R+1)\,D}$	Compound	90	All	C. R. Henderson Loco. Operation.
9	$T = \frac{2\,P\,C^2\,S}{3\,D}$	Two cylinder compound	90	...	Interstate Commerce Commission Circular No. 22.
	$T = \frac{P(\frac{2}{3}C^2+\frac{1}{4}c^2)\,S}{D}$	Compound	90	...	

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*See Table 1 for value of K.

TABLE No. 1—CONSTANTS K

Per cent cut-off H.P. cylinder	Ratio of L. P. to H. P. cylinder volume						
	2.2	2.3	2.4	2.5	2.6	2.7	2.8
90	....	....	.571	.557	.542	.528	.513
89	....	....	.565	.550	.526	.521	.507
88	....	.573	.559	.543	.529	.515	.500
87	....	.567	.552	.537	.523	.509	.494
86	.575	.560	.546	.531	.517	.502	.489
85	.570	.555	.540	.526	.511	.497	.483
84	.564	.550	.534	.520	.606	.491	....
83	.559	.544	.529	.515	.500	.486	....
82	.553	.541	.524	.510	.496	....	....
81	.548	.534	.520	.505	.490	....	....
80	.543	.531	.515	.500	,486	....	....

Main and Side Rods

A strap end main rod of tapered fluted section with heavy brasses and as narrow flanges as possible, setting up wedge located in front of the crank pin with single nutted bolts riveted over, with one grease cup, composition bronze bearings each end and approved adjusting feature at front end is what is wanted in a main rod for heavy locomotives or a solid back end of main rod with floating bushing. All details should be made as light as possible.

The same conclusion applies to side rods, except that main parallel connection may be equipped with floating bushing. They should have ample side clearance at knuckle pins with solid oil cups and single or castle nut for knuckle pin with cotter, or a lock nut. A tapped plug at top and bottom, or some similar design or plug, sufficient to prevent bushings from turning. We consider both arrangements good practice. Knuckle pins should be amply large and hollow to lighten them.

All offsets should be reduced to the minimum and special shapes eliminated except when there is interference. Collars on the inside of all bushings are helpful when it comes to pressing them in and checking the offset faces of the rods.

No welding of any kind to be used in fastening keys, wedges, etc., on main and side rods.

Extended Piston Rods

To obtain information as to what extent extended piston rods were being used, a questionnaire was submitted and replies have been received from 93 roads representing an ownership of 52,283 locomotives. Seventy-six roads, 81.7 per cent of all reporting, are not using extended piston rods. The 17 roads, 18.3 per cent of all reporting, which are using extended piston rods, own 21,684 locomotives, and of this number 2,692 or 12.4 per cent of the locomotives operated by them, and 5.1 per cent of the total number of locomotives operated by all roads reporting, have extended piston rods. In this connection, 875 of the 2,692 locomotives equipped with extended pistons are owned by one road. These figures do not include new locomotives on order. The road having the 875 locomotives equipped has on order an additional 533, which will then make a total of 17.7 per cent of locomotives owned by that road.

Twelve roads report they have either removed the extended rod or will do so. One road reports removing them from 210 locomotives, and one from 110.

The smallest cylinder reported equipped is 19 in.—the maximum, 44 in. diameter. The largest cylinders operated without extended piston rods are: 40 in. on five roads, 41 in. on four roads, 42 in. on four roads and 48 in. on one road.

The extended piston rod in general use is the outside crosshead supported type with packing gland. Only two of the 17 roads have the bronze sleeve and sheath type.

A majority of the replies (46 roads) indicate their belief that the extended piston rod is of no benefit unless it keeps the weight of the piston free from the cylinder walls—seven indicate that there is a certain value other than freeing cylinder walls of piston weight.

Seventy-five roads using cylinders from 19 in. to 48 in. diameter without extension rods report no unusual trouble. Four roads report troubles with cylinders from 19 in. to 34 in. diameter.

The question as to whether there is any practical limit to the size of piston which may be used without extension rod is answered as follows: Thirty-two roads believe there is no limit, while 15 say that there is, and would apply them to cylinders over certain sizes.

The committee finds from its investigation that there is a diversity of opinion as to the advantages from the use of the extended piston rod. However, it is the conclusion that the large majority of the railroads of this country do not consider there is sufficient merit in the extended piston rod to warrant the use.

Although there are certain roads which have used the extended piston rod for a number of years, and the advantages and service which they have obtained have influenced these roads to specify the extended piston rod on new equipment on order—an approximately equal number having used the extended piston rod, have or are now discontinuing the use of same, and are removing them.

It is presumed that the wide divergence of experience and opinion is due to the marked differences in operating conditions, including such features as superheating versus saturated steam, quality of boiler water, lubrication and materials used for cylinder walls and pistons.

The character of boiler water which has a direct bearing on lubrication is of more importance on saturated than on superheated locomotives, as the carrying over of water and solids into the cylinder, which is more likely to occur on saturated engines, has an important bearing on wear, and, therefore, the consideration of extended piston rods.

Again, some roads operate superheated locomotives either with drifting valves or require their engineers to crack the throttle and work steam while drifting. This has important bearing on lubrication and wear, and again reflects on the question of extended rods.

The materials used for cylinder walls and piston heads and rings also exercise a deciding influence on wear. In this connection, quite a few roads are now bushing cylinders with semi-steel bushings as the regular standard, while other roads do not bush except after excessive wear of the original cylinder barrel. One road abandoned extended piston rods a number of years ago, and is now operating pistons up to 41 in. in diameter made of cast steel and surfaced with phosphor bronze.

Perhaps the most important feature in connection with extended piston rods for large cylinders is that of lubrication. Some roads have relied upon the extended piston rod as a relief from certain existing evils, while the majority of roads have apparently controlled to a sufficient extent the same evils which are avoided more or less by the extended rod.

It cannot be denied that there are difficulties wholly incident to the use of extended rods. Whether these difficulties are more or less than the difficulties avoided is uncertain, and this committee finds itself unable to make a definite recommendation for or against extended rods.

Hydrostatic and Force Feed Lubrication for Cylinders and Steam Chests

There has been no rapid development in the extension of the force feed system of lubrication to locomotives although the adaptability of the force feed lubricators to locomotive practice as indicated by a few scattered installations has been under investigation for a number of years. In the introduction of the force feed lubricator to locomotive service, it was soon discovered that there were problems in design such as ruggedness and dependability that had not appeared in connection with the use of the same type in stationary practice. Opinions differ as to the relative merit of force feed and hydrostatic lubrication.

A questionnaire was sent to the 12 roads reported as having force feed installations. Aside from obtaining a record of the number and types of the different force feed systems in service and the method of application, little definite information was available. It appears that there are no records as to the relative merits of the two systems of lubrication as indicated by cylinder and valve packing ring wear or the relative consumption of lubricant.

It may be of interest to indicate the roads replying to the questionnaire showing the type and number of force feed lubricators they have in service and the location of the oil delivery:

Lubricators

Road	System	No.	No. of feeds	Location of oil delivery
C. & E. I.	Schlack	1	2	Outside steam pipe.
C. & N. W.	Schlack	..	2	Outside steam pipe.
	Madison-Kipp	..	2	Outside steam pipe.
	Nathan Mfg. Co.'s Friedmann	..	6	Outside steam pipe.
C. M. & St. P.	Schlack	1	2	Outside steam pipe.
D. L. & W.	Madison-Kipp	..	2	Main steam pipe.
	McCord	..	2	Main steam pipe.
Grand Trunk	Had Intensifore and Wakefield, Both now removed	..	5	Outside steam pipe and top of cylinder barrel
N. & W.	Schlack	1	2	Top of cylinder barrel.
	McCord	5	2	Mallet L. P. cylinders.
	Goodfellow	1	4	Steam pipe.
	Madison-Kipp	1	2	Steam pipe.
Pennsylvania	Nathan Mfg. Co.'s Friedmann Type FSS	1	6	Steam pipe.
	Nathan Mfg. Co.'s Friedmann Type DV	1	6	Steam pipe.
	McCord	50	2	Steam pipe.
	Schlack	50	2	Steam pipe.
Southern Pacific	Nathan Mfg. Co.	..	4	One to each steam pipe and top of cylinder barrel.
Union Pacific	Madison-Kipp	..	4	One to each steam pipe and top of each cylinder barrel.
	Schlack	..	4	Bottom of cylinder.
Erie	Madison-Kipp	..	4&6	Bottom of cylinder.
	Nathan Mfg. Co.	..	4	Bottom of cylinder.

The three systems of force feed lubrication that have received any measure of recognition by the railroads are the Nathan Mfg. Co.'s Friedmann, Madison-Kipp and Schlack (formerly identified as McCord).

It is the thought of the committee that, should the subject be continued for further consideration, it would be well to outline a test program and solicit the railroads having force feed lubricators to apply them to locomotives in conjunction with the hydrostatic system, thus providing for force feed lubricators on one side and hydrostatic lubrication on the opposite side, and keep a record of service conforming to the outline suggested.

Taking Up Driving and Truck Wheel Lateral

From the information we have been able to obtain no patented devices have been applied in quantity and little is known of the service, application and maintenance costs. A number of different adjustable or stationary hub plates have been tested and in some cases used to a considerable extent, but on account of some defect, their use has not been generally extended.

The lateral in locomotive driving boxes is taken up on practically all engines under construction at this time, either by attaching the liner to the wheel hub or to the face of the driving box. Most applications to the driving boxes are made by pouring the liner on the face of the box and then finishing. The majority of applications made are by finishing the liner, fitting it into a recess in the wheel hub and pinning it in place with bronze plugs driven in. As a general rule the liners are made of solid bronze, but a few cast iron liners are applied, and some bronze liners having white metal inserts.

In the absence of conclusive information as to the reliability of the various patented devices for taking up driving and truck wheel lateral, and in view of the satisfaction evidently obtained either by pouring or pinning bronze liners to the face of the driving box or wheel hub, as evidenced by their almost universal use, it would seem that until some better device is developed that the liner poured or pinned to the driving box face or driving wheel hub is the best means of taking up lateral.

Mechanical Stokers

The subject of mechanical stokers has been before the Association since the 1905 convention. It is the thought of the committee that it migh no be amiss o briefly review the history of the development of the mechanical stoker as applied to the locomotive and point to a number of interesting and valuable features in connection with the construction and operation, adding thereto the impressions as to what should be the further handling of the subject.

(The report includes a very complete resume of locomotive stoker development and of previous committee reports together with many comments thereon. Reference also is made to other papers and investigations.—Editor.)

The number of stokers of each type that are in service or on order as of April 1, 1923, are shown in the accompanying table:

Number of Stokers as of April 1, 1923

Manufacturer	In service	On order	Total	
Elvin Mechanical Stoker Company—				
Type A	5	10	15	
Type B	247	102	349	
				364
Hanna Stoker Company—				
Type V-H	109	0	109	
Type H-2	8	57	65	
Type S-1	34	0	34	
				208
Locomotive Stoker Company—				
Type, Street	1,458	0	1,458	
Type, Duplex	4,142	772	4,914	
				6,372
Standard Stoker Company—				
Type A-1	510	0	510	
Type A-1M	102	0	102	
Type DuPont	65	0	65	
Type, DuPont Simplex	34	59	93	
				770
Grand total				7,714

Longer experience with mechanical stokers has led the committee to the conclusion that while a stoker designed to handle run-of-mine possesses merit, this feature might well be sacrificed for further improvements in design and ability to perform the stoking operation and the exploitation of machinery for the preparation of fuel at coaling stations or wherever it might best be handled. This preparation should include not only crushing the coal so that it may be satisfactorily handled on the stoker without further preparation but also the grading to the extent of removing, as far as warranted, the finely divided material which would result in materially increasing stack losses.

The committee has been much impressed with the idea that the classification of coals for stoker service cannot be definitely established by the chemical properties alone, but the physical characteristics also must be taken into consideration. The importance of this increases in proportion to the quantity of finely divided material carried in the fuel. The determination of the physical characteristics should cover the available range of fuels to enable the establishment of the relative value of fuel per ton mile. By such a method the purchaser would be able to determine the price at which a given grade should be purchased. Such a range of values established for a road or the fuel from some particular field would not necessarily be applicable to other roads and this rating would probably have to be developed by individual roads.

It is thought that this latter phase of the subject now becomes paramount. In view of the enormity of the stack loss which is a direct measurement of the physical nature of the fuel so apt to be lost sight of, perhaps as a condition necessarily incident to stoker operation, it is recommended that the subject be assigned to the committee handling the locomotive fuel question and that the subject be investigated with the view of securing the best suggestions that can be offered for the saving of fuel by selection and preparation. It is well recognized that the preparation may not be so readily worked out and for many reasons, including local conditions, which might carry possibly the question as to the extent that the stack losses might be offset by relative cost of fuel and also what disposition might profitably be made of material screened from the coal. The material screened from the coal has value and should be used profitably for by-product plants, manufacturing industries or stationary power plants using powdered fuel or hand-fired yard service.

Feedwater Heaters

The increase in the number of feedwater heaters applied each year since 1920 shows considerable interest in this device. Reports indicated that there were 11 locomotive feedwater heaters in service in 1920, about 54 in service, or on order, in 1921, and 197 in 1922. Replies to the questionnaire and reports from the manufacturers this year indicate that there are 997 heaters in service and on order, as shown in the table. Practically one-third of the locomotives built and ordered during the past year are to be equipped with feedwater heaters.

Replies indicate that all the heaters are either those of the open type manufactured by the Worthington Pump & Machinery Corporation, or the closed type manufactured by the Superheater Company. We understand, however, that there are three other types which are either now in service or have been in service experimentally—one of the Foster-Thompson exhaust gas heater, one of the Skinner (also an exhaust gas heater), and three of the Caille (a closed type low pressure heater).

	Open type		Closed type		Total	
	In service	On order	In service	On order	In service	On order
N. P.	0	4	0	4	0	8
A. T. & S. F.	2	0	2	61	4	61
M. C.	0	0	11	0	11	0
C. V.	0	0	1	0	1	0
S. P. (Pacific)	58	100	2	0	60	100
S. P. (Texas)	4	9	2	0	6	9
F. W. & D. C.	1	0	1	0	2	0
L. I.	1	0	1	0	2	0
St. L. S. F.	0	2	2	0	2	2
C. & S.	1	0	1	0	2	0
P. & R.	1	0	0	0	1	0
N. Y. N. H. & H.	0	0	16	14	16	14
N. C. & St. L.	1	0	1	0	2	0
N. Y. O. & W.	0	0	0	0	0	0
N. & W.	1	0	0	0	1	0
K. C. S.	0	0	1	0	1	0
P. R. R.	104	375	0	0	104	375
D. & M.	3	5	0	0	3	5
T. & P.	0	0	8	0	8	0
C. R. I. & P.	1	6	0	0	1	6
N. Y. C. & St. L.	1	0	0	0	1	0
C. & N. W.	2	0	2	0	4	0
E. J. & E.	0	0	1	5	1	5
C. N.	1	36	19	26	20	62
M. K. T.	2	0	2	0	4	0
C. R. R. of N. J.	0	0	6	26	6	26
I. C.	1	0	1	0	2	0
C. C. C. & St. L.	0	0	49	0	49	0
Erie	0	5	5	0	5	5
Total	185	542	134	136	319	678
Grand total	....	....	....	....	....	997

A questionnaire was again submitted this year and a summary of the replies indicates considerable progress in the development. The report this year must be considered as a progress report, as many of the roads have only a few heaters in service and many of these have only been in service a short time.

[The replies, in a very condensed form, showed the following: Seventeen roads are not considering the application of additional heaters, while nine roads are considering the application of 590 additional heaters, most of them being of the open type.

Most heaters have been applied to heavy freight and passenger locomotives with a few in surburban and switch service. The fuel used on six roads is oil, and on 19 roads, coal. All kinds of water and operating conditions were reported.

Twenty roads reported no reduction made in size of exhaust nozzle on locomotives equipped with heaters with which five roads made slight reductions.

A wide variation in preferred location of the heater was reported.

In regard to the relative amount of boiler scale, eleven roads reported no change noted, two a reduction, and nine not sufficient time to observe results.

In methods of cleaning the heater and in the costs, the replies showed wide variations. Similar variations appear in the reported costs of maintenance.

Several roads reported trouble from the heater system freezing up, but it would appear that this could be remedied by locating drain connections at low points and applying circulating pipes.

Most roads return condensate from closed type heaters to the tender.

Several reported trouble with boiler checks. A number reporting no trouble, advise that larger or special checks are required and that the left of the valve should be reduced to 3/16 in. or less. Nine roads reported trouble with closed type heater tubes leaking, and eleven reported no trouble. Sixteen roads reported having had pump troubles and ten roads no trouble. But few reported engine failures due to the heater.

Five roads reported that oil separators were not used with open type heaters, and 20 roads reported using them with closed type heaters.

Twenty per cent of the roads reporting had found traces of oil in the boilers. Only one reported any injurious condition. One road reported a tendency to foaming after a long run, 600 miles. Reports showed that the period between washing was the same whether heater was or was not applied. Reports also indicated no change in length of time between flue renewals.

Twelve roads found no difference in control of water lever by heater pump or by injector, while nine reported that regulation was superior to injector.

Twenty-two roads favored the application of only one injector when a heater was used, and two roads favored retention of both injectors.

Most of those reporting considered using the pump while standing or drifting, a practice that might result in injury to the boiler. The use of top checks on locomotives having heaters was preferred by a number of roads.

Some roads have found a reduction in superheat on heater equipped locomotives.

Reports as to economies showed saving of from 8 to 15 per cent for locomotives having heaters, as compared with those having injectors only.

Eight roads stated that the capacity of the heater should be the same as that of one injector; seven thought that it should be slightly greater, while ten replied that capacity should be from 10 to 100 per cent greater.—Editor.]

One road reported taking steam from the main steam pipes of locomotives for use on heater for the following reasons: First—To get superheated steam for use on pump. Second—With the high temperature of feed water it was found that unless the pump throttle was closed before the main engine was shut off, relieving the heater from the back pressure caused by the exhaust steam, it would cause the water in the heater to vaporize, thereby causing pump to race, until sufficient cold water had pumped into the heater, to reduce the temperature below boiling point. While no damage was apparent from this racing, it was self-evident that it was not desirable, and that unquestionably, in time, damage would result to either pump valve or packing. Third—To get the best result from the heater, it is desirable that same be started immediately when the engine begins to work steam, and also that it be shut off as soon as main engine is shut off, as otherwise the temptation to pump cold water in the boiler was ever present, which is a most undesirable practice. Combining the steam supply for main engine and pump was thereupon decided upon, and the scheme has proven most satisfactory.

As an example of what can be accomplished by this method of feeding, and with proper training of engineer, engines in passenger service go over the whole division of 125 miles, making their regular stops, without the engineer having once changed the adjustments on pump throttle valve, the pump starting automatically as soon as the main throttle was opened, and stopping when same was closed. A remarkable fact in connection with these runs, and one that hardly seems reasonable, is that the water level only showed a variation of ½ in. from the start until the finish of the run.

Exhaust Steam Injectors

A report from the Specialty Company handling the one type of exhaust steam injector used in this country indicates that there are now in service ten exhaust steam injectors on four railroads. There are, however, as indicated in this report, 42 exhaust steam injectors on order distributed among six different railroads, as indicated in the table.

It is reported that one road has removed the one injector it had in service.

The information received from these roads is very limited, as some of these exhaust steam injectors have only been in service a short time. Two of the roads indicate that they expect to make extensive tests to compare the exhaust steam injectors with the standard injector in a short time. Until such time as these test reports are available, the only report the committee can make is a progress report.

Railroad	In service	On order	Total
N. Y. C. & St. L.	1	30	31
N. Y. O. & W.	6	5	11
Bing. & Garfield	0	1	1
N. Y. C.	1	0	1
B. & O.	2	0	2
A. C. & Y.	0	1	1
N. P.	0	4	4
S. P.	0	1	1

Crosshead Connection of Piston Rods

In order to make a thorough investigation and determine the type of crosshead connection of piston rod in general use, a questionnaire was sent out. Replies were received from 93 roads, representing an ownership of 52,283 locomotives. Seventy-five of the roads reporting advise that they use the key only as a crosshead connection to the piston rod—18 roads that they are using both types of connection, viz., some power equipped with key, and some with the nut. None of the roads reporting, however, use the nut exclusively as a crosshead connection to piston rod.

Sixty-one of the roads using the key connection state that they consider the use of a key as a crosshead connection to the piston rod preferable, and their reasons for so doing may be summarized as follows: More reliable, saving of weight, readily applied, easier to maintain, more secure, less trouble in enginehouse maintenance, firmer hold, more accessible, simpler, less parts, easier to remove, nut cannot be properly tightened, difficult to fit and keep nut tight, permits smaller crosshead and shorter guides, no trouble of key becoming loose, cheaper to repair, key will shear in case of water in cylinder, thereby saving cylinder head.

Seventeen of the roads which use both key or nut give as their reasons for using the nut, as follows: Easy to detect looseness and rarely breaks rod in crosshead, fractures develop in key slot, less liable to injure rod, rod is stronger with nut, keys shear, easier to turn piston head to equalize wear.

One road recommends the use of nut on light power, with cylinders up to 26 in. and the key for heavy power.

A summary of the tapers reported is as follows:

Taper of piston rod—crosshead fit: 48 use ¾ in. in 12 in., 27 use ¼ in. in 5 in., 10 use ½ in. in 12 in., 4 use ⅝ in. in 12 in., 1 uses ⅝ in. in 13 in., 1 uses 1 in. in 12 in.

Taper of key: 48 use ½ in. in 12 in., 17 use ⅜ in. in 12 in., 11 use 3/16 in. in 8 in., 5 use ¾ in. in 12 in., 3 use ¼ in. in 12 in., 2 use ¼ in. in 5 in., 2 use 5/16 in. in 12 in., 1 uses ⅝ in. in 8 in., 1 uses ⅝ in. in 12 in.

The taper of the piston rod fit in the crosshead and the key seems to be largely governed by the manufacture of the locomotives.

A summary of the number of threads per inch for nuts shows eight as the most common, although six and ten also are frequently used.

Seventy report little or no trouble when the piston rod is secured to the crosshead with a taper fit and key. Twenty-three report some trouble, much of which has been overcome.

Little trouble with the taper and key design breaking in the crosshead fit was reported when properly fitted. Some reported trouble with nuts but reports varied greatly.

It is felt by the committee that it is more important to rely upon a perfectly fitted taper to hold the rod in place than to depend upon drawing shoulder on the rod tightly against the crosshead boss with the key, as in the latter case workmen are prone to neglect the proper taper fit.

We believe that it is advisable that a ground fit be made for the piston rod in the crosshead, that standard reamers and gages be used to insure that the taper in the crosshead and the taper on the rod are exactly the same, and it is important that the key be properly fitted and a slight side clearance be allowed between the key and sides of the slot; also that the taper of the slot and of the key are exactly the same in order that the key impinges as intended.

The piston rods on modern locomotives are subjected to severe strains, which emphasizes the importance of careful designing, accurate machine work and the most careful assembling.

It is scarcely necessary to emphasize the importance of a large sweeping radius behind the collar for the purpose of dissipating the bending stresses well out into the body of the rod.

It is also believed the crosshead fit should, if possible, be made slightly larger in diameter than the body of the rod; in other words, if the crosshead fit of the rod is so designed and proportioned as to compel the bending stresses to distribute themselves over the body of the rod there is much less likelihood toward failure of the entire rod.

We also believe it is advisable that the keys be made of alloy steel, preferably heat treated, in order to develop the maximum shear values and prevent deformation.

The majority of replies strongly indicate that the key is the preferred method in making crosshead connection to piston rod—all 93 roads report using it exclusively, or on some of their equipment. Most of these roads report little or no trouble from the use of these keys.

In view of the above, your committee hereby recommends adoption of the taper rod and key connection to crosshead.

This report was signed by H. T. Bentley (chairman), C. & N. W.; F. H. Hardin, N. Y. C.; A. Kearney, N. & W.; H. C. Oviatt, N. Y., N. H. & H.; H. A. Hoke, Penn.; C. B. Young, C. B. & Q.; C. F. Giles, L. & N. W.; I. Cantley, L. V.; C. E. Brooks, C. N.; G. H. Emerson, B. & O.; H. H. Lanning, A. T. & S. F.; A. H. Fetters, U. P.; W. Kells, A. C. L.; H. M. Curry, N. P., and George McCormick, S. P.

Discussion on Tractive Force Formula

Mr. Bentley (chairman): It is recommended that these formulas be tried out for one year and at the expiration of that time recommendations made to the A. R. A. that they either have been found justified or that changes should be made therein. It is desirable that the I. C. C. be a party to any formula that is adopted and therefore I would suggest that the committee be continued with the understanding that a check be made of the formulas presented and a request be made for a representative of the I. C. C. to sit with us and approve what is finally decided upon.

O. C. Cromwell (B. & O.): We should back up this formula with further investigation, particularly in regard to the 50 per cent cut off locomotive. Roads generally are satisfied with the old Mallet locomotive formula. It would be well to approve the action of the chairman of the committee.

W. F. Kiesel, Jr. (Penn. System): As stated in the report, a standard formula, even though only an approximation, is desirable. The proposed formulas are theoretically correct in form. The coefficients, therefore, are the only factors open for discussion.

The coefficient for the four-cylinder simple Mallet, with 90 per cent cut-off, of 1.7, is well established. The coefficient of 1.5 for the four-cylinder simple Mallet, having 50 per cent cut-off, has been found correct, when additional steam is supplied through the valve leakage ports, which remain open until the piston has reached 80 per cent of its stroke. Without additional steam through these auxiliary ports, or their equivalent, the coefficient should be reduced to 1.2.

It is apparent that the committee formula for the four-cylinder simple locomotive, with 90 per cent cut-off, is based on an efficiency factor of 90 per cent. Taking *R* as the ratio of stroke to cut-off, the calculation becomes

$$\frac{.90 \times 4}{R + 1} = \frac{.90 \times 4}{\dfrac{1.00}{.90} + 1} = 1.7$$

Correspondingly, for 50 per cent cut-off, we have

$$\frac{.90 \times 4}{\dfrac{1.00}{.50} + 1} = 1.2$$

It is suggested that the committee eliminate the following:

"While the steam which passes through the auxiliary ports has an effect on the mean effective pressure, it is believed that the constant .75 may be used for any locomotive having approximately 50 per cent cut-off."

and substitute:

> "The constant .75 is recommended for all locomotives with approximately 50 per cent maximum cut-off, and with means for supplying auxiliary steam to a cut-off of at least 75 per cent. For locomotives with approximately 50 per cent maximum cut-off, and no means for supplying auxiliary steam, the coefficient .60 is recommended."

I suggest that because it is possible that a locomotive with approximately 50 per cent maximum cut-off and no means for supplying auxiliary steam will be built. In that case it will be necessary to change the coefficient.

The absence of a formula for a compound locomotive, when starting "simple," is commended.

Since the consideration of greatest importance is to have standard formulas reasonably close to actual results, as a basis of comparison between locomotives, the formulas should be adopted as the standard of the Association.

Mr. Bentley: I move that the formulas with the changes and modifications recommended by Mr. Kiesel be tried out and that definite recommendations may be made a year hence, taking into consideration that the Interstate Commerce Commission should be a party to this so that they will approve what is finally adopted.

Motion seconded and carried.

Discussion on Rods

H. H. Laning (A. T. & S. F.): One of these problems is lubrication—both the outer and inner areas. So far we have tried lubrication entirely from the outside. Another matter is controlling the lateral wear on the bushings. When we get all of these problems worked out floating bushings will be a complete success in both main and connecting rods.

A. H. Fetters (U. P.): The Union Pacific has gone into the subject of floating bushings quite extensively in the last three or four years. We began naturally on the middle side rod connection and our experience up to date indicates that the floating bushing will give 100 per cent more service than the single surface bushing.

There are two schools on the question of a wearing shell on the outside of the bushing. Some prefer an outside steel wearing shell as protection against the body of the rod, while others feel that they can get along without the extra shell. It is my belief that the simpler method is the best, and our experience indicates that the wear in the eye of the rod (if the bushing is permitted to turn in the rod) is such a minor matter that you can afford to put a little extra metal into the eye of the rod and turn the bushing in the rod. This has been our practice for the last two years. We experimented by putting a solid bushing on the back end of the main rod on one side of the locomotive and the usual split brass with key and strap connection on the other side. After that engine has been in service about seven or eight months the split brass has been down three times for repairs, and the solid connection has not been down once for anything. The total lost motion in the front and back where rotary bushings are used is 70 per cent less than for the split brass in the same engine.

For the rotary bushing on the main rod we are contemplating now replacing or making all replacement rods on our heavy power with solid back end as well as solid front end, getting away from all key connections. In doing that we will be able to save approximately 50 parts in one main rod—including straps, bolts, keys, washers, nuts, etc.

The material for the rotary bushing is of considerable importance. Something a little harder than brasses and bronzes can be used where only one surface rotates.

It is important to get almost as much surface on the outside of the brass as on the inside. That is to say, the width of the brass should be, if possible, nearly the full width of the brass on the pin, so that there will be little or no overhang on the outside rotating surface. That will help lubrication.

Another thing I think is going to be done in the rotary bushings is to put on two grease cups side by side on the same strap, with two grooves in the circular rotating parts, and two sets of holes so as to have more reserve, because more surface has to be lubricated than with one rotating surface.

W. C. Smith (Mo. Pac.): Some time ago, on one type of locomotive we had a lot of trouble with the middle connecting bushings getting loose. We changed from the pressed-in bushing to the floating bushing and found that we had no further trouble and the bushings ran as much as three times as long as the old bushings. That led us to try them out on back end main rods. On one passenger engine we placed a floating bushing on the back end of the main rod and a split brass on the other side, both in first-class condition. On that particular engine we renewed the split brass three times as compared to once for the floating bushing.

We have had no trouble with lubricating the floating bushings. We recently purchased 50 locomotives (46 heavy freight types and four Mountain type) and put floating bushings in the middle connection, main connections and the back ends of all the main rods. We recently ordered 10 Pacifics and 40 heavy Mikados, all of which will be equipped with floating bushings in the middle connections and back ends of the main rods. In buying new rods or renewing rods we have decided to apply floating bushings in all back ends of main rods on the heavier power.

A. Kearney (N. & W.): My recollection is that the L. & N. used the floating bushing in the front end of the main rod, but not at the back end of the rod. On the Southern Pacific the floating bushing is used in the back end of the main rod but not in the front end. Why is that done?

Discussion on Extended Piston Rods

Mr. Fetters: Some roads like the extended piston rods. Others have used and abandoned them. On the testimony submitted it is scarcely possible for the committee to make a recommendation on this subject.

L. P. Michael (C. & N. W.): The report of the committee indicates a great diversity of opinion as to the benefits from the use of extended piston rods. There must be good reasons why some roads have obtained excellent results where others have found not only no special benefit but have obtained better service without it. Roads which have not had satisfactory service from this device have been unfortunate in that they have used a design of extended piston rod, shoe and guide which has not been suitable. A number of roads which had trouble with original applications have changed the designs and since obtained satisfactory service.

The report of the committee indicates that several roads, when they experienced trouble with this device, removed it. In many cases this must have been done without attempting to change the design to overcome the trouble.

To give satisfactory service it is necessary for the design of an extended piston rod and its details to meet the following requirements:

First. The diameter of the extension rod must be sufficient to support the weight of the piston without springing out of alinement. This is essential, for where the diameter of the rod has not been great enough to prevent springing, the extension rod has in many cases defeated the very purpose for which it was intended by throwing the extension piston rod packing out of alignment and causing both main and extension rod packings to leak and wear out rapidly.

Second. The shoe on the end of the extension rod must be of such design that it will be securely held in position, have ample bearing surface and have a suitable arrangement for lining up the rod to compensate for the wearing away of the bearing surfaces. The adjustment must be such that it can be easily made and also be positive and secure.

Third A suitable positive method of lubrication must be provided for the extension guide and shoe. This lubrication should be continuous, the same as usually provided for main crosshead shoes and guides. The speed of the piston rod extension shoe on the guide is such that periodic oiling is not sufficient. Continuous lubrication is absolutely necessary for satisfactory service.

Fourth. A suitable cover should be provided for the extension rod shoe guide. This cover should be so constructed that it will keep out dust and dirt, be easily and quickly removable and be secure when replaced in position.

If the design and construction of an extended piston rod and its details are such that they meet the four above-outlined requirements, the life of the cylinder bushings, piston packing, piston bull ring and piston rod packing will be greatly increased by the use of this device.

However, it is necessary to maintain the adjustment and alignment of the extension rod; otherwise, the device will not function properly. If the device is not properly maintained it should be removed, as the extension rod and shoe add considerably to the weight of the reciprocating parts, which is objectionable, as it makes the problem of counterbalancing more difficult.

When the extension piston rod is used the length of the main rod must be maintained even more carefully than is usually done. If the piston is permitted to strike the front cylinder head only slightly it almost invariably snaps off the piston rod extension guide close to the cylinder head.

Many enginehouse foremen do not favor the use of the extension piston rod simply for the reason that, with this device, it requires considerably more time to examine or replace cylinder piston packing. The fact should not be overlooked that even though the extension piston rod does cause more work and requires a longer time to examine and replace packing and also requires additional labor and expense to maintain the guide, guide shoe and extension rod packing, this additional labor and expense will maintain the alinement of the piston rod and piston in the proper position to give the longest possible service for the piston rod, piston rod packing, cylinder or piston packing, piston, cylinder bushing and main guides and crosshead shoes. The extra labor and expense required to equip and maintain extended piston rods on larger locomotives is fully warranted on account of the longer wearing and better service rendered. This has been the experience on the Chicago & North Western, which has had locomotives equipped with extended piston rods for more than 11 years.

The report indicates that there is a wide variation in opinion as to the minimum size piston on which this device should be used. Thirty-two roads believe there is no limitation as to the size, while 15 roads say that there is, and would apply them to cylinders over 19, 22, 23, 25, 27 and 28 in. in diameter, each of these figures being the size indicated by one or more roads. The limiting size of piston on which this should be used is an arbitrary figure, which should be decided upon by the individual roads, the governing features being the constructional design and service required of the locomotives.

The Chicago & North Western has used extended piston rods on several lots of Pacific locomotives with pistons 25 in. in diameter and having a 28-in. stroke, and on several lots of Consolidation locomotives with pistons 25 in. in diameter with a 32-in. stroke. The first lot of each type was built over 11 years ago. This road has also extended piston rods on all Mikado locomotives with 27-in. by 32-in. cylinders. It began to build this type of locomotive over 10 years ago.

The service obtained from these locomotives equipped with extended piston rods has been very satisfactory. However, this device is of greater benefit with larger and heavier pistons than with smaller and lighter ones. It is standard practice of this road at this time to use extended piston rods only on locomotives having pistons 27 in. in diameter or larger.

C. E. Chambers (C. R. R. of N. J.): About what per cent do you think the life of the piston packing ring will be increased by using the extended rod?

Mr. Michael: We have no definite figures but we are satisfied that it is considerable and the pistons wear longer. It not only helps the pistons but it keeps the crossheads in line because a great many roads have a tolerance for their pistons. For freight locomotives we allow a wear of 5/16 in. before they are renewed. This means some little movement and permits the guides to get out of line slightly. The extended piston rod helps that condition, in fact, overcomes it.

Mr. Bentley: Would you mind developing, Mr. Chairman, why they are taking them off on some roads and putting them on on others?

C. F. Giles (L. & N.): Our experience coincides with that of the Chicago & Northwestern. We received a large number of U. S. R. A. locomotives during and since federal control without the extended piston rods, and in nearly every case the master mechanics on the divisions where they were operated have asked for authority to apply the extended piston rods.

We applied extended piston rods to the Pacific type engine, which we began building in 1911, but did not apply them to the freight engines. Owing to the differences in wear, extended rods were soon applied to the freight engines as they came into the shops.

Mr. Kiesel: We have used a great many extended piston rods but I do not know whether we ought to keep them or not. I doubt whether there is any road in the United States today that has sufficiently high-grade maintenance to keep up extended piston rods. We may come to the point again when the maintenance is sufficiently good to use the extended piston rod and keep the pistons from riding on the cylinder bushings.

In checking up counterbalance one time I came to the conclusion that by the elimination of the cast-iron rims and making a solid steel facing, the extended piston rod is just about equivalent to the weight that you save by taking off the cast-iron rim; therefore it should make little or no difference in the reciprocating weights.

I agree with Mr. Giles that with high-grade maintenance, the extended piston rod is good and should be used, and if the maintenance is not sufficient to keep the piston off the bushings it is useless, and that is probably the reason why the committee could not make a recommendation because it all depends on the maintenance.

C. E. Brooks (Can. Nat.): I did not intend to say anything about our experience in Canada because on our railways there is just as much difference of opinion whether the extended piston rod should be used or discarded as there is in this country.

We have parts of the road where the extended piston rod is used and sometimes maintained. We have other parts of the road where the extended piston rod is used and frequently not maintained. On the greater part of the road the extended piston rod is not used. Where the extended piston rod is used and maintained it is a good device, but where it is used and not maintained it introduces much worse conditions than if it had never been applied. If there is anything to justify the use of an extended piston rod on large cylinders, the same reasons apply equally to the small cylinders. The maintenance of the extended piston rod where the water conditions are such as to necessitate frequent examinations of the packing ring is a difficult thing and we have found, particularly in those districts, that it is almost impossible to get good service, and for that reason I might say we have generally discarded it.

C. E. Chambers (C. R. R. of N. J.): Our road had four locomotives with extended piston rods; they were taken off and put into the shops and today there is no reason why they want them back again. As a matter of fact, the piston floats when it is working under steam and only drags when it is drifting. If there is a wide base on the piston head you can take care of the additional wear under those conditions. Without them you eliminate three opportunities for steam leakage on the front cylinder head, and that is worth a hundred times what they might save by the best maintenance.

C. F. Giles (L. & N.): Mr. Chambers has mentioned one feature of the operation of locomotives with or without extended piston rods, and that is the character of the railroad over which they are operated with respect to working under steam or drifting. On a level road where they work under steam constantly they have much less trouble with lubricating cylinders than on roads where they have to go uphill for a long distance and then drift for a long distance.

Discussion on Lubrication

F. H. Hardin (N. Y. C.): The efforts of the committee to produce data of definite value that might indicate the course to pursue in the consideration of hydrostatic versus force-feed lubrication of locomotives were not attended by any great degree of success as there seems to be little definite information available as to the relative value of the two systems. While some are strong advocates of force-feed lubrication, there are others who look upon this method of lubrication somewhat skeptically and it appears that it may be necessary to make some special investigation to establish something definite as to the relative merits of the two methods.

The committee has recommended an outline of tests which should be carried out on a number of railroads. It is suggested that these tests, at least in a general way, be conducted under the supervision of the committee and that the roads using or experimenting with force-feed lubrication be called upon, if interested to that extent, to co-operate by fitting up some of their locomotives and conducting a test.

C. E. Brooks (C. N. R.): Mention is made of a few roads that have experimented, as we are experimenting, with the force-feed lubricator. There is no particular mention made of any troubles which have originated with this device. We are experimenting with one of the lubricators mentioned in the report, and we have yet to run into any trouble with this device.

Mr. Kearney: I think force-feed lubrication is very attractive but we have not been able to work it out. We had an engine equipped with the force-feed lubricator running between Richmond and Norfolk for quite a while, but we were unable to get any definite information as to the superiority of the device. At the same time, as I mentioned a moment ago, I am still of the opinion that there must be something in it.

Mr. Brooks: Might I ask what Mr. Lanning's experience has been on the ordinary rolling grades? Have you not been able to effect an economy in oil which we all expect from a force-feed? Have you not been able to get very much better lubrication with a force-feed lubricator than you ever got from a hydrostatic?

Mr. Lanning: In that case the results were satisfactory so long as weather conditions were good. We had a little trouble on account of priming in that particular location. I do not think we saved any oil. At least, I did not find that we did. We got along with about the same quantity, and it is my observation that the oil was not quite as well distributed over the wearing surfaces of the cylinder as it is with the hydrostatic lubricator.

Mr. Kearney: Our line between Richmond and Norfolk is in quite a level country; we did not get any increase in cylinder packing life where equipped with a force-feed lubricator.

Mr. Brooks: I can only give you our own results, which show an increase in mileage per pint of oil of approximately 30 per cent, and a very marked improvement in the condition of the cylinder walls, piston rods, and the life of packing rings, piston rod packing and everything which depends upon lubrication.

Mr. Kearney: How much more mileage are you getting out of your packing rings?

Mr. Brooks: We can't tell you definitely but we think it will run from 35 to 50 per cent more.

Mr. Kearney: That is a mighty big figure.

Mr. Brooks: Yes. That is a big figure.

Mr. Kearney: That is a good guess. We are getting about 22,000 miles from every set of four rings.

Mr. Brooks: That is not in high speed service, though. That would be in freight service. It would be very hard to get that in high speed service.

Mr. Kearney: I should say we get from 10,000 to 15,000 miles.

W. C. Smith (Mo. Pac.): I would like to ask Mr. Lanning what is the difference in the amount of oil consumed with a hydrostatic lubricator as compared with the force-feed lubricator? Have you any figures on that?

Mr. Lanning: I cannot give any definite figures, although we have them. I do not recall what they were. There was considerable increase in the oil consumed in the mountain territory. In the level territory the amount of oil used was about the same.

Discussion on Driving Wheel Lateral

B. H. Gray (Gulf, Mobile & Northern): Have any of the members had any experience with cast steel hub liners applied to driving wheels?

C. E. Chambers (C. R. R. of N. J.): We have used cast steel hub liners quite recently with very good success.

H. W. Codington (N. & W.): We have used sheet steel liners, working against bronze, and we have also used them in the reverse order. We have established in these tests that the rods and liners wear very much the same. If steel liners are to be used, why wouldn't it be just as well to finish the steel center without any liner at all,—it would run a number of years against the bronze box hub,—and then introduce a sheet steel liner when it is found necessary?

G. S. Goodwin (C. R. I. & P.): We noticed that a number of engines that came with steel centers had no hub liners and we let the hub wear on the cast steel and we found it worked out very well. Our practice at that time was to apply cast iron hub liners, but we have changed that practice now.

C. H. Wiggins (B. & M.): We have used plate steel liners and cast iron liners and there seems to be no question about the material. The question is to keep it in place.

Discussion of Mechanical Stokers

A. Kearney (N. & W.): The committee is very much in earnest when it suggests that this subject now be turned over to the fuel committee.

If there is any difference in the consumption of coal between the different types of stokers, I have never been able to find it. We have, however, made quite a number of tests and have found better figures with one than another under certain conditions. Those same figures have been more or less reversed under other conditions, which in the end brings us back to the idea that there is not very much difference in the stoker itself, but we do believe that the most important thing we have before us is the selection of coal for the stoker. In some runs we made in the Allegheny mountains a few years ago we found that the stack losses ran up as high as 47 per cent. Very little more can be worked out of this stoker subject by this committee, but we should get something worth while if we turn now to the selection of fuel for the stoker, and it would be our earnest recommendation that this subject be turned over to the fuel committee. You can get good results if coal is properly prepared, so that the finely divided material has been removed.

B. H. Gray (Gulf, Mobile & Northern): Has this committee made any attempt to figure out what is the cost of maintenance of the stoker?

Mr. Kearney: A few years ago we compiled some figures and it was done very carefully. My recollection is that the cost ran around one dollar per 100 miles. The maintenance amounted to about one-tenth of the cost of maintenance of the locomotive. At one dollar per 100 miles in those days, it will now run, say, five dollars per 100 miles.

M. H. Haig (A. T. & S. F.): Stokers have been firing locomotives pretty successfully, but it is only natural to anticipate still further improvements. Most of the stokers now in the locomotive service have been confined to rather limited space. Manufacturers should design the parts, or the whole stoker for that matter, to make them readily accessible for inspection and for repair.

A stoker will ordinarily run at least two years or perhaps three years with a limited amount of repairs. However, after that time various parts fail. If those parts were so accessible that they could be inspected and repaired readily, it would reduce the number of engine failures.

Because of the limited space in which the stokers are applied, certain parts are covered by pipes and other parts of the locomotive, and the locomotive designer should consider those details in the very first layout of the locomotive and arrange so that the stoker can be repaired without going to a large expense in taking down the parts around it or taking down large parts of the stoker itself.

Mr. Kearney: The manufacturers have been doing a great deal towards reducing the cost of maintenance just exactly as Mr. Haig has said, and I think they would be only too glad to get any suggestions from anyone. We have all the stokers made, except the Elvin. There is very keen competition between the stoker manufacturers and they are after us daily to make changes to increase the stability of the machines, very often faster than we can make the changes.

H. C. Oviatt (N. Y., N. H. & H.): What difference does it make how much fuel economy there is in the stoker; what it costs to lubricate; what it costs to maintain it? There is not a man in the room who would put a stoker on a locomotive unless he was obliged to. We put stokers on because it is a necessity.

It would be unwise and unfair for the committee even to suggest the best type of stoker. Any suggestions of that kind might destroy competition. But it is the duty of the men who come here to listen to these papers to point out the difficulties they are having with each individual stoker and give the committee an opportunity to take them up with the manufacturers and see if they can remedy the trouble.

C. F. Giles (L. & N.): Stokers are now boiled down to four different types. It would be an easy matter for anybody interested to find out for himself, based on the experience that the railroads have had with these four different types of stokers, which stoker is the best to suit the conditions under which he wants to operate. I do not believe there will be any difficulty whatever in applying any one of these four stokers to any locomotive that has been built in the last few years.

Mr. Oviatt: There has been nothing said here about any individual stoker. All we have talked about is *a* stoker and this committee has not given us anything on the economy of maintenance or operation of any one of the four. Where is the fellow way back in the country who is building locomotives going to find that information? If he goes to any one of the four stoker companies they will tell him that they have got the best stoker. He has got to pick out the one that he feels is the most honest. When we come here we should not simply repeat what the committee sets out in its report. We ought to argue the various points in order properly to develop the subject. We should try to find the fellow that has had difficulty with his stokers and have him point out his experience to us.

Mr. Bentley: During the discussion of the locomotive stoker question the subcommittee made a recommendation that has not yet been acted on. I would like to have the matter brought before the convention in order that some action may be taken.

Chairman Coleman: In the discussion the suggestion was made that the report be turned over to the Fuel Committee. Do you desire that done?

Mr. Kearney: That is the request of the committee.

John Purcell (A. T. & S. F.): I make a motion to that effect. *(This motion was duly seconded, put and carried.)*

Discussion on Feed-Water Heaters

L. P. Michael (C. & N. W.) read the section of the report dealing with feed-water heaters and exhaust injectors and then said: A table has been compiled to show the number of heaters in service and on order, and the total for both the open type and the closed type. The list in this table only includes heaters which were reported by the railroads which replied to the questionnaire; therefore the report showing the number of heaters is not complete.

The replies to the questionnaire were such that the subcommittee felt it could not make any definite recommendations and wishes to submit this report simply as a progress report.

H. T. Bentley (C. & N. W.): I would like to ask the members whether they have had improved service from the closed type of heaters when placed ahead of the smokestack. I was wondering whether the location under the smokebox door would seriously affect the vision of the engineer, for a bridge, particularly, and also whether the location on the top of the smokebox would overcome some of the objections that we had to it when it was located down below.

H. C. Oviatt (N. Y., N. H. & H.): We were one of the first railroads to use the closed type of feed-water heater. We installed five of them to start with and the application carried with it an automatic valve. If that operates, all well and good. If it gets out of order you are likely to have a freeze up. When we considered extending the application of the feed-water heater we sought a new location and decided to put it on top of the smoke arch ahead of the stack, and to satisfy ourselves that it did not obstruct the view of the engineer or the fireman we constructed a templet, and used it on a run over the road. We found that the location did not obstruct the vision of either the engineer or the fireman. Since that time, or subsequent to that first application, we have applied approximately 20 additional in the later location and had in mind the application of some 16 or 18. This location eliminates the automatic valve.

We ran all through this last winter without a freeze up that came to my attention, and it would have come to my attention if there had been any serious trouble, because we have been very particular to keep the cost of maintenance of the feed-water heater down as low as possible and I would have known it if there was anything that caused a great amount of difficulty.

We experienced some difficulty with the first installation of the feed-water heater. We expected that but the difficulties with the water pump and some other small details have been worked out to our satisfaction and we feel that we are getting results to justify the extension of the feed-water heater. The difficulties on the road by failures of the feed-water heater are negligible. We have had one or two very minor failures, otherwise nothing to speak of and we feel that the feed-water heater that we use is satisfactory for application on locomotives in either freight or passenger service.

C. E. Chambers (C. R. R. of N. J.): I will subscribe to what Mr. Oviatt has said. We have one located on the bumper, we have 15 located up by the headlight and have 16 coming that will be applied the same way.

E. E. Chapman (A. T. & S. F.): The growing demand for feed-water heaters is shown in that up to March 1 there was a total of approximately 1,000 feed-water heaters either in service or on order in America, and at the present time there are over 1,500, either applied or on order. This means that in about four months there has been an increase of approximately 50 per cent in orders for the application of feed-water heaters. The locomotives built between March 1, 1922, and May 1, 1923, showed that counting all locomotives built or on order in America one-third were to be equipped with feed-water heaters. If switch and industrial engines ordered in this time be eliminated there would be about 50 per cent of the road engines which are now being built or on order to be equipped with feed-water heaters.

The Santa Fe has had feed-water heaters in service under test for about three years, and has the definite policy of ordering new equipment with feed-water heaters. In the various investigations made the service and repair of these feed-water heaters have been closely observed, in which means of properly cleaning the feed-water heaters of the closed type were developed.

In following the feed-water heater locomotives on the long locomotive runs of over 600 miles, it has been found that these locomotives on the last 200 miles of the trip tend to foam more than locomotives not equipped with feed-water heaters. The probable causes of this were: First, the presence of oil in the water from the condensate, and, second, due to working the locomotive harder, thus evaporating more water. The amount of water used by the feed-water heater locomotives, counting the amount of condensate returned to the boiler, indicated that the locomotives having the feed-water heater were worked harder. Where there were only a few of the feed-water heater locomotives on the division the tendency of the enginemen due to the soft sound of the exhaust was to work them harder. The reduction of approximately 30 deg. F. in superheat would also require that an additional weight of steam be supplied to the cylinders.

The use of superheated steam in the steam engine of the water pumps would probably do away with considerable of the trouble which was encountered on this road while testing feed-water heaters which were operated by means of steam valves, as these valves would stick when the boiler foamed. The trouble which was encountered on the road with the open-type heater was that when the pump was stopped while the locomotive was working the water chamber heated up and caused the pump to lose water.

All this indicates that as the various roads are equipping the locomotives with feed-water heaters special attention should be given to keeping these locomotives on the same division so that the enginemen will work the various locomotives uniformly and in this way it is believed that greater economy would result more quickly from the use of feed-water heaters. With the advent of the feed-water heater system on the locomotives and the heating up of the water to an average of 210 deg. F. so that in bad water districts the carbonates are dropped, it would seem feasible to further develop the apparatus for the elimination of this and sulphate scale material from the water before entering the boilers and in this way to eliminate a fuel wasting condition in such districts. An apparatus of this kind has been developed on the Hungarian State Railway and should be taken into consideration while the railroads of this country are now changing the methods of introducing feed-water into the boilers.

Discussion on Exhaust Steam Injector

B. P. Flory (N. Y., O. & W.): The first exhaust steam injector on the N. Y., O. & W. was applied in November, 1921, to a Mogul type engine in milk train service. This engine has 21-in. by 28-in. cylinders and weighs 150,000 lb. on the drivers. It is superheated.

In December, 1921, a test was made of the exhaust injector in comparison with the live steam injector. The test was made between Middletown, N. Y., and Weehawken, N. J., a distance of 78 miles in each direction, the round trip being considered a complete trip.

The train handling milk cars varied from 14 to 19 cars in length. The same engineer and fireman were used throughout the test. The consumption of coal with the live steam injector averaged 4.10 lb. per car mile and with the exhaust injector 3.29 lb. per car mile, showing a saving of 19.75 per cent. As this test was made in the month of December the weather varied considerably. The temperature of the water going in the boiler averaged 198 deg. F. There was also a noticeable drop in back pressure in the cylinder when the exhaust injector was used.

As a result of the test four new Mountain type engines were equipped with one exhaust injector and have been in service a little over a year. There has been no opportunity to make a test on these engines but it has been noticed that when for any reason the exhaust injector is not used considerable more coal is required.

The maintenance of these injectors has been very small so far. There has been some little trouble experienced in the operation of the injectors as there are a number of levers to manipulate and it requires considerable attention from the engineman. The operating arrangement can no doubt be simplified.

Our opinion is that the exhaust injector will give nearly as much saving in fuel as a feed-water heater and that its first cost and maintenance will be less.

Discussion on Crosshead Connections

M. F. Cox (L. & N.): I think one of the most important things in the report is to have the fit just as perfect as it can be made; that is, the piston rod should touch at every point of its bearing in the crosshead.

Chairman Coleman: The secretary has a communication from W. O. Moody (I. C.).

W. O. Moody (I. C.): In preparing a discussion on this topic I feel that we should be privileged to consider what would be termed side lights on the general subject. As the committee has made definite recommendations in favor of the key connection, a general consideration also of this phase of the subject should be in order.

The questionnaire has brought out the fact that there is a wide divergence of opinion and practice in this country as to what is considered the most suitable taper on crosshead fits of piston rods and crosshead keys. For the piston rod ends it varies from ½ in. to 1 in. in 12 in., while the key tapers vary from ¼ in. to ¾ in. in 12 in. The determination of a correct taper for these two important details of construction is a matter of mathematical calculation and investigation and should also include a correct crosshead hub diameter for any given rod fit diameter. If the piston rod taper is too abrupt we loose the holding power due to the wedging action of the taper, while with a slight taper there is a tendency of the rod to draw into the crosshead, which does occur with water between the advancing piston and the front cylinder head, resulting in a partial loosening or shearing of the key. A slight taper has another disadvantage in that it draws the rod into the crosshead to a greater extent due to repeated removal of the rods for stated periods of inspection or repairs and when this slight taper is set it is more difficult to remove the rod than when fitted with a more abrupt taper.

A dummy or draw key device should preferably be employed to force the rod into the crosshead and when once set the standard key inserted. If the structural condition will permit the rod to be forced into the crosshead by blows on the piston end, as is done on the shop floor on trial fits, there would be little or no damage to either rod end or key. It has been noticed that repeated applications of the rod with the regular key upsets the metal in the rod back of and in line with the keyway slot and this upset metal gives a false indication of rod tightness as the rod seats on the upset portion, which may spell disaster before the next removal for inspection. This condition may also result in a loose fit between the key and the forward end of the crosshead hub and occasionally results in rods breaking ½ in. or more inside of the crosshead hub. New rods should be relieved slightly at this point, top and bottom, and should always be inspected for this upsetting before being applied and relieved with a file if necessary. For the best results the piston rods should be a ground fit in the crosshead and not be accepted until a fit indication is shown the full length of the taper. Also the piston rod should be of the best material obtainable and a key of high grade steel used as well. The key should be considered as a device for maintaining the rod in the crosshead fit and not an instrument to make this fit, as it causes too frequent damage to the key. In new rods it is also advisable to have the radius on the key edge correspond with that of the slot-in-rod so that the key will bottom and not wedge on the sides in an endeavor to bottom in the slot. The key should be of even thickness throughout its length with an easy fit at the sides in both rod and crosshead.

We could place ourselves in position to secure additional information by studying the designing stationary engineer's methods of using both nut and key, but occasionally varying these two methods to the extent of threading the rod into the crosshead fitted with a split hub and secured by clamping bolts. This arrangement makes adjustment for clearance easy and accurate, as well as removal of the rod.

Preferably regular assigned men should handle this work in either back shop or roundhouse to be selected not only for their mechanical ability, but as well for their ability to appreciate the importance of good mechanical fits and with a realization of their responsibilities in being assigned to this work.

The crosshead key should be located as close to the hub end of the crosshead as strength requirements will permit, which will bring the key slot in the greatest permissible diameter of the rod with resulting maximum net cross section.

Failures may be induced by the crosshead design or by a lack of maintenance due to excessive play of crosshead in guides, resulting in a bending action piston rod.

The "Laird" type of crosshead, for example, has a tendency to produce strains in the rod near the crosshead hub unless the wear is kept within a safe pre-determined amount.

Chairman Coleman: A motion will be in order to have the report printed and sent out by letter ballot.

Mr. Purcell: I make that motion.

(The motion was duly seconded and carried.)

* * *

Increasing the Average Mileage of Locomotives

Mechanical and Transportation Department Co-operation Essential—Pooling Recommended

By C. F. Giles

Supt. of Mach. Louisville & Nashville

THE FACTOR "average locomotive mileage" is primarily one in which the mechanical officials of the railroads are chiefly concerned for the reason that it affords an accurate record of a character that fairly reflects, in a large degree, the measure of service that is being obtained from the motive power of a certain road as compared with some previous period or with that of other railroads. The locomotive may undoubtedly be considered as the fundamental unit of earning power of a going railroad and, therefore, representing as it does, such a large capital investment, it is obvious that a more intensive use of this equipment within practicable limits will admit of handling a larger volume of business with the same number of locomotives, which will be productive of increased returns in revenue and consequently, greater economy of operation, the ultimate goal sought. However, there are many elements that have a direct or indirect influence upon the matter of increasing the average mileage of locomotives, which I will briefly dwell upon.

C. F. Giles

The Pooling and Distribution of Power

Of most importance, especially in freight service, is the pooling of locomotives, that is, running them first in and first out, or in the order in which they can be gotten ready for service. The distribution of power should be under the absolute control of the chief mechanical officer, or his representative, who will be charged with the responsibility of supplying each division, or territory, with the power needed, or in transferring same from one division or territory to another where it can be used to the best advantage.

Daily Situation and Report Showing Time in Enginehouse

To handle the matter successfully, he must keep himself fully informed as to the conditions existing on each division at all times. First, he should have a daily report to be furnished by the division officers, showing separately for each division the situation each morning; that is, the amount of tonnage ready to move and the number of locomotives available. He must also maintain a daily check as to the power situation at all engine terminals or turning points and have some means of knowing the time required to get engines ready by the mechanical forces, and also know if locomotives are being used promptly by the transportation department after they have been made ready for service. The form, suggested in Fig. 1, has proven of inestimable value for this purpose.

These forms should be prepared for each twenty-four-hour period by the mechanical officers in charge at each engine terminal and forwarded promptly each day to the office of the chief mechanical officer, a copy also being furnished to the superintendent of the division. The chief mechanical officer, or his representative in charge of locomotive operation, will then be in full possession of all information as to the time required to handle each locomotive and may call for a further explanation where it is deemed necessary and in the interests of economical operation.

A consolidation of these reports is made daily in the office of the chief mechanical officer showing the following results (Fig. 2) for each division, and a copy is furnished to the chief officer in charge of operations and transportation.

Dispatchers Notified When Engines Will Be Ready

In addition to these reports it is necessary, in order to prevent unnecessary delay to power after an engine has been made ready for service, to have an arrangement in effect whereby the roundhouse foreman, or proper designated party, will keep the dispatcher, or other designated officer of the transportation department in charge of the calling and dispatching of trains, informed as to the probable time of day or night that locomotives will be ready for service. This information should be furnished the transportation department as soon as possible after the engine reaches the roundhouse. If considerable work is required and it is impossible to make the estimate at the time of arrival, it should be done after the work of repairs has progressed sufficiently to enable him to determine about when it will be ready. A proper spirit of co-operation between the transportation and mechanical departments is essential as it has been found by actual experience that a very great reduction can be made in the time the engines are held in the enginehouse by the above arrangement. An occasional delay in getting a train out on call by reason of the engine not being ready at the time it was first estimated is more than offset by the time saved in getting engines and trains out faster and more readily than would be the case if they waited until all repairs were completed and the engine made ready in every respect before anything is said to the transportation department.

Responsibility for Utilization of Power

Where the distribution of power is under the supervision of the transportation department and the maintenance under the mechanical department, the latter have no special interest in the utilization of same after it has been prepared for service. Under the plan of holding the mechanical department equally responsible for its distribution, as well as its maintenance, should it develop that the transportation department is not promptly using the power after having been prepared for service, the surplus power may be shifted to other points where it can be utilized to better advantage. This method of distributing power has a very material tendency to increase the average locomotive mileage and produces highly beneficial and efficient results in many other respects.

Advantages of Pooling Versus Assigning Locomotives to Regular Crews

While the question as to the advisability of pooling locomotives and with respect to the opposite plan of assigning locomotives to certain engine crews appears to be divided, as both plans have their proponents and are in effect on a number of railroads, it stands to reason that a well organized pooling system in which the engines are delivered to service in the order as they can be first made ready, regardless of engine crews, thereby reducing the time engines are held at terminals, will unquestionably effect a more intensive use of the power and, consequently, reflect in increased locomotive mileage. It is recognized that locomotives, when assigned to regular crews may, to some extent, receive slightly better care while in their charge than when pooled, notwithstanding this fact the benefits from that source cannot be held to equal or offset the advantages had from the more intensive use and increased mileage under a properly organized pooling system. I have had experience with both plans on the same railroad for a number of years and unhesitatingly recommend the pooling plan as being the more economical and efficient from a general standpoint.

Prompt Handling at Enginehouses and Terminals

Any reduction of the period from the time a locomotive is detached from the train in the yard until it has been given the necessary attention in the enginehouse, made ready and attached to another train that is called to depart, should generally accrue to productive time and thus increase locomotive mileage. Therefore, it is obvious that the following operations should be handled with prompt dispatch, viz.: the movement between train yard and enginehouse, over the cinder pit and into the enginehouse for repairs, if necessary, otherwise over the repair or inspection pits outsid of the roundhouse, the coaling, watering, sanding and providing the necessary engineer’s tool equipment, oil cans and supplies, and the outward movement to the train yard sufficiently in advance of the time that the train is called, to admit of departure without delays. Inasmuch as the time devoted to extending repairs in the enginehouse usually consumes a large proportion of the total time that engines are held at terminals, the provision of adequate mechanical facilities at engine terminals, for promptly effecting necessary repairs, is a matter of vital importance. It is needless to state in detail the character of facilities that should be provided for this purpose, as this has been a live and much discussed subject for the past few years, and all railroad officials undoubtedly realize what is needed in this respect at their various engine terminals.

DAILY TIME REPORT OF FREIGHT LOCOMOTIVES HANDLED IN AND OUT

..(Name of Station)..ENGINE HOUSE....(Date)....1923

Loco.	Arrived			Departed			In Eng. House		Locomotive was Ready			Loco. held after being reported as ready for service		Remarks
	Date	Time	AM or PM	Date	Time	AM or PM	Hrs.	Min.	Date	Time	AM or PM	Hrs.	Min.	
	Total													

Note.—When delays occur on account of necessary work being done, full explanation must be made in Remarks column.

Fig. 1

Accounting for Mileage

That the chief mechanical officer and others interested in the subject may know to their personal satisfaction whether or not the results on their respective properties are good, bad or indifferent, it is suggested that they cause an investigation to be made to determine the following factors:

(1) Are your locomotives being credited with all the mileage actually made, including arbitrary switching miles, which, under the instructions contained in the I. C. C. classification of accounting rules, are to be allowed at the rate of six miles per hour for the total time consumed in switching at line-of-road points?

STATEMENT SHOWING TIME OF FREIGHT LOCOMOTIVES IN ROUNDHOUSE, AND LEAVING DURING TWENTY-FOUR HOURS

ENDING MIDNIGHT........................1923

Divn.	Place	Total No. Locos. Turned	Minimum Time		Maximum Time		Total Time of all Locomotives		Time Held Ready for Total		After Service Average	
			Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.

Fig. 2

(2) Compile a statement showing total miles made by individual locomotives each month in passenger and freight service, and after ascertaining the total average number of locomotives in service, less those in the shops for classified repairs; divide the total mileage by the number of locomotives in service and thus determine the average miles made by each locomotive. Comparison can then be made with the previous month, or previous year, and the matter followed up in this manner. Unless the officer in charge has this data, he is working in the dark.

Mr. Giles: (Continuing). I would not presume to say that many of the carriers are not using the same form that we are using for keeping a record of locomotive movements, but in order to make this paper complete I am going to file with the secretary a copy of the forms that we use for this purpose. If anybody cares to adopt them, they can be modified to suit the conditions that obtain on the individual railroads.

Discussion by J. N. Nicholson

Mr. Giles very elaborately covers the need for efficient handling of locomotives at terminals and its effect on locomotive mileage, also the advantage to be gained in pooling of power. These features have greatly increased the mileage per month, over that of the regular assigned locomotive. This is the foundation for the extended locomotive run over more than one operating division.

The extension of locomotive runs beyond the mileage made by one engine crew is being practiced on all main line through passenger trains between Newton, Kan., and Los Angeles, Cal., on the Santa Fe System. Four locomotives are used in handling each train over this territory, an average distance in each direction of 1606 miles, or an average of 401 miles per locomotive. A study of operating costs and conditions shows that it would not be practical at the present time to run passenger locomotives over more than one division between Chicago and Newton, Kan., first, because on the lines from Chicago to Kansas City, Mo., the terminal where most of the running repairs on locomotives are made is mid-way between these two points, at Shopton, Iowa, and on account of limited facilities at the Chicago terminal and congested conditions at the Kansas City terminal, it is not practical to run the passenger locomotives through Shopton. Second, because the division between Kansas City, Mo., and Newton, Kan., runs through the mid-continent oil fields and it is cheaper to burn oil than coal on the passenger locomotives. The length of each passenger division on the territory between Chicago and Newton is: 234.6 miles Chicago to Shopton, Illinois Division; 216.5 miles Shopton to Kansas City, Missouri Division; and 195.7 miles Kansas City to Newton. The locomotives in this assignment are doubled frequently and the twelve month average mileage for all locomotives assigned to through passenger service on the Illinois and Missouri divisions is 6,039 per month.

Extended Passenger Runs

Extended locomotive runs are used on six passenger trains daily in each direction between Newton, Kan., and La Junta, Col., four of these trains being handled through to Los Angeles, Cal., with one additional train daily in each direction between Albuquerque, N. M., and Los Angeles, this latter train being routed over the Southern district, Newton to Albuquerque. The different trains vary from eight to fourteen cars. The scheduled average speed over different operating divisions varies from 24.9 to 46.5 miles an hour for different trains, depending on the grade and number of stops.

The territory over the Western and Arkansas River divisions between Newton, Kan., and La Junta, Col., is practically level or up grade westbound, the ruling grade being 0.8 per cent. westbound and short stretches of 0.6 per cent. eastbound. The distance by way of Great Bend is 369.6 miles, via St. John 355.3 miles, and trains are handled by the company's 1200 class Pacific type locomotives having 23½-in. by 28-in. cylinders, 79-in. driving wheels, and a tractive force of 33,300 lb. These locomotives are hand fired, coal burners. The engine crews change at Dodge City, Kan., which is 157.9 miles west of Newton. The roundhouse is convenient to the station at this point and the locomotive is cut off and taken to the roundhouse for coal, water, cleaning the pan, and filling the lubricator and grease cups. Water is taken at one intermediate point on each of these divisions and no fuel is taken enroute except in extreme weather or with heavy trains. The average monthly mileage was increased 15 per cent. by extending this locomotive run.

Heavy Grades on New Mexico Division

The territory over the three districts of the New Mexico division between La Junta, Col., and Albuquerque, N. M., passes over the Raton and Glorieta mountains. Helper locomotives are used on 175.3 and 184.8 feet per mile grades on each side of the Raton mountains and also on the 158.4 feet per mile grade eastbound on the Glorieta mountain. Exclusive of these helper grades, the ruling grade is 1.7 per cent. westbound and 1.4 per cent. eastbound, with numerous ten degree curves. The distance is 347.5 miles and trains are handled by the company's 3700 class Mountain type locomotives, having 28-in. by 28-in. cylinders, 69-in. driving wheels, and a tractive force of 54,100 lb. These locomotives are stoker fired, coal burners. Prior to extending this locomotive run, three crews and three locomotives were used and the present plan is to use three engine crews, changing at Raton and Las Vegas, N. M., enroute. The mileage for each crew between intermediate terminals is 104.6, 110.6 and 132.3 respectively. Trains of 13 and 14 cars are handled from La Junta to Trinidad, a distance of 81.8 miles, over a practically continuous 1.1 per cent grade without stop, at average scheduled speeds of from 31.6 to 40.9 miles an hour, using about 11,000 gal. of water. Fuel and water are taken at Trinidad and the ash pan dumped at the coal chute. Water is taken at Raton in both directions, lubricators and grease cups filled, and engine crews changed, without cutting the locomotive off the train. The next district is practically continuous 1.3 to 1.4 per cent. down or up grade to Las Vegas and most trains go through for coal and water. At Las Vegas the locomotives are taken to the roundhouse, being convenient to the station, and given coal and water, lubricator and grease cups are filled, ash pan dumped, and engine crews changed. The grade out of Las Vegas is practically continuous 1.7 per cent. to the top of the Glorieta mountain and down grade from Glorieta to Rosario, after which there are rolling grades of 0.5 per cent, to Albuquerque. The hours of scheduled locomotive service are practically the same in both directions and vary from 11 hr. to 14. hr. 35 min. with the different trains. The extending of passenger runs on this territory resulted in an increase of 45 per cent. in average monthly mileage.

The grades between Albuquerque, N. M., and Winslow, Ariz., are 0.6 per cent. in both directions from the top of the mountain at Gonzales, there being 97 miles of this continuous grade on the east side of the mountain. Helper locomotives are used from Albuquerque to Dalies westbound over a one per cent. grade. The entire distance over this territory is 289.2 miles and trains are handled by the company's 1309 and 1327 class Pacific type locomotives, having 23½-in. by 28-in. cylinders, 73-in. driving wheels, and 39,650 lbs. tractive force. These locomotives are hand fired, coal burners, and take coal at Grants westbound and at Houck and Grants eastbound. Water is taken at each coal stop. All locomotives take water, dump ash pan, fill lubricator and grease cups, and change engine crews at Gallup, about mid-way.

Average Monthly Mileage Increased 29 Per Cent

Heavy mountain grades are again encountered over numerous broken mountain ranges between Winslow, Ariz., and Los Angeles, Cal. The altitude at the summit of the Arizona divide is 7,355 ft. above sea level, dropping down to 481 ft. at Needles, Cal. In passing over the Cajon summit of the California mountain range, an altitude of 3,820 ft. is reached, after which the grade descends to an elevation of 267 ft. at Los Angeles. Helper service is used eastbound on this territory as follows: On occasional heavy trains from Los Angeles to Pasadena, 114 ft. per mile grade, on all trains San Bernardino to the Cajon summit, 116.2 ft. per mile grade, and on heavy trains from Ash Fork to Supai, on 95 ft. per mile grade. The ruling grades where single engines are used are 1.6 per cent westbound and 1.8 per cent eastbound. There are numerous curves on this territory with a maximum main line curvature of 10 deg. The distance of locomotive runs on this territory is 606.4 miles via Pasadena and 617.1 miles via Fullerton eastbound. Tracks divide in places on this territory on account of grades, and the westbound track is 3.2 miles shorter than the eastbound. Four crews are used over four passenger divisions and the locomotive is not cut off the train in the entire distance. The company's 3700 class Mountain type locomotives are used, having 28-in. by 28-in. cylinders, 69-in. driving wheels, and 54,100-lb. tractive force. These locomotives burn fuel oil and take a supply at Hackberry and Bagdad enroute in both directions. Water is taken at Flagstaff, Ash Fork, Hackberry, Needles, Bagdad, Victorville and San Bernardino enroute. From 10,000 to 11,000 gal. of water are used between these water stops which is made possible by use of 12,000-gal. tenders on this class of locomotives. The scheduled running time westbound varies from 19 hr., 8 min. to 25 hr., 35 min. eastbound from 19 hr., 20 min. to 24 hr. 20 min. Extending locomotive runs on this territory increased the average mileage per month 29 per cent.

Mileage Increased 53 Per Cent

A passenger locomotive run of 490.6 miles is made from Phoenix, Ariz., to Los Angeles, Cal., consisting of one train in each direction each day. This run joins the main line at Cadiz, Cal., crossing the Cajon mountains described above. The scheduled running time in each direction is 15 hr. The ruling grades are 1.6 per cent in each direction with the exceptions of the 114 ft. per mile grade Los Angeles to Pasadena and the 116.2 ft. per mile grade San Bernardino to Cajon summit, previously mentioned. The locomotives used are the company's 1270 class Pacific type, having 23½-in. by 28-in. cylinders, 73-in. driving wheels, 37,800-lb. tractive force, and burn fuel oil. Prior to extending this locomotive run, three locomotives and three engine crews were used, and since extending the run, three crews are used with one locomotive, the average monthly mileage per locomotive assigned being increased 53 per cent.

Three passenger trains daily in each direction are handled between Kansas City, Mo., and Tulsa, Okla., a distance of 256.1 miles with one locomotive each. The crews are changed at Chanute, Kan., a distance of 126.2 miles from Kansas City. The locomotives used are the company's 1400 class, Atlantic type, balanced compounds, having 15-in. and 25-in. by 26-in. cylinders, 79-in. driving wheels, a tractive force of 22,200 lb., and burn fuel oil.

[Mr. Nicholson also gives full details regarding several other long locomotive runs on the Santa Fe. In general the average monthly mileage as shown in these cases has increased from 18 to 29 per cent.—Editor.]

The coal used between Chicago and Kansas City is from the Illinois and Missouri fields and is classed as high moisture, high ash, clinkering coal, running from 9,500 to 10,260 B.t.u. per lb. as fired. The Colorado coal is used between Newton and Albuquerque and between Clovis and Belen. This coal is a high ash, non-clinkering coal of a low moisture content, runing about 11,700 B.t.u. per lb. The Gallup, New Mexico, coal is used between

Albuquerque and Winslow, it being a non-clinkering, high ash, semi-bituminous coal, running about 11,000 B.t.u. per lb.

Limiting Factor in Long Runs of Coal-Fired Locomotives

The limiting factor in how far locomotives can be run most economically on coal burning divisions, is the condition of the fire. This is influenced by the quality and nature of the coal furnished as well as the skill with which the locomotive is handled and fired. It is believed that there are possibilities of greatly reducing the removable impurities and ash in fuel which will have an important bearing on the condition of fires. Coals having a high content of clinkering ash are not adaptable for long locomotive runs, on account of having to clean the fire by removing clinkers from the firebox. The high ash, non-clinkering coals require frequent dumping of ash pans enroute, which in most cases can be done while taking coal and water, or waiting for orders. The skilled fireman has a tendency to neglect his fire on the last part of the trip as he approaches the final terminal. If banks are allowed to form or the fire allowed to get heavy, there is a loss due to incomplete combustion before reaching the terminal, in addition to the loss due to this unburned coal being dumped into the cinder pit. If it is once established that fires are to be run over the next operating division, the incoming fireman will take better care of his fire and use less coal as a result.

The carrying capacity of the ash pan limits the amount of dead ash that can be shaken through the grates. This capacity in many cases is not large enough to carry the accumulation from high ash, non-clinkering coal over more than one division. The importance of this feature in conection with extending locomotive runs is worthy of serious consideration in the use of ash pan hoppers on the outside of the frame where the trailer design will permit. Also, if the coal is the best that can be furnished and is skillfully used, it is possible that the fire can be kept in good condition for a longer period of time by a better designed grate.

With Oil Burning Locomotives Boiler and Machinery Conditions Limit Runs

The fuel oil used is all put through a process of distillation to remove the lighter, high volatile oils. California fuel oil is used on the Pacific coast from Winslow, Ariz., west. Mid-Continent fuel oil is used from Kansas City to Newton in passenger service and from Newton south to Purcell and west to Clovis in all classes of service. Mexican fuel oil is used from Purcell to Galveston.

The limiting factor in how far an oil burning locomotive can be run most economically is governed by boiler water conditions or machinery conditions rather than the condition of the fire. In Arizona and California, the untreated water on the desert has from 5.5 to 37.9 grains of incrustants in solution and from 9.7 to 63.0 grains of solids in solution, and requires heavy treatment. The treated water contains from 2 to 7 grains of incrustants in solution, and when boilers are washed frequently, they do not scale excessively. The solids in solution are reduced by treatment but it is necessary to wash boilers at the end of each trip over four operating divisions to reduce the concentration of foaming impurities. On this run, from 75,000 to 80,000 gal. of water are used by Mountain type locomotives on passenger runs of from 24 to 25 hr. service. It is necessary to blow out systematically and frequently to keep down the concentration of foaming impurities in the boiler. Where treated water is used, little or no trouble is experienced from the mixing of different waters on the desert territory.

The most severe strains which are set up in a boiler are brought about by expansion and contraction due to heating and cooling that takes place during the process of knocking fires and re-building them. Each time this process is eliminated will increase the life of a boiler, besides save from 2,000 to 4,000 lb. of coal for each terminal that the locomotive is run through.

Increased Lubricator Capacity Needed

In most cases a sufficient force is maintained at intermediate terminals to meet locomotives and fill lubricators and grease cups. The practice of having men meet locomotives to give this service is costly considering the amount of service rendered, and it is believed that a design of increased lubrication capacity can be worked out that will reduce the need for this service at intermediate terminals to such an extent that it can be handled by car inspectors and enginemen. The use of floating bushings has been found to greatly reduce the trouble with hot pins.

Long Runs Not Primarily Responsible for Hot Bearings

The bearings on a locomotive heat up gradually in service until a uniform working temperature is reached. If the bearing is properly proportioned and adequate lubrication is maintained, this working temperature will remain about constant. A check of the hot bearing failures experienced in four months on the Winslow to Los Angeles run of 20 to 25 hr. continuous service shows that 30 per cent of the hot bearings occur on the first operating division out of the terminal, 65 per cent on the two districts of the Arizona division, and 5 per cent of the total cases occur on the last division before completing the run. The two districts of the Arizona division comprise about 52 per cent of the total mileage, making the percentage of total failures per mile about the same as on the first division out of the terminal. This shows that other causes are responsible for more hot bearing trouble on these locomotives than the length of locomotive runs. If the bearings continue to run hotter at the end of four to six hours out of the terminal, it may be that the run over one operating division is the limit for this class of power. The extended locomotive run will require liberal bearing proportions that are as low in weight per unit of area as conditions will permit.

The road-side facilities in the way of coal chutes and water cranes have been located with the idea in mind that the locomotive will always be furnished with a full tank of coal and water at the terminal. Where no main line coal chute and water crane are provided, this will require an aditional stop for coal and in some cases another stop for water, and in some cases will require additional stops on the next operating division. The facilities will have to be developed along lines to meet the needs of extended locomotive runs. In most cases there is apparent need for main line water cranes at the depots at terminals where passenger locomotives are run through. New coal chute locations should be carefully studied with the idea of being able to serve locomotives on the main line as well as at the terminal.

Maintenance Work at One Terminal

It has been the practice for many years to do practically all of the work on a locomotive for the round trip at one terminal and to provide modern facilities for doing work at this terminal. It would cause an increase in repair costs to run locomotives by such a terminal and attempt to maintain the locomotives at a much less efficient terminal. Under these conditions, it is desirable to reduce the layover at the minor terminal to a minimum and make the layover at the principal terminal as great as conditions permit. The issue of prime importance is the highest mileage per day per locomotive with the least expense for repairs with the existing facilities.

Reductions in Repair Costs

The reduction in repair costs varies with different divisions, depending on how much the work is reduced at intermediate terminals by running either the freight or passenger locomotives through. In most cases a slight increase in forces has been found necessary at terminals handling the repair work on locomotives where the runs have been extended. This increase varies from 15 to 47 per cent of the reduction made in forces at intermediate terminals. Changes in locomotive assignment, the increased business handled, the extension of runs on a certain percentage of locomotives handled at the different terminals, and other variable conditions make accurate comparisons on repair costs hard to obtain without exhaustive study. The comparisons available show a decrease of 12½ per cent in total man hours per locomotive turned between Chicago and Kansas City, where only the through freight locomotive runs have been extended. The passenger locomotives between Newton and La Junta, and between La Junta and Albuquerque, are maintained using 147 less men at intermediate terminals and 50 more men at points where repair work is being done. The locomotives on extended passenger runs between Winslow and Los Angeles are maintained using 81 less men at intermediate terminals and 38 more men at points where repair work is being done.

When an intermediate terminal is discontinued, the delayed time of locomotives that were handled at that point is transferred to the point where the locomotive is cut out and unless the assignment of locomotives is reduced or the volume of business increased, there will be a decided increase in locomotives at the end of the run awaiting trains or undergoing repairs. In running locomotives through intermediate terminals, the assignment should be cut a percentage of approximately as much as the intermediate delay reduces the total time per round trip, or congestion of power will occur. If the locomotives depart from the terminal in fleets, there will be a larger assignment needed than where they are scheduled to leave at more regular intervals.

Effect of Variation in Grades

The variation in grades of adjoining operating divisions on the Santa Fe is from 0.6 to 3.5 per cent, which, to some extent, limits the extension of locomotive runs. Divisions of this kind require an assignment of different types of power fitted for the work they are to perform. Mountain type passenger locomotives or the low wheeled Santa Fe type locomotives could not be operated economically over a prairie country nor could the high driving wheeled passenger or freight locomotives be operated economically on a mountain grade.

The Santa Fe is not classed as a road making long locomotive runs as far as mileage is concerned, but mileage alone is not an index of performance that will give the roads operating over mountain grades credit for what they are doing. The scheduled hours of continuous passenger locomotive service and the continuous hours of scheduled through freight locomotive service seems the only basis of comparison that is fair to the roads encountering mountain grades.

Long Runs Not Practical on All Divisions

There are divisions and terminals where the extension of locomotive runs is not practical with the present facilities. However, the extended locomotive run is making marked progress and it has been demonstrated that the increase in locomotive mileage is equal to or greater than the increased mileage due to the general pooling of power over the regular assigned engines. The pooled locomotive and the extended run have doubled the mileage of locomotives on many territories over the regular assigned locomotives. The reduction in forces at intermediate terminals is the largest item contributing to reduction of cost of repairs to locomotives per unit of service. The economies due to making the extensive repairs at a terminal having a high standard of terminal facilities will make possible a high standard of labor efficiency. This, in addition to reducing the amount of work at less efficient terminals, will tend to reduce repair costs. The increased mileage per month gives a larger return from the capital invested in locomotives. The heat stored in a boiler when arriving at a terminal is equal to the heat which can be abstracted from a ton of coal or its equivalent in fuel oil, and this is wasted if the boiler is allowed to get cold. This fuel, and the fuel used holding the boiler under steam waiting for a train, are saved. With these economies in view, the development of facilities to extend locomotive runs more efficiently will follow.

By O. S. Jackson

S. M. P. & M., Union Pacific

Previous to 1921 passenger trains between Council Bluffs, Ia., and Cheyenne, Wyo., 509 miles, changed locomotives at Grand Island, Neb., North Platte and Sidney, Colo., making four engine divisions. In March, 1921, Sidney was cut out, resulting in runs from North Platte to Cheyenne of 225 miles. Results were such that a year later Grand Island was cut out, resulting in a run of 284 miles from Council Bluffs to North Platte—later North Platte was cut out, resulting in a 509-mile run from Council Bluffs to Cheyenne.

The long locomotive run in passenger service is now established practice on the Union Pacific and regular scheduled passenger trains are operating as follows without changing locomotives:

Council Bluffs, Iowa, to Cheyenne, Wyo.	509 miles
Council Bluffs, Iowa, to Denver, Col.	562 miles
Cheyenne, Wyo., to Ogden, Utah	483 miles
Denver, Col., to Ogden, Utah	577 miles
Kansas City, Kans., to Ellis, Kans.	303 miles
Ellis., Kans., to Denver, Col.	337 miles

The Council Bluffs-Cheyenne, Council Bluffs-Denver, and Ellis-Denver runs are operated with Pacific type locomotives developing 38,600 lb. tractive effort, hauling trains having from 10 to 12 all-steel cars, with schedules, including stops, ranging from 32 to 44.9 miles per hour.

The Cheyenne-Ogden run, 483 miles, and Denver-Ogden run, 577 miles are operated with Mountain type locomotives, having a tractive power of 54,838 lb. These engines, which were delivered last winter were particularly designed to withstand the long runs over the mountain territory, where a maximum grade of 1.55 per cent obtains for 30 miles, in addition to hundreds of miles of undulating grade of .82 per cent.

In freight service the following locomotive runs are established in regular service:

Omaha, Nebr., to North Platte, Nebr.	284 miles
North Platte, Nebr., to Cheyenne, Wyo.	225 miles
North Platte, Nebr., to Denver, Col.	278 miles
Kansas City, Kans., to Ellis, Kans.	303 miles
Ellis, Kans., to Denver, Col.	337 miles

We have had the same success in operating locomotives over these long freight runs as in passenger service, and the result has been to reduce the number of freight engines required to handle a given volume of business by approximately 20 per cent.

Training of Personnel Important

We do not feel that the accomplishment of these long runs was a particularly difficult problem, although there were certain factors that required careful attention, particularly the training of all personnel in assuming the new and different duties introduced. We realized from the start the successful operation of coal-burning locomotives in regular passenger service on long runs was contingent on the motive power being in good condition, and on the co-operation of enginemen. While some honest reluctance was naturally encountered in introducing so abrupt a change from the routine to which enginemen were accustomed, this opposition was effectively overcome and our men are now entirely in accord with our policy.

The Union Pacific is fortunate in having admirably adapted fuel for this service. It is a non-clinkering, coking, high volatile coal with low ash content of the following average analysis—

Moisture	11.6 per cent
Volatile combustible	35.92 per cent
Fixed carbon	47.53 per cent
Ash	4.95 per cent
Sulphur	1.48 per cent
Heat value, B.t.u.	11,430

We found it necessary, however, to re-educate our firemen in the handling of their fires so as to bring a proper fire into intermediate terminals, until now it has become the conscientious duty for each fireman to turn over to the next man a fire in such condition as the original fireman would desire to start out with.

There is some saving in fuel by the fireman knowing he must turn over a fire in good condition. This, however, is an unknown quantity. The cleaning of fires while engine is on train is now a very rare occurrence.

Varying Boiler Waters Present a Problem

The harmonizing of the action of the totally different kinds of boiler waters encountered in such a long territory is an additional problem, which our chemical experts have solved in a very satisfactory way. Two important details in this process are the judicious use of anti-scale boiler compound and anti-foam compound. The road-side water softening plants must also be operated with special reference to variation in water supply. Our boiler maintenance due to water troubles, if anything, is less than under former operating conditions.

So far as boiler deterioration and maintenance is concerned, it is evidently an advantage to take the mileage out of a locomotive with a minimum number of times a locomotive is fired up and cooled off, therefore, the long run cannot help but produce a flattering saving in boiler work estimated on the mileage basis.

The principal advantage of longer locomotive runs is the saving in the number of locomotives required to produce a given number of train miles. Another obvious advantage is the saving effected by keeping the locomotive out of intermediate terminals through saving effected in enginehouse expense, running repairs and fuel. We estimate a saving of one ton of fuel for each intermediate terminal passed.

This arrangement of locomotive runs has relieved already congested terminals where additional roundhouse stalls and other facilities would have been necessary in a short time.

Locomotives on our long runs are in continuous service from a minimum of 11 hours to maximum of 16 hours, and the average layover is now about 15 hours after each trip. We expect to reduce the average layover to 12 hours or less, having preferred to be liberal while inaugurating the system. Layovers of less than eight hours after so long a period in service would not be practical except for a few trips at a time.

At approximately mid-points on the long runs, as at North Platte and Green River, lubricators are filled both east and westbound.

These long runs have developed the desirability for a lubricator of sufficient capacity to carry oil for a 700-mile division.

One relief engine is placed at a midway terminal, which can be prepared for service on short notice. This engine protects from 20 to 22 passenger trains per day. We originally started with relief engines at three terminal points, but the reliability of the service justified cutting out all but one. Trains are held at intermediate terminals from five to ten minutes, and at terminals where shop or roundhouse is close to the depot we have a machinist and helper meet all trains. The machinist looks the engines over and makes any light repairs they need or can be made, while the helper fills or screws down grease cups.

Terminal Repair Facilities Concentrated

One of the possibilities of the long locomotive runs is that of concentrating on more adequate improvement at a few important terminals, instead of spreading out the appropriation to cover additional stalls, machine tools, ash pit facilities, etc., at a lot of poorly equipped intermediate terminals. The concentration of improvements at the more important points will bring a bigger return on the investment by making possible a higher degree of labor efficiency at these points.

It is, of course, necessary that after an engine runs 500 miles or more it will require a closer inspection and more work than after it has completed a 150-mile run, but the length of layovers on the long runs has been adjusted so that the extra inspection and work will carry the locomotive through the long run without increasing the chance for engine failure, and our records show that we are now making greater engine mileage per failure than formerly.

Other Discussion

E. F. Allard (C. & N. W.): Mr. Nicholson called attention to the effect on fireboxes of the less frequent knocking of fires. Is there any record as to just what saving there has been?

Mr. Nicholson: I am not able to give any figures on that.

Mr. Allard: How frequently do you find general shopings with the long runs as compared with the previous practice?

Mr. Nicholson: Less, if anything.

Mr. Jackson: The Union Pacific is not trying to get big mileage between general shoping. To keep our locomotives in condition to start out on these long runs we have got to take our locomotives in more carefully. However, we figure that when we do take them in it is less expensive.

Mr. Brazier: I move that a vote of thanks be extended to Mr. Giles for his very able paper on increasing locomotive mileage.

(*The motion was seconded and carried.*)

Message from Sir Henry Thornton

[Sir Henry Thornton, president of the Canadian National Railways was scheduled to address the meeting on Friday. He was unable to attend the meeting, however, but sent a message. Chairman Coleman before reading this message said: I have another message from a man who is a protege of one of the biggest railways in this country. He left this country a number of years ago to accept a position in Europe. He has since returned to Canada to take charge of what I suppose is one of the largest railways, due to consolidation, in the world.]

It was with keen regret that, owing to engagements already made in Western Canada, I was obliged to advise the president of the American Railway Association, Mr. Aishton, that it would not be possible for me to attend the annual meeting of the Mechanical Division of the Association.

As a member of the board of directors of the American Railway Association, I would request you, as chairman of the Mechanical Division, to convey my greetings to the members of that division assembled for their annual meeting, and my best wishes for the success of their discussions and deliberations.

Had I been present personally, I would have said to the members that the board of directors of the American Railway Association, and in fact all of those charged with the administration of railways in the United States and Canada, are looking to them for help not only in maintaining that high degree of service which the roads generally have always given the public, but in improving the service still further.

The public is probably unaware of the good work which is being performed, unostentatiously but effectively, by such bodies as yours. The spirit of co-operation and teamwork which exists in your division, whose members are drawn from many railways with diverse interests and varying conditions, is gratifying and commendable. Very many of the important improvements and economies in transportation service have been due to your efforts and your untiring zeal in the study of mechanical problems and their suggested solution. In these days when transportation costs are to a considerable extent beyond the control of the managements themselves, the work you are doing, having, as it does, for one of its main objects the development of more economical operating methods, is particularly important; and I am sure, in voicing my personal appreciation of your efforts, I am speaking for the executives as a whole. I would like to leave this thought with you: That we are looking to you to help us give the public of the United States and Canada a transportation service which cannot be excelled anywhere in the world.

Sir Henry W. Thornton, K.B.E.

The History of Locomotive Development

Ninety Years of Unceasing Effort By Railways to Utilize Increasing Capacity and Economy

By S. M. Vauclain*
President, Baldwin Locomotive Works

As far as is known, the first vehicle to be actually propelled by steam was a gun carriage built by Nicholas Cugnot, in Paris in 1771, while the first locomotive designed to run upon rails was built in 1803 by Richard Trevithick, a name that is still associated with the locomotive industry in England; a name that has received distinction as well in Egypt and Japan. Strange to say, the first successful effort in locomotion by steam in America was the Oructor Amphibolis, constructed by Oliver Evans in the city of Philadelphia in 1804. Mr. Evans' shops occupied the ground on which the United States Mint now stands; a site now surrounded by the buildings of the present Baldwin Locomotive Works. This locomotive was really a dredging scow. In order to get it from the factory to the river it became necessary to use it as a locomotive that would operate on the streets and without rails to guide it. Its performance was successful, but its utility questionable. Even at that time Mr. Evans realized the advantage of using a high steam pressure and expanding it in the cylinder so as to obtain some greater economy in its use.

S. M. Vauclain

It would be useless to attempt to trace the development of the locomotive in foreign lands. Mention should be made, however, of the first locomotive with a horizontal multitubular boiler, built by Seguin in France in 1827; and also of the famous Rocket, constructed in England by George Stephenson in 1829.

This locomotive was awarded the prize in a contest on the Liverpool & Manchester. It was the first locomotive to combine three basic features which are still universally employed, viz., a horizontal multitubular boiler, pistons directly connected to the driving wheels, and the use of the exhaust steam, which was discharged up the stack, to furnish a draft for the fire, and thus make possible the generation of large quantities of steam in proportion to the size of the boiler.

The first locomotive to be used in the United States was built in England and was named the Stourbridge Lion. It made a few trips on the Delaware & Hudson Canal Company's road at Honesdale, Pa., in 1829, but was considered too heavy for the track and bridges, and was soon withdrawn from service. The first locomotive actually built in America was the Tom Thumb, designed by Peter Cooper, a merchant of Baltimore, and used experimentally on the Baltimore & Ohio in 1830. It was about the size of a hand car, but it demonstrated the practicability of steam as a motive power. Then came the Best Friend, the first locomotive built for commercial purposes in this country, constructed in 1830 at the West Point Foundry in New York for the South Carolina Railroad. This engine was very successful for about seven months, when its boiler exploded, because the fireman became annoyed at the blowing-off of steam at the safety valve and weighted down the lever to ease his mind.

Old Ironsides was built by Matthias Baldwin and put in service in 1832 on the Philadelphia, Germantown & Norristown. Its weight was five tons. It was built under great difficulties. Its operation, all things considered, was very successful. It was quite a while before the officers of the company would permit this locomotive to go out in the rain—on rainy days horses were used—but one day it was caught out on the rails when the rain descended, and proved its utility to operate under such discouraging circumstances. The American locomotive has been out in the rain ever since. It will be noted that Old Ironsides had its driving wheels ahead of the firebox, with one large pair of carrying wheels supporting the front end of the engine. This added greatly to its adhesive qualities.

The further development of the locomotive by Mr. Baldwin led him to introduce a four-wheeled truck, and in this design the driving wheels were placed behind the firebox, which materially reduced the adhesion for traction purposes. The truck had first been used by John B. Jervis in 1831, and it provided the flexibility of wheel-base so essential to locomotives that operated on the sharp curves and uneven tracks of that period.

The engineers of that day seem to have realized the benefit to be derived from high pressure steam, and when Mr. Baldwin introduced ground metallic joints in place of canvas and red lead joints for steam pipes, he opened the way for those who were to follow him in future and employ still higher steam pressure.

About this time the Norris Locomotive Works was established. Mr. Norris succeeded in building a locomotive of the same total weight as Mr. Baldwin's engine but of greater hauling power, by using a four-wheeled truck and placing the driving wheels in front of the firebox, so that a greater portion of the weight of the engine was utilized for traction. The next logical step in locomotive development in order to gain power was to use two pairs of driving wheels, placing one pair in front of the firebox and one behind it. This was done by Henry R. Campbell in 1836, who designed the first American (4-4-0) type locomotive, and had such a machine built by James Brooks of Philadelphia. This locomotive had no equalizing beams between the two pairs of driving wheels and, therefore, did not perform very satisfactorily. In 1837, however, Garrett & Eastwick of Philadelphia built a locomotive for the Beaver Meadow Railroad, and introduced an equalizing bar between the two pairs of drivers, which device was patented by Joseph Harrison, Jr., who later became a member of the firm known as Eastwick & Harrison. Quick to perceive the value of this device, Mr. Baldwin was so pleased with it that he purchased from Eastwick & Harrison the right to use and apply it to all the locomotives he might thereafter build.

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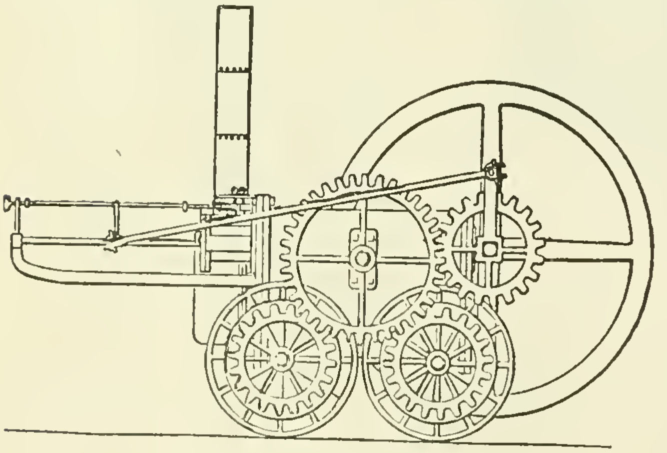
*Mr. Vauclain, because of the serious illness of his wife, was unable to attend the meeting. The address was read by Vice-president Grafton Greenough, of the Baldwin Locomotive Works.

Rigid Wheel Base Introduced by Ross Winans

Mr. Baldwin, ever aggressive, felt that for moving heavy traffic which the railways then were called upon to handle required locomotives of greater power than any previously built. He conceived the idea of a flexible beam truck which would enable him to build locomotives with six coupled wheels. Such locomotives were put in service in 1842, and in the year 1846 had grown into a design using eight coupled drivers, the first two pairs being combined in the flexible truck. The largest locomotives of this type weighed about 30 tons. Ross Winans, of Baltimore, in this same year produced a locomotive with four pairs of drivers coupled, but very compactly grouped and held in a rigid frame. It is therefore doubtless due to his courage that there was introduced and generally adopted the rigid frame construction now employed in our most powerful locomotives. The most notable of these Winans locomotives were the famous Camel engines, which were among the most powerful freight haulers of their day and were built in large numbers up to 1860.

In the late '40's and early '50's the public desire for more rapid passenger service led to the employment of large driving wheels for this class of transportation. Mr. Baldwin, first in the field with the Governor Paine, gave great impetus to the desire for better passenger locomotives. James Milholland, of the Philadelphia & Reading, whose work in the development of the locomotive will pass down into history, in 1852 constructed for that railway passenger engines having driving wheels 7 ft. in diameter. In detail of design, the Milholland engines were undoubtedly among the finest of their time.



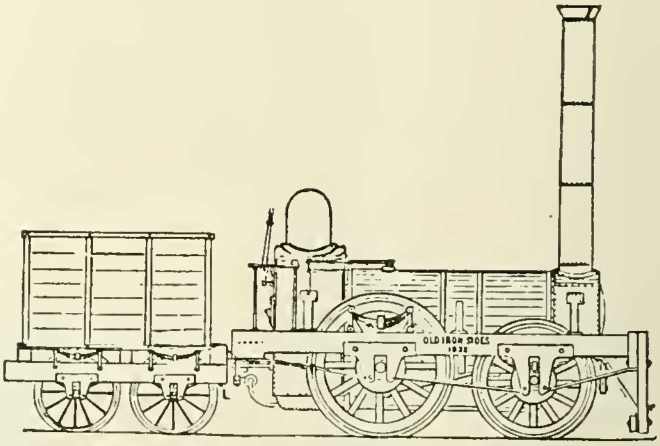
Trevithick's Locomotive, 1803

The Tiger, built by Mr. Baldwin in 1856, for the Pennsylvania, was one of the most successful passenger locomotives of that period. It used wood for fuel and its total weight was some 28 tons. In this same year an engine of this type was built for service in the south and is still working every day at Valdosta, Ga., being in its sixty-eighth year.

During the period of the Civil War almost anything that would run on wheels in the shape of a locomotive was acceptable. Many remodelings were made of antiquated structures, and locomotive designers became quite as numerous as the locomotives themselves. John P. Laird, at the Altoona shops of the Pennsylvania, was most active, and some of his improvements, as for instance the Laird guide, exist today. Much was accomplished, and during the years intervening some of our railway systems began to consider the standardization of their power. This was most consistently and determinedly put in force by the Pennsylvania, and the changes of types on that system, while made regularly in order to keep abreast of the times, have always been given the most conservative consideration before adoption.

The Wootten Boiler

It was not until 1877 that interest was taken by the Philadelphia & Reading in locomotives to burn the refuse anthracite coal then produced in large quantities at the mines, and for which no market was available. The first locomotive of this character was designed by John E. Wootten, of the railway company, and was quite successful. Owing to the increased demand since made upon the steam generators of locomotives, the use of the Wootten boiler has developed what is known as the wide firebox boiler, now used with all kinds of fuel and in all classes of service. The Wootten design was a great departure, in my opinion did more for development and increased locomotive power than any other improvement of that period. It was quite a while before the merits of this construction were acknowledged, but it is now universally used.



Baldwin's "Old Ironsides," 1832

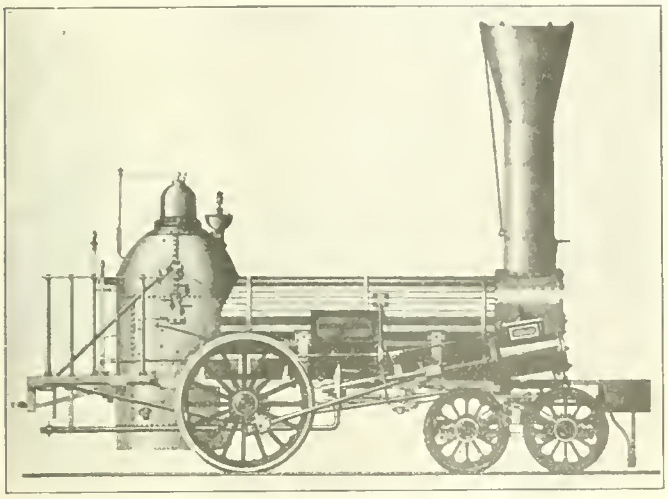
The desire for high speed with large trains where great tractive power was not necessary, led to the introduction, in 1894, of what is known as the Atlantic type locomotive, built to meet the requirements of the Atlantic Coast Line. This type was so successful that it became almost universally employed in passenger service, though under various names such as the Central Atlantic type, Chautauqua, etc. The underlying principle in each case was the same, namely, the use of the trailing wheel to carry the excess load involved by the employment of a boiler of exceptional steaming capacity and having a deep firebox suitable for burning bituminous coal.

The increased requirements of transportation, produced what is now commonly known as the Pacific (4-6-2) type locomotive, which is in general use throughout the country for heavy passenger service. For the heaviest class of service on steep grades, the Mountain (4-8-2) type is now being successfully employed.

The first so-called Consolidation type locomotive, built by The Baldwin Locomotive Works in 1866, was named in honor of the consolidation of the various small railway lines now comprising the Lehigh Valley System. It was a great success, and upon the same principles, Consolidation locomotives of enormous size and great efficiency have continued to be built.

Compounding and Superheating

About the year 1889, American locomotive designers became deeply interested in the compounding of locomotives. A considerable number of compounds of various types has been built and operated abroad. Almost any single expansion type then constructed was capable of having compound cylinders of some design applied, resulting in a more economical performance. Among the various types in use abroad were four-cylinder Mallet locomotives, originally designed for light service, and later built in large sizes for use in Russia. The first locomotive of this type built in the United States was purchased by the Baltimore & Ohio, and had two six-coupled units. It was exhibited at the St. Louis Exposition in 1904, and later operated very successfully in mountain service. But inasmuch as this was a single locomotive, the type did not creat sufficient interest among railway managers to come quickly into general use; and it was not until 1906, when James J. Hill, the Great Northern, purchased five of these engines on my recommendation, that wide-spread interest in the type was created. In order to get a proper estimate of their value, he isolated them and placed them on one section of the road, removing the locomotives of all other types. These locomotives were equipped with leading and trailing trucks, but in other respects were of the same type as the locomotive that had been previously constructed and put in use on the Baltimore & Ohio. The experiment was successful and Mallet locomotives for steep gradients or extreme conditions became popular.



An Early Norris Locomotive

Notwithstanding the fact that compound locomotives proved their economy and gave wonderful results, so far as economical consumption of fuel in freight service and high speed hauling power in passenger service were concerned, owing to the clearance limits prescribed, the constantly increasing size of locomotives made the use of compound cylinders more and more difficult. The use of superheated steam about this time, however, enabled engineers to produce locomotives almost, if not quite, as efficient as the compound locomotives had proven themselves to be, and to still further enlarge the size of units, increase their power and maintain a most satisfactory performance.

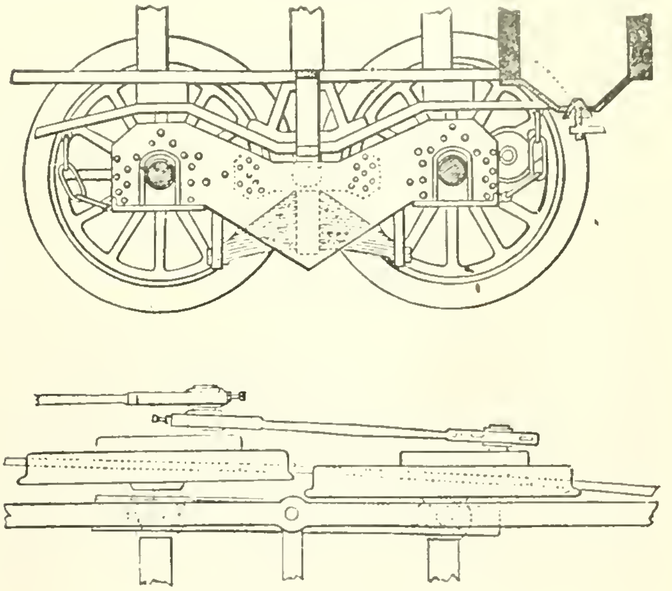
In this connection, mention should be made of two types of locomotives which have proved particularly successful in heavy freight service. These are the Mikado (2-8-2) and the Santa Fe (2-10-2). In both of these the trailing wheel principle as originated in the Atlantic type, has been applied for the purpose of providing increased boiler capacity. Furthermore, there is an added advantage in the trailer, as it provides a guide when running backward.

The standardization of locomotives by the Railway Administration was a great benefit, as the consideration of the designs resulted in a much closer intercourse and exchange of thought among motive power men than could have been obtained in any other way; and while none of the classes developed will be continued in their entirety, many recent designs have as their bases administration locomotives.

There has at all times been an unceasing effort on the part of railway managers to use locomotives not only of greater capacity, but also of greater economy. Determined and loyal support has been given to every invention or contrivance intended to improve the efficiency of the locomotive and thus enable it to accomplish more work. To one who has given his whole life to this work and who has had opportunity to note the changes made from time to time in locomotive designs and appliances, the modern locomotive may be looked upon with some satisfaction; but also with a realization that the end has not been reached, and that the inventive genius of the future motive power experts will considerably change its form and increase its durability, efficiency and economy.

When the Giffard injector supplanted the pump for forcing water into the boiler, it proved a feed-water regulating device that enabled an engineer to operate his locomotive with absolute confidence. Now these same wonderful devices are being replaced by feed-water heaters and purifiers operated by exhaust steam. Can we not expect in the future an improvement that will purify the water before it enters the pump and thus prolong the life of flues and fireboxes?

When the size of locomotives had grown beyond the endurance power of the fireman to supply coal in proper quantity, the mechanical stoker came into play not only to relieve him of this back-breaking recreation, but also to supply the requisite amount of fuel and in a proper manner mechanically to the firebox. The superheater, the mechanical stoker, the feed-water heater and the power reverse gear are now absolute requirements on the modern high duty locomotive. The firebrick arch in its perfected form, a perfection that has required some 50 years to accomplish, is indispensable.



Baldwin Flexible Beam Truck

The trailing wheels under our large locomotives, some of them carrying as much as 60,000 lb. of weight, have suggested the use of what is commonly known as the booster. This mechanical contrivance is simply a small steam engine attached to the locomotive trailing wheels, automatically controlled so that the weight carried by the trailing wheels can be utilized for starting heavy trains or overcoming of short grades which govern the tonnage that can be hauled over certain divisions of the road. By this means trailing wheel locomotives in many classes of service can be made much more remunerative in their operation.

For many years the locomotive has been considered by the layman the most extravagant steam user and coal burning device in existence. This is entirely erroneous. The Pennsylvania at the present time is having built 475 locomotives with a tractive effort of 87,000 lb., equipped with mechanical stokers, fire brick arches, feed water heaters and superheaters of the most advanced type. The cylinders are operated at half-stroke cut-off when developing full tractive effort, and the coal consumption per horsepower by actual test is equal to that of some of our best electrical power houses where turbines and condensers are employed, namely an indicated horsepower-hour for 1.83 lb. of coal. Every user of locomotives should examine carefully the construction of these engines. Notwithstanding the fact that they carry 250 lb. boiler pressure, there are many features employed worthy of general adoption.

A successful effort is now being made by railway managers to increase locomotive mileage by increasing the length of runs, and on a number of roads, notably in oil-burning districts, passenger trains are being run over five, six or seven hundred miles without change, except as to engine crews. One of the important factors responsible for the success of this method of operation is the use of hard grease as a lubricant, as this has eliminated much of the "oiling around."

American Transportation Facilities Best in the World

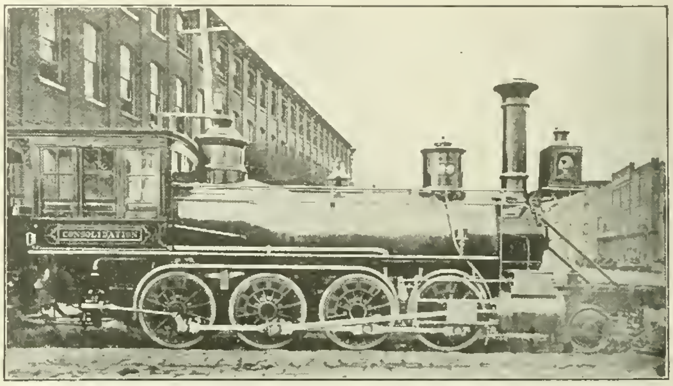
Locomotive development during the past 90 years has been due entirely to the constantly increasing demand of business for better and cheaper transportation. The railway systems we now enjoy have been made possible by the enterprise of our pioneer railway builders of the past, who were courageously supported financially by the public as investors. The people of the United States quickly realized the prosperity that would follow the Iron Trail. Foreign investors were quick to absorb our railway securities and the twentieth century found us far better equipped with transportation facilities than any nation in the world.

This prosperity was naturally noticeable and perhaps in excess of that pertaining to other industries. The political aspirants to fame seized upon the opportunity offered for establishing some very serious opinions among our business friends. The regulation of transportation, as to quality of service, methods of accounting and regulation of rates were soon paramount considerations and indulged in not only by our national legislators, but by state governments as well. The transportation horse was well curried but poorly fed, soon its bones were more in evidence than before so-called scientific management and regulation had been introduced.

Locomotive Built in 1866 and Still in Service

What was intended for regulation in many instances proved to be strangulation, but by superhuman effort our great transportation lines were maintained equal to our business requirements. Terminal facilities had been perfected, the right of way made staunch and secure, by using new bridges, heavier rails and all other underlying requirements for the operation of maximum cars and locomotives.

The large expenditure of $1,540,000,000 this year by the railway systems of this country to perfect and provide their facilities to enable the general business of the country to proceed without interruption, is well known by all. A further reflection shows that an annual increase of 7 per cent in our requirements, will during the next 10 years require at least a 7 per cent increase in railway construction and equipment in order to keep abreast of the demands of an exacting public. In other words, an expenditure of approximately $1,500,000,000 must be made annually during the next decade if we are to have dependable and proper service.



The Original Consolidation Type Locomotive, Built in 1866 for the Lehigh Valley

Over 4,000 new locomotives will be placed in service by our railways this year, capable of developing in the aggregate over 10,000,000 horsepower.

Public Opinion Must Be Put Straight

The time has now arrived when public opinion regarding the railway transportation systems of this country and the operating devices employed thereon must be put straight. There should be a campaign for the dissemination of information and facts concerning terminal facilities, extension of lines, and reduction of delays, also as to the improved mechanical appliances, that are vitally necessary to safety and service, not alone applicable to locomotives but also to other equipment, and the facilities that must be employed to maintain and keep in proper repair the modern high duty rolling stock, so that once more the general public will have confidence in the various railway organizations and will point to their accomplishments with a great degree of pride.

The general business of the country cannot progress faster than its transportation facilities will permit. The productiveness of our farms and workshops will go for naught if we do not have more efficient and more rapid facilities for the distribution of our products. The way to increase prosperity is to increase our general business, and to promote our transportation facilities and various public utilities by confidence and financial support, coupled with the creation of more efficient and economical devices in transportation equipment. We must all go out into the highways and byways of business, and speak to our business friends, encourage them to address their associates and workmen as to the necessity of abandoning the demagogue, political or otherwise, and to create among the general public a return of confidence in the vast army of transportation managers now responsible for the future of our country, and to become stockholders in all public utilities that contribute to our greatness, and especially the American railway.

Increasing Efficiency of Modern Locomotives

Changes Suggested in Various Details of Design—Part Played by Operating Department

Baltasar Martinez, representing the National Railways of Mexico and operated lines, read the following paper describing a new device that is being applied to Mexican locomotives.

Draft Regulator and Low Degree Superheater

Under the subject of "Increased Locomotive Efficiency" I wish to offer remarks in reference to a combined draft distributing deflector and low degree steam superheater, which has been tried out and is being applied generally to the locomotives on the National Railways of Mexico and Operated Lines.

Since the advent of the locomotive as a power unit, one of the principal problems has been the question of proper drafting and distribution of heat to the entire heating surfaces of the firebox and flues. The maximum capacity of a locomotive can only be obtained through perfect combustion in the firebox and by the total and uniform utilization of heating surfaces, together with a proper circulation of water in the boiler.

With the standard Master Mechanics and other draft appliances commonly in use, the center and lower boiler tubes burn out and require renewal sooner than the balance of the tubes and the center and lower parts of the flue sheets show the effect of excessive temperature more than any of the lateral or upper parts of the flue sheets or of the flues in the corresponding parts of sheets. Therefore, it can plainly be seen that the greater portion of the gases passing at a very high temperature from the firebox have followed the path of least resistance, that is, through a triangular section of the flues with the base at the bottom of the flue sheet leading up to, or near the center of the sheet. Due to the fact that the exhaust jet is centrally located in the smokebox and that the area of the point of suction is a great deal less than the grate area of the firebox, it follows that the tendency of the gases or products of combustion is to be drawn through the triangular flue section referred to.

The device we are using is a hollow plate practically corresponding to the dimensions of the periphery row of flues, and placed transversely in the smokebox and parallel to the front flue sheet, at a distance of from 3 to 4 in. from it, thereby retarding to a certain extent the flow of gases through the center section of flues and at the same time creating an increased use of the outer and upper flues, which has the effect of spreading the fire and causing the flames to uniformly heat not only the crown sheet but the side sheets as well.

As a proof of this statement, after one and a half year's service in the smokebox of an oil-burner locomotive, the device was removed and it was found that the impinging of the sand against the plate had created an equal erosion opposite each flue.

By these means we accomplish the utilization of the entire heating surfaces of the firebox and flues, with a consequent and natural increase in the thermal efficiency of the boiler and a better combustion over the entire grate surfaces, resulting from an even and more constant pull over the fire surface; besides, operation of locomotives equipped with this device demonstrates that the fire burns evenly over the entire grate surface, and that as a result there is considerable economy obtained in fuel.

In addition to a more complete distribution of draft, the deflector plate being a hollow one, either part or all of the steam may pass through it, thus delivering to the cylinders a steam of fairly dry quality which may be termed a low degree of superheated steam. Practice has proven that there is sufficient heat taken up by the steam while passing through this device to about offset any tendency to condensation during the period of expansion in the cylinder.

The drying out of steam or low degree superheating is accomplished by allowing the steam to pass through the plate, which maintains a high temperature owing to the impinging and friction of the hot gases as they are expelled from the tubes.

As previously stated, the combined heat distributing deflector and low degree steam superheater was thoroughly tested during 18 months, four years ago, by the National Railways of Mexico. At the present time there are 150 locomotives, both oil and coal burners, equipped with this device and it has been decided that the remaining locomotives should be so equipped.

The general results obtained with the use of this device are as follows: (1) a 13 per cent fuel economy when burning oil; (2) a 15 per cent fuel economy when burning coal; (3) a reduction of 9 per cent in water consumption; (4) a very noticeable decrease in staybolt breakage; (5) a substantial decrease in engine failures due to leakage of flues; (6) the temperature of steam in the cylinders of the locomotive increases 32 deg. F. above the corresponding steam temperature at 200 lb. boiler pressure; (7) a proper and sufficient draft can be obtained through the flues and around the periphery of the deflector plate, with an increased nozzle opening of approximately 3 per cent; (8) no difficulty is experienced in keeping dry pipe and steam pipe joints tight, as this particular construction provides sufficient flexibility to permit expansion and contraction without setting up undue strains at dry pipe and steam pipe joints; (9) one noticeable feature in connection with this device is that there has not been any trouble experienced with flues becoming stopped up. This is explained by the fact that all of the flues are uniformly working.

We have demonstrated to our own satisfaction that the engines are easily lubricated and such lubrication is maintained as easily as in the case of the saturated steam locomotive.

No special oil is required for the lubrication of locomotives equipped with this device, and no difficulty has been experienced as to packing or valves blowing.

There are many other salient points in connection with this device, such as reduction in running and enginehouse repairs, conservation of cylinder and piston packing, etc., all of which have convinced us of the high sustained over-all efficiency of locomotives equipped with this device. I will not attempt to cover these points in detail, as we believe it would be easier and more satisfactory for you to send your own representatives down, who will see for themselves and testify to my statements.

Lighter Weight and Increased Power from Special Steels and Use of Three Cylinders

A. H. Fetters (U. P.): We sometimes forget that the efficiency of the modern locomotive is as much a matter of proper operating conditions as of design. However well a locomotive may be designed we must realize in practice the operating efficiencies by taking advantage of the many daily factors that go toward wasting or conserving locomotive fuel and locomotive service hours. When full advantage is taken of these factors the ultimate economy is reached.

The mere addition to a locomotive of a number of well recognized economical devices does not necessarily produce economy in ultimate operation, but the well planned and scientific application of certain of these devices, based upon their reaction to specific operating conditions, will produce the economies sought.

The last ten years have been marked by a pronounced effort toward increasing the thermal efficiency of the locomotive, as noted by the adoption of the superheater, feed water heater, exhaust steam injector, brick arch, syphon, etc.

Other devices contemplate improvement of mechanical operation, including many well designed specialties of earned recognized merit, and others that have not yet been proven. In contemplating the addition of these economy producing devices to a given design, we should try to strike a balance, so far as possible, between fuel and operating economies thus produced, and the extra maintenance and time out of service, which the addition of a large number of these devices is liable to entail. A 25 per cent saving in fuel is only a saving during the time the locomotive is in actual operation. A well designed conventional type of locomotive without economy producing adjuncts will earn a better reputation on the road than a poorly designed locomotive with plenty of economy accessories.

It is possibly true that the modern locomotive design has reached a point where further progress will be slow and laborious—there are, however, some further possibilities, particularly in the matter of improving the horse-power weight ratio. It is possible that lighter designs will be built in the future, without in any way impairing the strength, by taking advantage of better materials and improved ideas. At present there is undoubtedly an opportunity for eliminating a part of the weight of the heavy conventional design of locomotive frame, which is uneconomical for two reasons: first, on account of the poor stress distribution of metal; second, on account of large sections in cast steel working out poorly in foundry practice. Cylinders are also too heavy and should be designed more frequently in cast steel, with proper wearing bushings.

In the future I believe that staybolts will be made of high-grade alloy steels, having a tensile strength two or three times that of the present iron staybolts, with as good or superior fatigue properties. This seems possible, particularly in view of the large introduction of flexible staybolts.

We have not yet reached the ultimate limit in the reduction of reciprocating weights made possible by the use of still better materials.

In the last few years the metallurgist has presented the locomotive designer with a valuable heritage in highly improved steels, bearing alloys, etc., in which the designer is not always permitted to invest for his employer, who unfortunately so frequently sees only the first cost, and not the dividends.. Limitations in this direction are deplorable and tend to stunt real progress.

We should abandon the practice of buying locomotives like we buy a pair of shoes—ready-made. If we can design a fair locomotive in four months and one good one in six months, we can design a better one in a year or more, and the dividends on the extra time involved will be large.

The modern trend toward longer locomotive runs calls for the use of the best materials that science can produce, coupled with a new effort by the designer to incorporate a real stamina, as the locomotive of tomorrow will be called upon to run a modern marathon in place of the 100-yard dash of our past experience in locomotive runs.

Acknowledging that the modern locomotive has about reached the available limitation of individual axle load, and that little further can be expected in this direction or in the increase in number of axles available for traction, it would appear that any improvement that could be made in the conventional adhesion factor of four to one would give the designer a new hold upon the problem of how to build a more powerful locomotive within the present weight limitation.

As the present adhesion ratio of the two-cylinder locomotive is definitely fixed within narrow limitations, it is my belief that the possibilities of the three-cylinder simple locomotive will soon be exploited. The adoption of a third cylinder makes it possible safely to reduce the factor of adhesion to 3.5 or less, whereby a proportionate amount of tractive force can be developed without increasing the present axle load.

It is my thought that a carefully proportioned three-cylinder simple locomotive with its uniform torque and increased starting effort is worthy of a great deal of study in connection with the problem of starting and handling our excessively heavy modern passenger trains.

Operating Department May Secure Locomotive Efficiency

W. L. Robinson (B. & O.): It is generally understood that proper maintenance, particularly of fuel and capacity increasing devices, is essential for efficient operation, and it is further generally recognized that adequate locomotive terminals and facilities for promptly caring for existing power is necessary. It is understood that many terminals are undergoing re-arrangement of layouts and re-designed facilities for inspection, coaling and cleaning of fires. The efficient operation of the best designed and most modern locomotives is dependent upon such handling at the terminals as will insure flues being properly cleaned, superheater elements functioning properly, smokebox air leaks eliminated, etc. The installation of proper methods of cleaning out carbon from the exhaust passages of cylinders is worthy of consideration. Cases have come under observation where an engine was not performing satisfactorily, but when exhaust passages were cleared of carbon, the operation was equal to what it was when the engine was received from the builders.

Assuming that the mechanical maintenance and handling forces are approaching an efficient basis, attention is directed to features commonly classed as belonging to the transportation or operating department, which if given proper consideration further promote efficiency, among which may be mentioned the following:

1. Determination of greatest gross ton-mileage per hour of crew time or proper tonnage rating and maintenance of highest economical train load.

2. Necessary competent road supervision for instruction of engine crews as to what is expected of them to get the most out of improved design and proven fuel and capacity increasing devices.

3. Disbursement of a continuous uniform quality of fuel. Some coal is too good for railroad use, some not good enough; however, it is preferable to have uniformity in order that the crew may know definitely what to expect.

4. Encouragement and insistence on engineers definitely determining the cause of locomotives not efficiently operating and reporting the irregularities or defects correctly.

5. Serious study of local conditions to determine by what methods increased miles per day may be obtained from locomotives. On a large railroad, one territory may obtain good results by extending the runs over more than one division, another territory by assignment of locomotives to regular crews and another by the extension of the turn-around system.

6. Scheduling of freight trains, thereby permitting roundhouse forces to anticipate when locomotives have to be available.

7. Proper classification and dispatching of trains, making them up so they require little or no switching at congested points, thereby reducing yard delays and permitting of increased amount of "main-tracking," as well as longer runs of locomotives. A study of the instructions regarding "System, Divisional and Through Classification of Freight Service," in effect on the B. & O., prepared by E. T. Horn, chief of yard and terminal operation, cover what has generally proven beneficial.

8. Increased attention to the cost of operation of the various types and classes of locomotives in order that the total cost of operation of the various classes can be determined. The cost of fuel and wages generally runs over 50 per cent of the cost of operation and at present many roads made studies of fuel and wage cost, but are handicapped through inability to obtain the maintenance cost by types or classes of locomotives.

9. Satisfactory water supply in order to reduce the necessity at shop terminals for delays incident to frequent boiler washing, repairing boiler leaks, etc.

The last thought that I had in mind was expressed in a most effective manner by Mr. Storey yesterday in his talk, that was with relation to bringing about a better understanding between the various departments.

I have had considerable experience in some of the various departments and I think that the average mechanical man—I mean in the minor class to which I belong—should better understand the transportation officer and that the transportation officer—the minor ones I am speaking of—should better understand the mechanical officer. I think that is one of the best ways of increasing efficiency on the modern locomotives, a better understanding between the roundhouse foreman and the yardmaster and those people down to and below the rank of superintendent.

General Comments

C. A. Seley: I hesitate to take issue with my friend, Fetters, but there is one point in his paper about which I would like to raise a warning, that is regarding steel staybolts. A friend of mine some years ago, in charge of a road, a subsidiary of the Steel Corporation, said to me, "Why can't we use steel for staybolts?"

I said, "There is a very good reason and, as proof of that reason, there is not a steel staybolt in any locomotive in the United States that I know of."

"Well," he said, "look at the improvement there has been in steel in the last few years. You can tie steel in a double bow knot and do all of these things that you could not do formerly, and that is what you need in a staybolt."

I said, "Try it and let me know what the results are."

I did not see the man for some time, but another representative saw this man within a few weeks and he said, "I will take off my hat to Mr. Seley. I got some chrome-alloy steel, the finest I could get at Pittsburgh; you could do everything with it in a laboratory. I made it into staybolts and put it into the boiler, but it didn't last a week."

Another western road some years ago thought it would try steel for staybolts and got some soft steel and put it in. It lasted a while and then it commenced to break, but the unfortunate feature of the breakage was the fact that the bolts broke in bunches. You are all aware of the breakage of steel axles, crank pins and other parts and doubtlessly have noticed the rather fresh break that sometimes made you wonder what sort of a blow or push or twist or strain could be put on fresh material to do that. It is a characteristic of steel to break in a curious fashion, on account of its homogeneity. Staybolt iron on the contrary is built up. As a result you get your fracture time when you don't know much about it, and that is when you are firing up, when your firebox is full of smoke, when you can't observe the action of the staybolt, and that is the time that it gets a little check.

That starts the progressive fracture and final failure of the staybolt. There are certain things you can do to lessen the breakage of staybolts by design. It is not necessary to go into that in this connection, but as regards the use of steel, permit me to make at least the warning, "Try it if you like."

It is a fact that steel is permitted for staybolts in the marine service of the United States. I have talked with the General in Washington and he admitted it and said he was sorry, but he couldn't help it. He also said that any engineer having trouble with steel staybolts in a marine boiler generally stops the trouble by putting in an iron one.

Another point I would like to bring up is efficiency; whether it is real or whether it is only apparent. In that connection, the remarks of Mr. Aishton with reference to getting acquainted with all the accounting methods were very pertinent. The cost of all these things, in the final analysis, is what counts, and we want to get the proper distribution of all the costs in making tests of new devices or materials that are on the road, of different classes of locomotives against one another, etc.

I was struck with the application of that idea on the discussion of the stoker. It is true that the stoker will permit the use of an inferior fuel and has rather encouraged the use of an inferior fuel. Why shouldn't it? What is the ultimate cost? There is the true measure.

We do things on a railroad in rather a rough fashion. Very often we have been computing these results in ton-miles. What does a ton-mile mean? You multiply the number of tons by the number of miles and you get ton-miles, but in making a test on a locomotive, particularly on a freight run, you are not taking into account the more important factor, that is, the question of time. An engine may take twice the hours that another engine takes in going over the road, but you get the same ton-miles.

As an instance of that, recently a test was made on the N. C. & St. L., a syphon-equipped engine produced a result in ton-miles of a saving of 10.7 lb. of fuel, but in addition to that there was a time saving of 6.55 per cent. Now, there was something worth while. The operating officers of that road think more of that time saved than they do of the coal, and it occurred to me to combine those two expressions into one of saving, "ton-mile-hours," and I got a result of 16½ per cent. The question of time is an element in costs on a railroad, whatever you do.

In this connection I would refer you to a recent discussion in the New York Railroad Club where Col. Emerson, of the U. S. A., gave a very pertinent discussion of ton-mile-hours, or elapsed time, in reference to the real cost of relative operations.

Grafton Greenough (Baldwin Locomotive Works): The thing which affects the efficiency of a locomotive is its ability to grow. It has two limitations. One of these may be termed financial and the other physical. The financial limitations are those that can be removed. Those things have been discussed. They are discussed on every road. They are discussed with almost every order for locomotives which is placed. Those are the things that can be removed. The physical limitations of the tunnels, the gage of track, the quality of the road, its ability to stand a load, those are the things which are ultimately going to be the limiting factor as to what we are able to do with the locomotive until they are removed.

Now the strange, paradoxical aspect of this situation is that those very limitations up to the present time are the things which have made it necessary, irrespective of financial cost or convenience to bring the locomotive to the state of economical efficiency which it now enjoys. For instance, if we had had roadbeds of infinite stability it would not have been necessary to go into the matter of counterbalancing and the use of higher grade steels for moving parts so that the dynamic augment would be reduced to a minimum. Had it not been for the limitations in height and width it would not have been necessary for us to use the superheater and various other devices to get all that is possible out of a boiler in a limited space of time.

The one thought that I wish to leave with you is that we should try to overcome the financial difficulties so that we would plan for the future instead of the present. The time is coming when we will have seriously to consider what is to be done to get more room in which to put the tremendous units of power which we are now making and developing.

* * * *

Locomotives Ready for Shipment, Eddystone Plant, Baldwin Locomotive Works

Report of the Committee on Loading Rules

New Regulations Added for the Pyramidal Loading of Straight Concrete Pipe on Flat Cars

During the past year, the committee as a whole, as well as subcommittees, have held meetings with shippers concerning recommendations for changes and additions to the loading rules. A number of suggestions for changes in the rules were also received from the members. Trial loads, embodying new forms of loading, were sent out and carefully followed to destination in order to determine the safety and practicability of such loadings. In its work, your committee has had the hearty co-operation of the steel and automobile industries and is indebted to their representatives for their able assistance.

As a result of these deliberations the committee submits the following recommendations for changes in the rules for your approval and submission to letter ballot for adoption by the Mechanical Division:

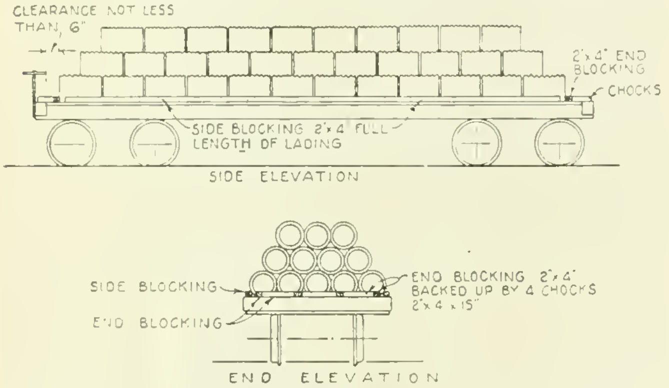

CLEARANCE NOT LESS THAN 6"
2"x4" END BLOCKING
CHOCKS
SIDE BLOCKING 2"x4" FULL LENGTH OF LADING
SIDE ELEVATION
SIDE BLOCKING
END BLOCKING 2"x4" BACKED UP BY 4 CHOCKS 2"x4"x15"
END BLOCKING
END ELEVATION

Fig. 110-A—Loading of Straight End Concrete Pipe on Flat Cars

Rule 5

To make clear to the shipper what weight of lading may be placed on cars, the following additional note is proposed:

"*Where cars are marked with capacity, 80,000 lb. or over, they can be loaded to the above 'Load Weight Limits,' except where other load limit markings are stenciled on the cars.*"

Rule 9

The wording of the section (a) of this rule has been revised as follows to clarify the meaning; the principle of the rule or permitted load weights has not been changed:

"(a) For loads carried on one bearing-piece per car (with or without sliding-pieces) located at or near center of car, the weight of lading must not exceed two-thirds the capacity of car when carried on flat or *drop-end* gondola cars of all-steel or steel underframe construction, or on flat or *drop-end* gondola cars of wooden construction having more than two truss rods. On all-steel *or steel underframe* flat or drop-end gondola cars constructed with fish-belly girders, the weight of lading must not exceed three-quarters of the capacity of car."

It is recommended to omit reference to Fig. 68 in fourth line of Rule 9 (e) and relocate bearing-piece on middle car of Fig. 67. Fig. 68 does not apply to this rule. The bearing-piece on middle car of Fig. 67 should be relocated on account of weight limits.

Rule 19

This rule is revised as follows to take care of special material, such as bridge girders, columns, etc., that are heavy at one end:

"All carrying cars must be considered of the same capacity as the one of lesser capacity, *except where the lading consists of specially constructed material that is heavy at one end. Care should be taken not to exceed weight restrictions covered in Rules 9 (a), 9 (b) and 9 (c) for each carrying car.*"

Rule 21

This rule is revised as follows to permit securing the lift lever where it cannot be readily disconnected from the coupler lock lift:

"The cars must be jacked apart by placing one jack on each side of the coupler, separating the cars until the couplers are pulled out to the fullest extent, inserting metal blocks (except cast iron) to completely fill the space between horn of coupler and end sill, disconnecting the lock pin connection (*where practical*) *or securing the lift lever so as to render it inoperative.* See Figs. 3 and 4.

"*Note.*—Composite spacing block, as shown on Fig. 3-A, may be used as an alternative arrangement for twin or triple loads."

Rule 27

In the twelfth and thirteenth lines it is proposed to change the reference "Figs. 48 or 53" to read "Figs. 49 and 53." Fig. 48 is obsolete. Fig. 49 is included as an additional reference.

Rule 28

The rule is revised, as shown below, to overcome the difficulty experienced by shippers in obtaining the required 4-in. clearance between lading and floor of car with flexible material. The committee considered this safe on steel or steel underframe cars.

"Bearing-pieces must never be placed between bolster and end of car, unless special provision is made therefor in detail instructions. When there is but one bearing-piece on a car, it must be placed at least 12 in. from center of bolster toward center of car. *Sliding-pieces should preferably be placed over the car body-bolster, but in the case of flexible material, in order to obtain the required 4-in. clearance from floor of car, the sliding-pieces may be placed not more than 18 in. ahead of center line of bolster on cars of steel or steel underframe construction.*"

Rule 155

The second paragraph of this rule is revised to omit reference to 10-in. clearance between lading at the doorway and inside of the door line. In maintaining the 10-in. clearance, material loaded longitudinally with the car works out between the sides of the car and tiers at the doorway. The revised rule permits loading material at the doorway to the inside line of the car. This will prevent material loaded longitudinally from working out of place.

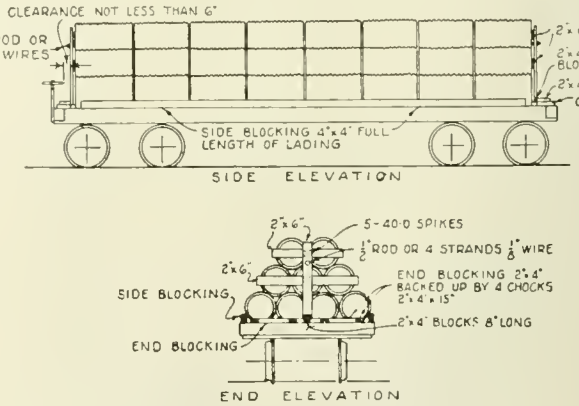


Fig. 110-B—Loading of Straight End Concrete Pipe on Flat Cars

It is proposed to change Fig. 39 to conform to the proposed change in Rule 155.

Rule 207

This rule is revised to omit reference to form of loading shown on Figs. 47 and 48, which are obsolete, and placed on basis of loading shown in Fig. 49, which is the form in common use. It is proposed to omit Figs. 47 and 48 from the rules.

"Large girders loaded on flat side on flat cars, must always be carried on bearing-pieces not less than 3 *in. by* 8 *in. in section.*

Bearing-pieces must be placed near each bolster and not more than 18 in. from center line of bolster. *Spacing planks not less than 2 in. by 8 in. in section must be placed between consecutive girders and girders must be clamped together as shown in Fig. 49. Top clamping pieces to be not less than 4 in. by 6 in. in section (hardwood with ½-in. bolts in each end to prevent splitting) and vertical rods not less than 1 in. in diameter, passing through bearing-piece, floor of car and cleat 2 in. by 4 in. by 18 in. placed longitudinally nuder floor of car.* With loads 24 in. in height or over, braces must be added as shown in Fig. 53."

It is proposed to omit the last three lines of the note at bottom of Fig. 49, reading as follows: "When bearing- pieces must be bolted through floor and cleat as shown in Fig. 37." The bearing-pieces referred to are secured by rods passing through bearing-pieces and floor of car, as shown on Fig. 49, and latter portion of note is unnecessary.

Rule 208

The first paragraph of this rule is revised to permit loading girders and half-roof trusses (single loads) without bearing-pieces where they can be so loaded without damage to the material.

"Open girders, half-roof trusses, and similar material, loaded on *single* gondola cars, as shown in Fig. 50, must rest on two bearing-pieces *when bearing-pieces are necessary to protect car and lading. When loaded on single gondola car with overhang protected by an idler, as shown in Fig. 50-A,* two bearing-pieces not less than 6 in. wide and 4 in. thick *must be used. On all loads, whether supported by bearing-pieces or not, two timbers not less than 4 in. by 6 in.* must be placed above lower chord of trusses or girders, and securely bolted through bearing-pieces, floor and longitudinal cleat under floor. Load must be secured from shifting transversely by pairs of 4-in. by 5 in. hardwood stakes or green saplings 5 in. in diameter at center, and opposite stakes fastened together by means of two 1in. by 6-in. tie boards, one on each side of stake, and secured at each end by three ten-penny wire nails, the boards passing under and touching top chords of trusses or girders. Two blocks about a foot in length and of sufficient height to block outside girders must be securely nailed with not less than six ten-penny wire nails between tie boards against outside girders. Diagonal braces must be fastened to stakes and cross-tie boards."

Rule 223

This rule has been revised as follows to permit increased length of overhang where cars of long wheel base are used.

"This method of loading, as shown by Figs. 58, 59 and 60, may be made use of to load long lattice girders, columns, one-half roof trusses and similar material that would be injured if loaded on more than one car. *The total length of material loaded in this manner shall not exceed twice the distance between center of bearing pieces plus 5 ft., where the material is of uniform weight throughout its length. Where the material is of special construction, with light overhang, a length of overhang not to exceed 70 per cent of the distance between center of bearing-pieces will be permitted. In all cases the limits in Rules* 13 *and* 221 *for length, width and height of overhang shall not be exceeded.* From a point of safety in transit, it is a very undesirable method and should be used only when absolutely necessary. A maximum limit of 80,000 pounds is placed on loads of this character."

Rule 224

It is proposed to omit from the last paragraph reference to Rule 207, making last sentence of paragraph read as follows: "To prevent longitudinal motion, plates or clamps should be applied in the most suitable manner." Rule 207 is no longer applicable.

Rule 225

To conform with the proposed revision of Rule 28, this rule is revised as follows:

"Bearing-pieces must never be placed between bolster and end of car, unless special provision is made therefor in detail instructions. When there is but one bearing-piece per car, either on floor or on top of car sides, it must be placed at least 12 in. from center of car body-bolster toward center of car. *Sliding-pieces should preferably be placed over the car body-bolster, but in the case of flexible material, in order to obtain the required 4-in. clearance from floor of car, the sliding-pieces may be placed not more than 18 in. ahead of center line of bolster on cars of steel or steel underframe construction.*"

Rule 227-B

It is proposed to change the limit for height of load in paragraph (g) from 6 ft. to 7 ft., making the paragraph read, "Loads are limited to 7 ft. in height. For allowable weight of load see General Rules 9-A, 9-B and 9-C."

The width of twin and triple loads is greatly restricted on drop-end gondola cars that are narrow between end gate stops, and it is necessary to load 7 ft. high to get the load allowance permitted under Rules 5 and 9.

Rule 227-D

In the first line of the third paragraph, it is proposed to change the limit for height of load from 6 ft. to 7 ft., making the paragraph read, "Loads 4 ft. and not over 7 ft. in height, two binders, located between bearing-pieces, each binder to be located 3 ft. from bearing-piece."

The change is proposed to conform with change in Rule 227-B, Paragraph (g).

Fig. 61

It is proposed to show the bearing-piece at right side of cut, on top of car side in place of below the top of car side, to conform with requirements of Rule 229.

Sketch A—Page 117

It is proposed to change the note reading "wrought iron plate" to read "iron or steel plate," to permit use of material available at the mills.

Rules for Loading Rolled Material of Small Sectional Area, Rails, Etc., on Open Cars

It is proposed to include General Rule 15 with the group of general rules shown for this class of lading. General Rule 15 covers the wiring together of opposite stakes and applies to the side stakes mentioned in the detail rules under this group.

Rule 302

Rule 302: It is proposed to omit the fourth paragraph of this rule. The paragraph does not adequately cover boiler shells loaded on two or more cars and as this is a special shipment it is recommended that reference to same be omitted from the rules.

New Rule 400-A

It is proposed to add a new rule on pyramidal loading of straight end concrete pipe on flat cars, as follows:

Rule 400-A. Pipe must not be loaded more than 6 ft. 6 in. high from floor of car.

Pipe 12 in. to 32 in. in diameter to be loaded in pyramidal form as per Figs. 110-A and 110-B.

Corrugated pipe must be stepped back from end, one-half length of one pipe; smooth pipe must be stepped back full length of one pipe when end bulkhead is not used.

When necessary to load out to a flush end, a suitable bulkhead with a crossarm on each course above bottom course, as per Fig. 110-B, must be placed on each end, tied with a rod not less than ½ in. in diameter or four strands of ⅛ in. diameter wire from bulkhead to bulkhead through top course of pipe or along center line of load near top. Bulkhead to consist of one 2 in. by 6 in. upright chocked at floor with one 4 in. by 4 in. by 8 in. block, or two 2-in. by 4-in. properly spiked to floor, and one 2 in. by 6 in. cross arm fastened to upright with five forty-penny nails for each course above bottom course.

For pipe 12 to 18 in. in diameter inclusive, use one 2-in. by 4-in for side blocking. For pipe over 18 in. and including 36 in. in diameter, use two 2-in. by 4-in. for side blocking. For pipe over 36 in. in diameter use three 2-in. by 6-in. for side blocking. End blocking for pipe 12 in. and over in diameter to be in accordance with Fig. 110-A.

This rule is prepared to cover straight end concrete pipe loaded on flat cars. This product is now being shipped in large quantities.

Figs. 115 and 117

It is proposed to change these figures to show 2-in. by 4-in. bracing between the bulkheads at doorway in place of 1-in. by 6-in. bracing now shown, in order to increase the strength of the bracing. The change is in line with present practice.

Table of Woods Under Rule 508

It is proposed to omit "Virginia and Carolina Pine" from Group No. 1. It is proposed to substitute. "Short Leaf or Long Leaf Yellow Pine" for the classification "Southern Yellow Pine" in Group No. 2.

After a number of years' experience, the automobile shippers are of the opinion that long leaf or short leaf yellow pine wheel blocks are practically equal in efficiency for blocking automobiles. Further, the character of the wood is such that it is often difficult to distinguish between the two grades. "Southern Yellow Pine" is a more general classification and has led to some confusion in its interpretation. "Virginia and Carolina Pine" is a species of short leaf yellow pine and should be omitted from Group 1 to conform with the proposed change in Group 2.

Rule 519

The note under this rule is changed to cover devices that are in use and giving satisfactory service. "Note—Any mechanical device *used as a substitute for the wheel blocks, side strips or wheel tie downs specified in the rules* will be accepted as an *alternative if equally efficient to that specified in the rules. Drawings and specifications of such devices shall be filed with the loading Rules Committee.*"

Rule 532

This rule is revised to permit use of decking constructed of 2-in. by 4-in. commercial material for cars under 2,000 lb. in weight. This decking when carefully prepared and applied, has given satisfactory service with the lighter cars.

"The truss or horse method is the one recommended. It is adaptable to any size or kind of vehicle. The horse required for vehicles up to 3,000 lb. in weight, consists of two legs to the floor and an arm to the wall of the freight car. *For vehicles up to 2,000 lb. in weight, 2-in by 4-in. commercial lumber may be used for the legs if the horses are prepared and applied in accordance with specifications on file with the Loading Rules Committee. For vehicles over 2,000 lb. in weight and up to 3,000 lb. in weight, 2-in. by 6-in. material shall be used for the legs.* Four horses are required for double-decking and two for tilting vehicles, one for each wheel or axle raised. (See Rule 500 which governs.)"

Rule 533

This rule is revised to conform with proposed changes in Rule 532.

"The horse required for vehicles over 3,000 lb. in weight consists of three legs to the floor and an arm to the wall. *Where three legs are used, 2-in. by 6-in. material will be sufficient for legs on cars up to 5,000 lb. in weight.* For increased weights increase the size of lumber; for instance, a truck weighing 10,000 lb. would have a central leg not less than 4-in. by 8-in. (See Figs. 131 and 132.) (See Rule 500 which governs.)"

Recommendations for New Cars

In a recent conference on Loading Rules, the Steel Shippers offered the following recommendations in connection with new cars:

First—All drop end gondola cars to be equipped with end gates that are easily removed and replaced (pin and cotter type hinge). With drop-end gates secured to the car permanently (and lying flat on the floor) the shippers have difficulty in getting the required 4-in. clearance between end gate and lading on twin and triple shipments.

Second—All flat and drop end gondola cars to be equipped with drop down type brake staff

Third—Allow greatest possible distance between end gate stops on drop end gondola cars.

As these suggestions are matters of design, they are submitted to the Car Construction Committee for consideration in connection with designs for new cars.

The members of the committee are R. L. Kleine, Chairman, Pennsylvania; R. H. Dyer, N. & W.; E. J. Robertson, M. St. P. & S. S. M.; Samuel Lynn, Master Car Builder, P. & L. E.; Ira Everett, Lehigh Valley Railroad, and G. R. Lovejoy, Detroit Terminal.

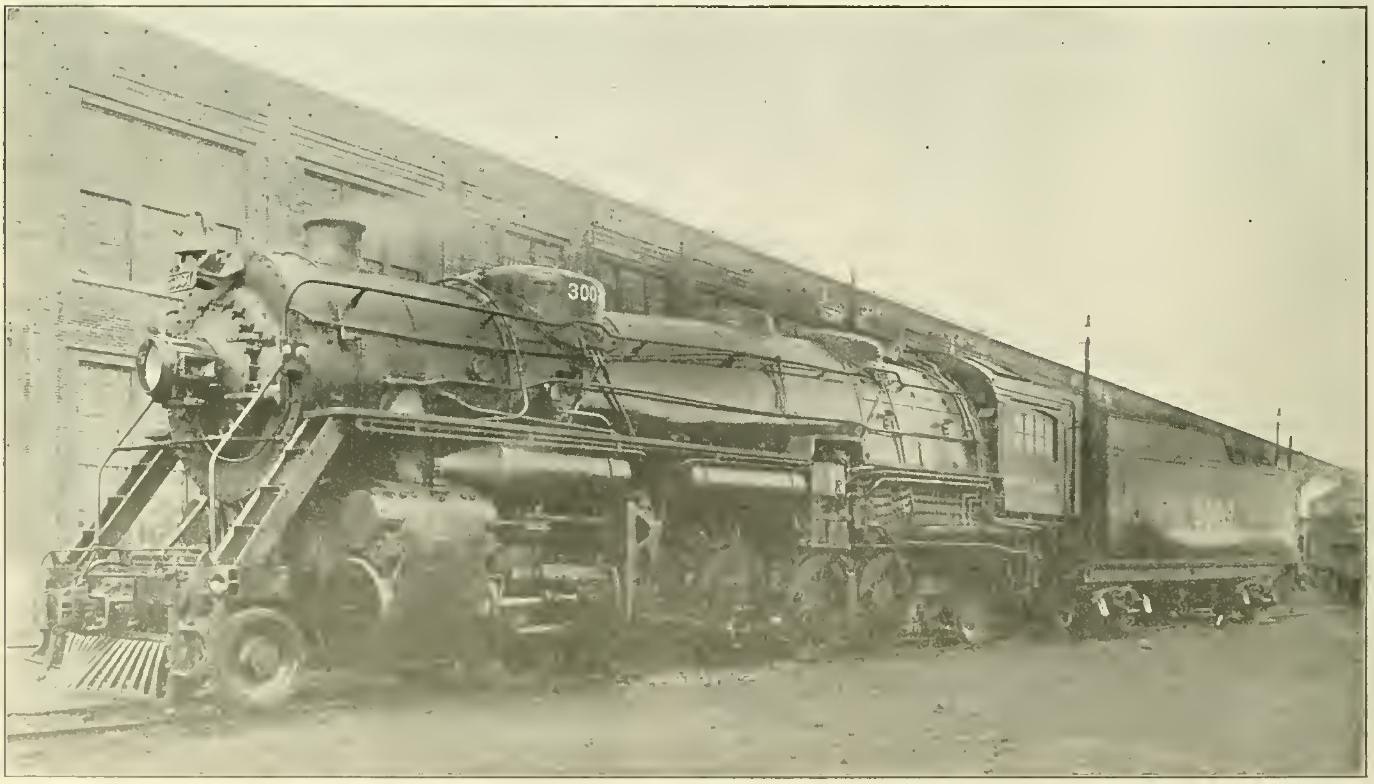
Discussion

F. W. Brazier (N. Y. C.): *I move that the report be accepted and submitted to letter ballot.*

Motion seconded and carried.

Port Washington, Long Island, 15 miles out from New York City, on the Long Island Railroad, is celebrating the twenty-fifth anniversary of the opening of railroad communication into the town. The plaza at the railroad station is the scene of some of the principal festivities, including concerts by three bands.

* * *



New Boston & Maine 2-10-2 Type Locomotive at Billerica Shops

Report on Electric Rolling Stock

The Committee Proposes General Specifications for Periodical Inspection and Maintenance

The committee submits the accompanying rules for the maintenance of electrical equipment, both locomotives and cars, in such general terms that rules covering local conditions can be added to them, and recommends consideration of these rules as the recommended practice of the Mechanical Division of the American Railway Association.

Instructions for Maintenance of Electrical Equipment of Rolling Stock

These instructions are based, in general, on the experience and actual practice of those roads having electrically equipped rolling stock. They are offered as suggested practice for other roads having equipment of this character. It should be understood, however, that the requirements are not binding and may be modified in any respect to suit the local conditions on the roads adopting them. Inasmuch as these instructions necessitate the performance of work on electrical apparatus and circuits, attention is called to the fact that such additional instructions, as may be necessary, must be issued to insure that the work is performed in such a manner as to avoid personal injury to the workmen.

1. Such parts of these instructions as are applicable to any class of equipment, shall be considered to apply to that class of equipment.

2. The periods of regular inspection shall be as follows:

(a) *Locomotives*—Every 2,500 miles, or such other mileage as may be considered suitable.
(b) *Multiple Unit Cars*—Every 1,500 miles, or such other mileage as may be considered suitable.

3. The periods of heavy inspection shall be as follows:

(a) *Locomotives*—Every 10 regular inspections.
(b) *Multiple Unit Cars*—Every 10 regular inspections.

4. The periods of class repairs shall be as follows:

(a) *Locomotives*—Every 150,000 miles.
(b) *Multiple Unit Cars*—Every 100,000 miles.

5. At regular inspections the following work shall be performed:

Main Motors—(a) Inspect motors for mechanical and electrical condition. (b) Gage with feelers the mechanical clearance between armature and pole faces to determine wear of armature bearings; also check lateral movement of armature. (c) Clean commutator and string band. (d) Inspect brushes and brush shunts to determine that brushes are properly seated on the commutator and fit the brush holder, that the brushes do not have copper embedded in the contact face, that the shunt connections are tight and shunts are not broken. Repair defects or renew brushes or shunts. (e) Lubricate armature and axle bearings. (f) Examine air connections and repair defects. (g) Inspect motor nose suspension, gears and pinions, and repair if necessary. (h) Blow out all dirt with dry compressed air. (i) Test insulation resistance with 35,000-ohm magneto, or 1,000 volts to ground for one minute, for short circuits and grounds.

Main Motor Wiring, Including Bus Jumpers—(a) Inspect motor circuit wiring and conduit for mechanical defects and defective insulation. See that all connections are tight. Repair all defects found. (b) Test all motor circuit wiring and connected apparatus, such as rheostats, circuit breaker, switches, etc., with 35,000-ohm magneto, or 1,000 volts to ground for one minute, for short circuits and grounds. Repair all defects found.

Rheostats—(a) Inspect all rheostats for broken grids and loose connections. Repair all defects found. Test rheostats with 1,000 volts for short circuits or grounds.

Circuit Breakers—(a) Clean circuit breaker and inspect contacts and connections. Clean insulators. Dress or renew defective contacts. Inspect supporting bolts and insulators. Test operation, including re-set and tripping device. (b) Where oil circuit breakers are mounted outside of car or locomotive, it will probably be necessary to change the grade of oil in winter and summer. This should be done at the nearest regular inspection.

Reverser—(a) Clean reverser and inspect contacts and connections. Dress or renew defective contacts. Clean insulators. (b) Inspect magnet valves and clean or adjust as needed. (c) Test to see that reverser operates properly.

Switch Group or Contactors—(a) Clean switches and if necessary renew or dress contacts. Examine arc chutes and repair or replace sides if necessary. Wipe off insulator. (b) See that all connections are tight. (c) Examine and clean interlock contacts, examine fingers for tension and adjust if necessary. (d) Inspect magnet valves and clean or adjust as needed. (e) Test to see that switches operate properly.

Transformer and Impedance Coils—(a) Examine connections for mechanical condition. See that connections are tight. Repair all defects. (b) Examine air connections and repair defects. (c) Blow out ducts with compressed air.

Pantographs and Connections—(a) Examine shoes and horns, replacing if necessary. (b) Examine hinges, tubing, links, etc., for wear or defects. (c) Examine shunts and connections for signs of heating or breakage. (d) Examine hoses for leakage or weakness. Wipe off insulators and see that they are in good condition. (e) Test operation. Gage height of low voltage pantographs. See that high voltage pantograph pressures are within required limits.

Trolley Pole and Parts—(a) Inspect trolley base, pole, harp and wheel. Straighten or renew bent or defective poles. Adjust contact tension between harp and wheel if needed. Renew defective wheels. (b) Inspect trolley rope and retriever. Renew rope and repair or renew retriever as needed. (c) See that all parts operate properly.

Third Rail Shoe Beams and Brackets—(a) Inspect third rail shoe beams and brackets for split or broken beams, and broken or loose bracket bolts. Tighten bracket bolts or renew defective parts.

Third Rail Shoe Leads—(a) Inspect third rail shoe leads, connections and conduit. Tighten connections and renew defective parts.

Third Rail Contact Shoes—(a) Inspect third rail contact shoes. Renew worn or broken shoes. (b) Gage third rail contact shoes to see that they are in proper position in both vertical and horizontal planes. Adjust to correct position if necessary. (c) During and immediately prior to cold weather, examine extra pressure devices and sleet scrapers, maintaining them in first class condition. (d) Examine, test, and gage automatic train stops, repairing any defects found.

Third Rail Shoe and Other Fuses—(a) Inspect fuses, fuse blocks and supports. See that proper number of fuses is in each box. Repair or renew if defective. (b) Test fuse clamp, operation to see that it works freely.

Knife Switches and Grounding Switches—(a) Inspect to see that blade meets jaws squarely; that contact surfaces are smooth and make contact all over with proper pressure. (b) Inspect operating mechanism, if any, and see that it operates properly. (c) Inspect connections to see that they are secure and show no signs of heating.

Trolley Lightning Arrestor and Ground—(a) Inspect trolley lightning arrestor. Repair, renew or tighten as may be necessary.

Conduit Carrying 600-Volt Wiring Inside Car—(a) Inspect grounds and test with bank of lamps to make sure the conduit is properly grounded.

Main and Regenerative Control Circuits and Electrical Connections to Air Break Apparatus, Including Jumpers—(a) Inspect control circuit, and electro-pneumatic brake circuit, wiring and conduit for mechanical defects. Repair or renew any parts found defective. (b) Test all control apparatus and electro-pneumatic brake apparatus with 35,000-ohm magneto, or 500 volts, for shorts and grounds. Repair all defects found. (c) Inspect all interlocks for worn or broken fingers and loose connections. (d) Try out sequence of switches and operation of electro-pneumatic brake; checking out for grounds with voltmeter at the same time.

Master Controller and Electro-Pneumatic Engineer's Brake Valve—(a) Remove covers and inspect for burned or broken fingers, rough drum, loose connections, etc. Operate controller to see that fingers have proper lift and clearance. Renew or repair as needed. (b) Test operation of control plug or cutout switch and push buttons. Repair or adjust if needed.

Edison Battery—(a) The electrolyte shall be adjusted to the proper level, using an Edison cell filler, by adding distilled water. (b) The voltage of the battery as a whole shall be read, the battery discharging for one minute at approximately normal rate. Individual cell readings shall also be taken. (c) Should the voltage of the battery as a whole average 1.2 volts per cell or less, the battery shall be fully charged. If any cell is materially lower than the average, action shall be taken to overcome the trouble.

Lead Batteries—(a) Check the voltage and specific gravity of each cell. If the voltage of the battery as a whole is lower than normal, or if the individual voltage or specific gravity of any cell is lower than the average, determine the cause and rectify it. (b) Fill all cells with distilled water to proper level. If the level of electrolyte in any cell is found materially lower than that of the average, determine the cause and rectify it. (c) Keep the terminals and connections clean and cover with vaseline to prevent corrosion.

Circuit Breaker Re-set Switch—(a) Inspect circuit breaker re-set switch. Dress or renew contacts if necessary. (b) Check operation of circuit breaker.

Relays—(a) Inspect and adjust if necessary, all relays, seeing that they function properly and are in good condition.

Comptroller Motor, Blower Motor and Motor Generator Set—(a) Inspect motors and motor generator set for electrical and mechanical condition. (b) Check bearing wear by use of feeder gage in air gap. (c) Clean commutator if necessary. (d) Inspect brushes and shunts, see that brushes fit properly to commutator and in brush holder. See that holders are not worn and that shunts are in good condition, that no copper is embedded in brush surfaces. Repair defects or renew brushes. (e) Lubricate bearings and see that oiling device is in good condition. (f) Make any other repairs necessary. (g) Blow out with compressed air.

Compressor Governor and Governor Switch—(a) Inspect contacts. Dress or renew if necessary. Examine shunts. (b) Clean switch piston insulator. (c) Test operation. Adjust for pressure desired, if necessary, or renew diaphragm.

Switchboard—(a) Clean panel. (b) Inspect switches. Dress or tighten contacts as may be necessary. (c) Inspect fuses. Renew defective ones. See that they are properly held by clips.

Headlights and Headlight Resistances—(a) Clean lens and reflector. (b) Renew lens if necessary. (c) Inspect connections and resistance, and test if necessary. (d) Test headlight.

Heater and Heater Wiring (During Heating Season Only)—(a) Inspect heater connections. Tighten if necessary. (b) Test heaters. Repair or renew defective parts.

All Auxiliary Apparatus and Circuits—(a) Test all auxiliary apparatus and circuits with 35,000-ohm magneto, or 1,000 volts, for shorts and grounds. Repair all defects found.

Fan and Intake Box—(a) Check fan for vibration and repair if necessary. (b) Open intake box. Remove air straining device if used, and replace with clean one, after blowing out box thoroughly with compressed air.

Miscellaneous apparatus—(a) Inspect all apparatus not mentioned and place in good condition.

Blowing Out With Compressed Air—(a) After completion of inspection and repairs, all apparatus should be thoroughly blown out with dry compressed air, taking care not to use sufficient pressure to damage insulation.

6. At heavy inspection periods, in addition to the above work, the following shall be done:

Main Motors—(a) Test all parts with 1,000 volts alternating current to ground for one minute. (b) Clean string bands and paint with insulating paint or varnish if needed.

Main Motor Wiring, Including Bus Jumpers—(a) Test all motors, motor circuit wiring, and connected apparatus, with 1,000 volts alternating current to ground for one minute.

Circuit Breakers—(a) Clean and oil all moving parts. Clean and oil piston, renewing packing cup if needed. Remove valve magnet armature and valves, cleaning and repairing as needed. (b) Test breaker under load to see that it opens at proper current.

Reverser—(a) Clean and oil all moving parts. Clean and oil pistons, renewing packing cups if needed. Remove valve magnet armatures and valves, cleaning and repairing as needed.

Switch Group or Contactors—(a) Remove magnet valve armature and valves, clean and repair as needed. (b) Give interlocks and fingers special attention. (c) Replace leaking packing cups.

Pantographs and Connections—(a) Clean insulators of high voltage-pantographs and test with megger. (b) Test insulation of low voltage pantographs, with 1,000 volts alternating current to ground for one minute. (c) Clean and lubricate cylinders of high voltage pantographs every fifth inspection, and of low voltage pantographs every tenth inspection.

Third Rail Shoe Leads and Shoes—(a) Remove tape from terminals and examine for broken wires or defective soldering. Repair as needed and re-tape. (b) Clean and paint shoe beams with black asphaltum paint. (c) Test shoes and cables with 1,000 volts alternating current to ground for one minute.

Main and Regenerative Control Circuits and Electrical Connections to Air Brake Apparatus, Including Jumpers—(a) All control wiring and connected apparatus shall be tested for grounds and shorts with alternating current, as follows: Battery control equipment, 500 volts; line control equipment, 1,000 volts.

Control Jumpers—(a) At least once each year all train line jumpers to be removed from service, cleaned and repaired. A current of 45 amperes for ½ minute shall be applied to all wires as a test for fractured cable strands and loose connections.

Edison Batteries—(a) Clean tops and outside of Edison cells with dry compressed air or dry steam. Coat top of cans with heavy vaseline and seats of valve caps lightly with Edison battery oil.

Lead Batteries—(a) Remove battery, and after filling each cell to proper level with distilled water, give the battery an overcharge at normal rate for at least one hour after the specific gravity for each cell has become constant. After this overcharge, adjust gravity in each cell.

Compressor and Blower Motors—(a) Test with 1,000 volts alternating current to ground for one minute.

Motor Generator Sets—(a) Remove motor generator, clean, repair and paint as found necessary, test windings by applying 800 volts alternating current for a period of 30 seconds on the alternating current end and 500 volts alternating current for a period of 30 seconds on the direct current end. (b) Replace on car or locomotive and check output on direct current end with ammeter and voltmeter.

All Auxiliary Apparatus and Circuits—(a) Test with 1,000 volts alternating current to ground for one minute.

7. At class repairs, in addition to the work done at regular and heavy inspections (except voltage tests) the following shall be done:

Main Motors—(a) Inspect motor shaft for wear, etc. Renew if necessary. (b) Remove armature, clean, dip in insulating paint and bake. (c) Renew band wires if necessary. (d) Turn commutators and undercut. (e) Inspect, clean and paint motor housing. (f) Clean, dip in insulating paint and bake motor fields. (g) Inspect armature and axle bearings. Renew or repair as may be necessary. (h) Inspect pinions for wear and defects. Renew if necessary. (i) Inspect gears and flexible drive for wear and defects. Renew any parts found unfit for service. (j) Inspect all bolts and suspension parts. Repair or renew as needed.

Main Motors and Main Motor Circuits—(a) Test insulation resistance with megger before and after voltage test. (b) Apply 1,500 volts alternating current momentarily and 1,000 volts for one minute. (c) Clean and paint all cables.

Main Transformers and Impedance Coils—(a) Remove from car, clean thoroughly. (b) Paint all connections. (c) Test windings with megger. (d) Replace on car.

Circuit Breaker—(a) Remove circuit breaker, clean, dip and bake coils. Place in good mechanical and electrical condition. Renew worn parts as needed.

Main and Regenerative Control Circuits and Apparatus—(a) Remove switch groups or contactors, master controllers, relays, etc. Entirely dismantle and overhaul. Adjust tension of fingers and clean interlock contacts. Adjust magnet valves, replacing parts as needed. Replace packing cups in all air cylinders and renew contact tips and arc chutes as needed. Repair worn parts of switches or contractors. Dip and bake contractor coils. In reassembling, see that all parts are in adjustment. (b) Test control parts of battery control equipment with 500 volts to ground for one minute. Test control parts of line control equipment; and main current parts of all equipment, with 1,500 volts momentarily to ground, followed by 1,000 volts to ground for one minute. (c) Test insulation resistance with megger before and after voltage test.

Blower and Compressor Motors and Motor Generator Sets—(a) Remove and dismantle. (b) Clean, dip and bake armatures and fields. (c) Clean and paint frames and leads. (d) Turn commutators and undercut if needed. (e) Renew band wires if needed. (f) Examine bearings and renew if worn. (g) Reassemble and test with 1,500 volts alternating current momentarily to ground, followed by 1,000 volts alternating current to ground for one minute.

Other Apparatus and Circuits—(a) Dismantle, overhaul, and place in first class condition. Inspect wiring for chafed or broken places, loose terminals and defective taping. Repair or replace as needed.

Edison Batteries—(a) Clean tops and sides with dry steam to remove all foreign matter and loose paint. (b) Dip in suitable insulating paint to coat bottoms and sides of cans and crate, but not tops of cans. (c) Test for capacity. (d) Renew solution if needed. (e) Replace defective cells and fully charge battery.

Lead Batteries—(a) Remove the battery and dismantle entirely. Wash out sediment and clean plates. Straighten or replace buckled and worn plates, replace defective separators, test jars for leakage, repair or replace weak crates, reassemble and fill with new electrolyte, overcharge for at least one hour and adjust gravity of electrolyte.

All Equipment—After assembling on locomotive or car, test all apparatus and connected wiring as follows: (a) Apparatus and wiring carrying power current, 1,500 volts alternating current to ground and between circuits momentarily followed by 1,000 volts alternating current to ground for one minute. Test with megger before and after voltage test. (b) Control apparatus and wiring on line control equipment, 1,500 volts alternating current to ground momentarily followed by 1,000 volts alternating current to ground for one minute. In addition, test between all circuits with 1,000 volts alternating current momentarily. Test with megger before and after voltage tests. (c) Control apparatus on battery control equipment, 500 volts to ground for one minute. In addition, test between all circuits with 500 volts momentarily. Test with megger before and after voltage tests.

The members of the committee are: G. C. Bishop (Chairman), Long Island; W. L. Bean, N. Y., N. H. & H.; J. H. Davis, Electrical Engineer, B. & O.; J. V. B. Duer, Pennsylvania; A. Kearney, Superintendent Motive Power, N. & W.; C. H. Quereau, N. Y. C., and L. K. Sillcox, C., M. & St. P.

Discussion

J. H. Davis (B. & O.): I did not come prepared to present this paper, thinking that Mr. Bishop, the chairman, would do so. There has been no meeting of the committee, and Mr. Bishop prepared the information and submitted it to the committee members.

There has been some criticism relative to recommending these rules, or submitting them as recommended. No provision has been made for the daily inspection of electrical equipment for either locomotives or multiple unit cars. I believe it would be well for the committee to consider a revision of the paper and provide for further inspections.

In general these specifications or instructions are applicable to any class of equipment. Reference is made to the third-rail shoe and other fuses. I believe the committee will want to modify that a little. What we are really trying to cover is fuses as well as third-rail shoes.

I believe that this paper, when finally prepared and put into a little better shape, will be a valuable one for the member companies having to do with the operation and maintenance of electrical locomotives and multiple cars and I hope there may be some discussion in order that the committee in making any revision may have before it all the information possible.

Chairman Coleman: The committee would like to review this paper, possibly, for another year. It is now before you for discussion and a motion would be in order to accept the paper to be printed in the proceedings and the committee continued for further investigation, to prepare a full report next year.

Mr. Giles: *I move that the paper be accepted and printed in the proceedings and the committee continued.*

Mr. Oviatt: It will be noted that the committee has specified certain mileages and still leaves it optional with the operating officials to determine the extension of that mileage before the inspection is made. From my knowledge of this class of equipment one of the most important things is an inspection based upon definite mileage; in other words, to find out your troubles before they really happen. This refers to mighty important electrical equipment and I would second the motion that the committee be continued and this paper brought before the convention next year with not only definite recommendations as to the mileage, but more complete material in line with the suggestions as to inspection, maintenance and so forth.

Questions Wisdom of Proposed Instructions

L. K. Sillcox, (C. M. & St. P.): In general, a uniform set of instructions for the maintenance of electrical equipment of rolling stock is, at least under the present conditions, neither feasible nor desirable. Such rules or instructions must have as their purpose either one or both of the following objects: 1. The standardization of maintenance practice. 2. To serve as a guide for a set of instructions to those roads which are in a position to need such assistance.

With the first object in mind, I believe that the tendency to comprehend under uniform rules complex and often dissimilar equipment operating under dissimilar conditions and which particularly as regards locomotives, is not and, in the present state of the art, cannot be standard, is to be deplored. I am heartily in accord with the standardization, not only on paper but actually in practice, of those things which in their use and application are universal enough and similar enough to make their standardization profitable, but do not believe that the proposed attempt comes into this class. The resulting rules can, at best, be but a compromise and actual practice will vary just the same.

A competent management will adhere to a program based upon its own experience or the expert experience of those familiar with the problem. If the proposed rules are intended for the guidance of those contemplating electrification, their value will be questionable as, owing to the fact that certain items cover certain types only, it will not be known which are applicable and which are not, without the advice or under the direction of those having experience, in which case the rules would be unnecessary. In any event, the maintenance work will actually have to be done by men who are experienced in such work, and to them many of the detail instructions, covering operations required and involved in maintenance, will appear superfluous and unnecessary.

The most feasible and profitable way for any road to handle the standardization of maintenance, either of methods at one shop or as regards uniformity at the different shops of the road, is through meetings at which are represented those who are connected with the operation and therefore in the best position to determine the questions involved and keep the situation lined up to the requirements as they develop. This might be supplemented by occasional interchange visits of proper supervisors of the different roads, so that proper improvements in methods or practice developed in a particular case may, if applicable, be mutually taken advantage of.

It will be seen from the above that I question the soundness of the principle of the proposed instructions, feeling that the latter cannot be laid down with the specificness attempted, for the equipment and conditions varying so widely, and still possess the value which A. R. A. rules, etc., should possess.

Suggests an Alternative Course

If the urge for the standardization of maintenance, under such dissimilar conditions, cannot be resisted, the following alternative course might be considered:

Agree to what is meant by the terms "regular inspection," "heavy inspections," "class repairs," etc., as applied to electrical equipment and as is undertaken in your pamphlet, "Steam and Electric Locomotive Repairs," June, 1921; develop the character of the work usually covered under each term and, if desired, supplement this with a statement by each road covering, in general, the character of equipment it maintains, and its usual maintenance practices.

The proposed instructions, outside of the length of periods, are fairly comprehensive for 750-V. direct current locomotives or multiple-unit equipment and the low-voltage and the high-voltage alternating current locomotives and multiple-unit equipments, but do not fairly comprehend the high-voltage direct current locomotives or multiple-unit equipments or the high-voltage end of alternating current locomotives. If these could be eliminated, then the objections might be less.

Disregarding the views, as expressed above, the following general comments are made on the rules as they stand:

Comments on Proposed Rules

Introduction. The wording of the first sentence does not make clear, it seems to me, what the purpose of the instructions may be. Are they considered as the result of investigation of the practices existing on different railroads to represent the best practice, and is it the intention that the different roads joining in the investigation are in the future to be governed by them? Or, are the rules gotten up merely for the guidance of those roads which do not have an organization suitably experienced to evolve their own set of rules? The instructions are stated to be based "on the experience and actual practice of those roads having electrically equipped rolling stock." What roads, then, are the "other" roads referred to?

I think that the wording of the first sentence is misleading, as in many cases, at least as far as our railway is concerned, practice deviates from that indicated by the suggested rules more than the use of the modifying words "based" and "general" justify.

I think it might be inferred from the third sentence in the introduction that the roads participating in the preparation of the instructions have agreed to adopt them as general practice with but minor modifications, whereas I think it will be found where the best maintenance obtains, that the modification "to suit location conditions" will govern, rather than the practice outlined.

I presume "to suit local conditions" comprehends differences in policy with respect to standard of maintenance, etc.

The last sentence might be considered as implying that no additions to the instructions would be necessary except those required to insure safety to the workmen. This, we are sure, cannot be intended. The additional detailed instructions which must be issued adequately to cover the type of equipment used on a particular railroad would comprise a very appreciable addition to the general rules.

Article 1: This is not quite clear. Does it mean that all the rules do not apply to all classes of equipment and only the rules that fit a particular class of equipment are to be deemed applicable?

Article 2: Inasmuch as it is left to each road, and properly should be if the most economical and satisfactory results are to be obtained, to determine the suitable mileage figure, I do not quite see the desirability of giving a fixed figure. Moreover, there may be in individual cases, other bases which would determine the inspection period, rather than the mileage basis; for instance, particularly in the class of multiple-unit systems. Here the practice of inspecting after the use of a certain number of kilowatt-hours is looked upon with favor. I do not mean to intimate that this would be a desirable basis in all cases, but to emphasize the point that circumstances alter cases.

As only two classes of inspection are covered (the current inspection given a locomotive when it reaches a terminus and goes into the engine house apparently being disregarded), the inference would be that usually there is no other inspection given or required. I presume this is not the intention.

Article 3: I consider the periods given as too arbitrary; they should at least be modified by some such additional wording as, "or as many as operating experience may indicate to be best and most economical."

Article 4: General remarks above apply. The use of the word "shall" in the instructions indicates compulsion and we believe is out of place; but particularly objectionable with respect to Article 4. The reason a railway makes classified repairs at a certain time, or after a certain period of mileage, or after something else, is because it needs to, the necessity being determined as indicated by an unusual number of failures, or by observation of general conditions, or by past experience either with the equipment or similar equipment in a given service, and not because it happens to be a rule which has been agreed upon.

With respect to "Class Repairs," we are not clear as to how the use of this term corresponds to its use in your pamphlet of June, 1921, in which the class of repairs is based essentially on the character of the work necessary, rather than on mileage, the latter being referred to merely as an expectancy.

Regular Inspection, Heavy Inspection and Class Repairs

Testing Insulation. Under regular inspection, main motors, etc., it is stated, "Test insulation resistance with 35,000 ohm magneto, or with 1,000 V to ground for one minute, for short circuits and grounds." What might be intended is first roughly to test the insulation resistance by 35,000 ohm magneto to ground or between isolated circuits, or to test the di-electric strength of insulation to ground or between circuits. If no di-electric test is intended by the use of 1,000 V. (a. c. or d. c. not specified), then a voltmeter, or megerg, would of course be implied, unless only an indication of a complete breakdown is wanted. If no di-electric test is wanted, then a time interval is of no value. If di-electric test is wanted, then the voltage, to do any good, would depend upon the character of the insulation and the voltage for which it is designed. Incidentally, under heavy inspection a. c. voltage is specified.

Regular Inspection, Main Motor and Motor Wiring, etc. If it is intended to apply proper a. c. voltage for one minute to interconnected d. c. machines, certain voltages detrimental to the insulation may be set up if the current is taken from transformers, etc., having a steep wave front and if the inductance and capacity of the circuits bear certain relations.

The clarifying of the intention, as above, of the use of suitable high potential, instead of 1,000-Volt a. c. or di-electric test, and the cautioning against the improper use of a. c. voltage for interconnected d.c. circuits is recommended.

General: R. I. (Regular Inspection) and H. I. (Heavy Inspection). In some cases only inspection is called and no rectification. Should not a uniform form be adhered to?

R. I. and H. I. In some cases inspection is called for under a sub-letter and then the following subs cover detail which is really comprehended by the general term of the preceding sub referred to.

R. I. and H. I.—Pantograph. Why differentiate between the inspections, adjustments, cleaning, etc. (except insulators), between high and low voltage, between a. c. and d. c.? What is high voltage? What is low voltage? What about lubrication of pantograph shoes?

R. I.—Fuses. What about inspection as to proper size as well as proper number of fuses?

R. I.—Lightning Arresters. What about height and condition of electrolyte? What about removal of lightning arresters in winter?

H. I.—M. G. Sets. Why remove M. G. sets? Why check output?

C. R.—Main Motors. Is it necessary or desirable to take out field coils? Is it necessary or desirable to turn and under-cut commutators? We have many that have never been turned.

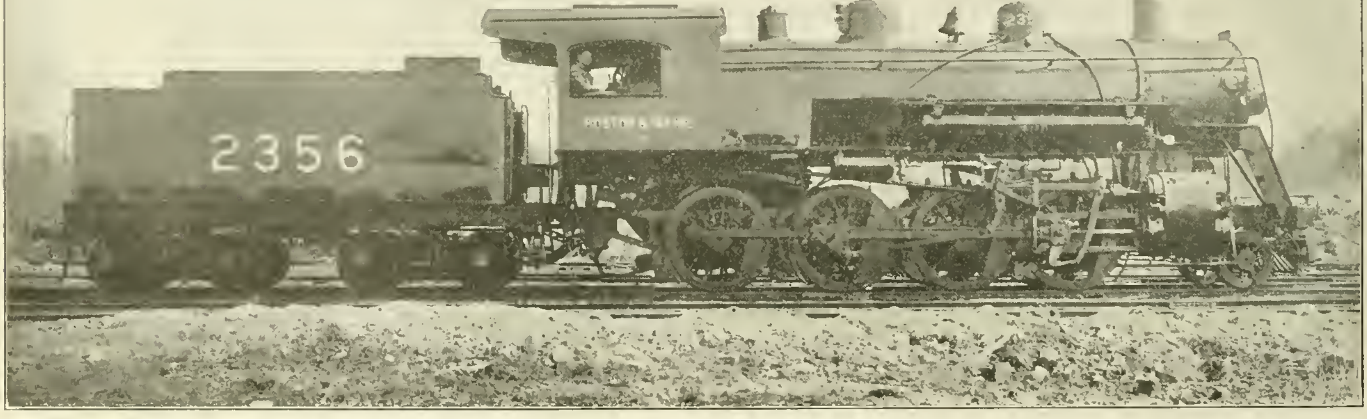
C. R.—Circuit Breakers. Is it necessary or desirable, particularly in the case of low voltage control, to remove coils and re-insulate unless necessity is indicated by test or otherwise?

C. R.—Main and Regenerative Control Circuits and Apparatus. Is it necessary to remove and dismantle contactors, etc.?

C. R.—Compressor Motors and M. G. Sets. Is it necessary or desirable to remove field coils?

(The question was then called for, put and carried.)

* * *



Rebuilt and Modernized Boston & Maine Consolidation Locomotive

Specifications and Tests for Materials

Numerous Changes in Present Requirements—New Specifications for Water Glasses, Hose, etc.

The committee submitted a report on subjects before it for consideration during the past year and in addition to making many changes in the present specifications, recommended new specifications for water glasses, hose and lighting belts.

Sub-Committees

Sub-committees are working on the following specifications which will be reported on next year: (a) Mechanical Rubber Goods, (b) Welding Wire, (c) Water Gage and Lubricator Glasses, (d) Wrought Iron, (e) Steel Sheets for Passenger Equipment and (f) Paints.

Report to the Association in 1921

Since no action has been taken by the association towards promulgating the tentative specifications submitted in this committee's report of 1921 as Exhibit A, Revision of Standard Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks, and Exhibit B, Revision of Standard Specifications for Carbon Steel Castings, the committee withdraws its recommendations and has prepared a new revision of the axle and steel casting specifications submitted herewith for approval.

Recommendations

Revision of Standard Specifications

(a) Specifications for Galvanized Sheets to be revised and changed from standard to recommended practice. The specifications have been revised with the co-operation of the manufacturers and have been changed in form; in providing for a copper bearing base metal when specified; in varying requirements for weight of coating for different gage sheets; reducing requirements for bend test of coatings because of heavier coatings specified and including permissible variations in weight, size and gage.

(b) Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks to be revised and changed from standard to recommended practice. The specifications have been revised to remove requirements for annealing because the standard practice is to use unannealed axles; the carbon range has been raised slightly in the interest of securing a stiffer axle in the larger sizes; the addition of a requirement for calipering the actual diameter of the test axle; the removal of engine truck axles from this classification, since most of such axles are bought under annealed forging specifications, and the requirements of these specifications are intended for tapered axles; one drop test formula only is given for all lengths of axles; revision of permissible variations allowing somewhat wider tolerances on oversizes on account of difficulties in forging, and the addition of a table of maximum weights for both smooth forged and rough turned axles. These weights have been obtained from weighing of a large number of axles and represent current practice.

(c) Specifications for Steam Heat Hose to be revised and changed from standard to recommended practice. The form of the specifications has been changed and long length as well as car heating hose is covered; the rack steaming test is substituted for the digester test and hydrostatic and deflection tests added; tolerances are given for outside and inside diameters; the physical test requirements for tube and cover and friction have been changed slightly to agree with standard practice but the quality of hose has not been affected.

(d) Specifications for Mild Steel Bars; Structural Steel for Passenger Equipment Cars; and Structural Steel for Freight Equipment Cars to be revised and combined into one specification which includes locomotive material and changed from standard to recommended practice.

Since all the above materials are of the same grade, it seems advisable to combine the specifications into the prevailing form in use by other associations. Chemical requirements are for phosphorus and sulphur and for copper when it is specified; rewording of sections on tolerances and other minor changes in wording.

Revision of Recommended Practice Specifications

(a) Specifications for Annealed Carbon Steel Castings for Locomotives and Specifications for Annealed Carbon Steel Castings for Passenger and Freight Equipment Cars to be revised and combined into one specification.

These proposed specifications are the same as those reported as information in this committee's report of 1922 and represent the recommendations of the Joint Committee of this association and the American Society for Testing Materials. These specifications have also been approved by the American Railway Association Car Construction and Coupler Committees. The principal change in these specifications is in the method of expressing the requirements; limits for carbon have been omitted and the form of the physical requirements changed so that minimum yield point is specified while tensile strength is not. The tensile strength is required to be reported, however, as it is necessary that it shall be obtained as the elongation and reduction of area are made a function of the tensile strength.

The committee feels that these specifications represent the best that have yet been offered and recommends that the members of the association put them into force for the purchase of steel castings at the earliest opportunity.

(b) Specifications for Lap-Welded Charcoal Iron Boiler Tubes for Locomotives to be revised. The principal change in these specifications is revision of the tolerances for gage so that the tubes shall be not less than the thickness specified. Some changes were made in the physical test requirements to bring the specifications into harmony with those of the American Society for Testing Materials.

(c) Specifications for Lap-Welded and Seamless Steel Boiler Tubes for Locomotives to be revised. The principal change in these specifications is revision of the tolerances for gage so that the tubes shall be not less than the thickness specified. Some changes were made in the physical test requirements to bring the specifications into harmony with those of the American Society for Testing Materials.

(d) Specifications for Rivet Steel and Rivets for Steam Boilers and other Pressure Vessels to be revised. The principal changes in these specifications are the inclusion of chemical requirements for rivets; the omission of tensile requirements for rivets; the addition of a table of permissible variations for bars.

(e) Specifications for Lined Journal Bearings to be revised. The number of compositions specified has been revised to one for both the back and the lining metal, and the compositions selected are those which are in most general use and which have been found to be satisfactory.

(f) Specifications for Engine Bolt Iron to be revised. The principal change made in these specifications is in the form and in the variation of tensile requirements with size of the bars.

(g) Specifications for Solid Staybolt Iron to be revised. The principal changes made in these specifications are in the form and wording of some sections and in the reduction of manganese permitted from 0.10 to 0.05 per cent.

(h) Specifications for Hollow Staybolt Iron to be revised. The principal changes in these specifications are the reduction in manganese permitted from 0.10 to 0.05 per cent; revision of the tensile test requirements to include elongation measured in 4 in., and yield point changed from 0.55 to 0.60 tensile strength; the addition of a splitting test and certain minor changes in form.

(i) Specifications for Tender Tank Hose to be revised. The principal changes in these specifications are in the form; and a small change in the physical requirements for tube and cover, and the friction; but there has been no change in the quality of hose required.

(j) Specifications for Bronze Bearings for Locomotives to be revised as follows: Section 2, Chemical Composition of Medium

Bronze, change Phosphorus from 0.2-0.6 to read 0.1-0.25. This change has been made because the present phosphorus specification is rather high for a so-called medium bronze, and the percentages given are more in line with common practice.

New Recommended Practice Specifications

(a) Specifications for Glasses for Reflex Type Water Gages. These specifications have been drawn up so as to require a high grade of glass and the committee requests that the members put these specifications into effect and let the association have the benefit of their experience.

(b) General Instructions on Standard Methods of Tests for Mechanical Rubber Goods.

(c) Specifications for Wrapped Cold Water Hose.

(d) Specifications for Wrapped Air Hose.

(e) Specifications for Braided Air Hose.

(f) Specifications for Fire Hose.

(g) Specifications for Axle Light Belting.

The general instructions on Standard Methods of Tests for Mechanical Rubber Goods and the individual specifications for hose and for axle light belting have been prepared hy a subcommittee working in co-operation with representatives of the Rubber Association of America; and the committee requests that the members put these specifications into effect and let the association have the benefit of their criticisms. Attention should be called to the fact that the individual specifications do not contain any methods of tests. All of these have been transferred to the general instructions. Only the required results are given in the individual specifications.

The committee recommends that the above revisions and new specifications be submitted to letter ballot of the association.

The report is signed by F. M. Waring (Chairman), engineer tests, Pennsylvania System; J. R. Onderdonk, engineer tests, Baltimore & Ohio; Frank Zeleny, engineer tests, Chicago, Burlington & Quincy; A. H. Fetters, mechanical engineer, Union Pacific; H. G. Burnham, engineer tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern Railway; J. H. Gibboney, chemist, Norfolk & Western; H. P. Hass, engineer tests, New York, New Haven & Hartford; T. D. Sedwick, engineer tests, Chicago, Rock Island & Pacific; G. N. Prentiss, engineer tests, Chicago, Milwaukee & St. Poul; G. E. Doke, engineer of materials and equipment tests, New York Central and H. D. Browne, engineer tests, Chicago & Northwestern.

Discussion

F. M. Waring (Penn.): The committee would like to call your particular attention to the proposed specifications for annealed carbon steel castings, which represent several years' work on the part of the committee in co-operation with the American Society for Testing Materials and the steel casting manufacturers. Your committee feels that these specifications represent the best that has been offered and recommends that the members of the Association put them into force for the purchase of steel castings at the earliest opportunity.

Under new specifications the committee recommends a specification for glasses for reflex type water gages. These specifications have been drawn up so as to require a high grade of glass and the committee requests that the members put them into effect and let it have the benefit of their experience.

There is just one amendment to the report as printed which the committee would like to make. In the specifications for steam heat hose, wrapped cold water hose, wrapped air hose and braided air hose appears the requirement to the effect that the ends of each length shall be uncapped and without fittings. The manufacturers have pointed out that some of them are making hose of that type, particularly steam hose with capped ends and therefore it would not be fair to discriminate against that type of hose. The committee gave this matter consideration and wishes to eliminate the sentence entirely from the four specifications in which it occurs.

Recommendations of the committee, then, are that the report as printed with the amendment just given be submitted to letter ballot of the Association.

J. H. Gibboney (N. & W.): Just one phase of the report that the chairman might have brought to your attention in a little more detail, and that is the demand within recent years for specifications for copper steel. The introduction and use of copper steel as an aid in rust resistance has made rapid strides within the last two or three years, and there have been about 40,000 all-steel cars constructed from that steel in the last two or three months. This has been the result of some very comprehensive tests made by the American Society of Testing Materials by comparing copper steel with non-copper steel of substantially the same composition.

It is unnecessary to go into the details of that test. There was a demand for that class of material and the specification which the committee has provided in the galvanized specifications and the specifications for structural steel shapes, plates and bars permit the use of copper. They have not written a separate specification but have introduced the minimum copper content. I thought it might be well to call your attention to that fact, due to the desire of a number of the roads to use that class of materials for car roofing purposes and for construction of coal-carrying cars.

W. J. Bohan (N. P.): It is a well-recognized fact that the careful selection of materials and their judicious purchase in an open and competitive market is fundamental to and is reflected in efficient and economical railroad operation. All properly managed properties appreciate that well prepared specifications and tests for materials that fully meet, but which do not "overmeet" the requirements of the service intended for, and which do not impose unessential and expensive demands on manufacturers, are necessary in making such selection and purchase.

Efficiency is based upon common understanding and co-operation, and its attainment and maintenance are greatly assisted by written instructions that clearly set forth all the things desired. Efficiency depends upon the human equation and like the human being moves toward perfection by growth in knowledge and experience.

In going over the report I find under Recommendations, reference to four specifications as "Revised as shown and changed from Standard to Recommended Practice." It occurred to me as I read this clause that this might be an opportune time to mention a matter which has been long on my mind. It is my impression that the application of the word standard has been stretched too far. One definition given by the Standard Dictionary for the word "standard" is "A criterion of excellency." This I am sure is what the originators of the phrase "Standard Practice" had in mind in connection with railroad activities, materials and appliances. Is it not a fact, however, that the phrase has come to too largely convey the impression of something settled and closed for all time, instead of as the definition states "A criterion of excellency." Not perfect but in step with progress. A thing, which in order to maintain its excellency must be assiduously cultivated to prevent its becoming stagnant. We all know the human tendency to apply the brakes and move in well-worn grooves. Having this in mind I would like to offer in the interest of progress the suggestion that the phrase "Standard Practice" be changed to some other phrase, which better expresses activity. I will not attempt to suggest a phrase believing there are those in the Association that can do it better.

The gentlemen composing the Committee on Specifications and Tests for Materials are well known as authorities in their line and their names stand for efficiency and thoroughness. The Association is extremely fortunate in their selection and is to be congratulated. The report bespeaks excellency and value to railroad advancement and the unselfish and painstaking labor of its writers. *I would, therefore, move that it be accepted without change, the committee be continued and extended a vote of thanks from the Association for its splendid work.*

(This motion was seconded and carried.)

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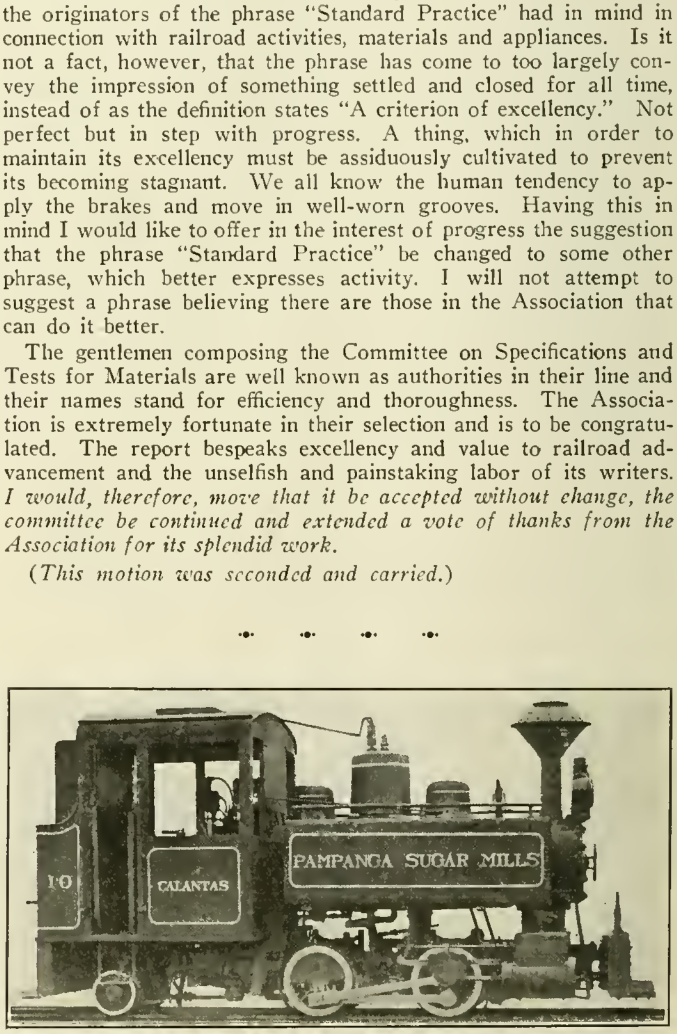

Built by American Locomotive Company for Use in the Philippine Islands

Co-operative Research in the Railroad Field

Request for Research Bureau Recommended to General Committee—Support of Universities Pledged

After an animated discussion on the subject of Co-operative Research, which was participated in by railroad members and also by representatives of several important universities, a motion was passed referring the matter to the General Committee of the A. R. A. for further action. The resolution carried a strong endorsement by the Mechanical Division of the proposed plans for a co-operative research bureau.

W. J. Bohan

Assistant General Mechanical Superintendent, Northern Pacific

A comprehensive treatment which so important a subject as that of co-operative research from the railroad standpoint should receive is hardly possible in the time allotted. A brief mention, however, of a few points, which may perhaps be considered the high spots, is offered in the hope that it may be the beginning of aggressive activity in a direction too little known not only in the railroad field but in most commercial fields. It is appreciated that this is a rather broad statement but it is believed that careful inquiry will show it to be substantially correct.

Two generals, "General Opinion" and "General Statement" both very unreliable, have too much voice in the present tactics of the business army; it is gratifying to note that economic pressure is urging that these generals be superseded.

Research is diligent protracted investigation and studious inquiry to determine *facts*. Co-operative research is the combined activity of one or more individuals or organizations in that direction. It is understood in this particular instance that the co-operation suggested will be between the different railroads and the universities.

Fixed fundamentals must be recognized in order to establish co-operative research on a basis that will be productive of conclusive, satisfactory, and practical results in the acquirement of useful knowledge and its application to more economical and efficient operation. The research must be *operative* as well as co-operative. There must be a meeting of minds, a full understanding and agreement not only to render real assistance in the research work itself but to abide by the conclusions reached and make them effective. If this is not done, any effort at co-operation will result in failure. When this agreement is reached, a carefully worked out organization is necessary to conduct the work and submit the findings and recommendations. This organization should be well balanced technically and practically and it *must* be composed of men having trained analytical minds; minds trained both in technical schools and in the school of experience.

The field of activity of the organization should be unlimited and cover the whole range of questions from selection of proper materials and appliances, power and fuel, shops and terminals, engineering and maintenance-of-way, general and divisional operation, freight and passenger transportation, including their sale, accounting, etc., etc., to the deeper social and financial problems.

Most sound and permanent fruitage is obtained by careful planting and by gradual well cultivated growth. In order, therefore, that co-operative research may not fail, it seems best that a conservative start should be made by undertaking one or two subjects such as "Fuel," and "Material and Supplies." Fuel is mentioned as a separate item as it is of sufficient importance to be so considered.

The organization for co-operative research, as previously stated, must be operative and be unhampered; and it must also show real profit on the investment. It seems self-evident, therefore, that it should be detached from the forces regularly engaged in the routine of operation and its work should not embarrass or retard that operation.

The development of this organization should be approached with analytical thought and care. Two schemes of organization may be mentioned in a general way. One, a centralized institution to handle the work for all the railroads; the other, separate organizations on each railroad distributing their findings through a central bureau. The first has the advantages of being under one head and the possible disadvantages of being cumbersome, top-heavy and provincial, and the fact that its success is absolutely dependent on agreement of all the railroads to rely upon the organization. This may be found difficult to accomplish. The second has the disadvantages of handling a large number of organizations but has the advantages of being cosmopolitan and the fact that each road, knowing its own property best, has possibilities of contributing greater knowledge for the general good. Both plans probably would require about equal expenditures to handle. Each has its advantages. No plan should be put into effect until carefully worked out. Co-operative research is a step forward and some plan should receive early consideration. It will net handsome returns.

Prof. E. C. Schmidt

University of Illinois

Certainly the members of this organization do not need to be urged or argued with concerning the importance of research. The proceedings of the Mechanical Division and the 90 odd volumes of the Master Mechanics' and Master Car Builders' Association are an impressive record of the very extensive research in motive power problems which this organization has carried on for 40 years, and there is a similarly impressive record in other fields of railway work in the volumes of the proceedings of the American Railway Engineering Association, the Fuel Association, and many other railroad organizations. I suppose in the past, however, there has been some lack of co-ordination certainly between these organizations, some lack of organization in the problems to be undertaken, some overlaping, so that any movement towards general co-operation in research and general co-ordination of this work is very timely.

The consideration of this subject is certainly gratifying to those of us who have been trying to plant this idea for a number of years. I do not know what form the co-operation contemplated may take but whatever the form—whether it be merely co-operation between the various railroads so that research may go forward under the control of some such a body as the Mechanical Division, or whether it be co-operation between the railroads and some of the established laboratories—it makes no difference, it seems to me.

The effort towards co-operation is one which ought to prevent overlaping and find the common problems. There certainly are a lot of them despite the great volume of work that has been done already. Everybody will agree, I think, that the work can't stop. There is much more to be done in the future than has been done in the past.

There are innumerable problems connected with fuel and the use of fuel; with locomotive design, especially boiler design with reference to the use of fuel; problems related to draft appliances, and I could go on, I suppose, for 10 minutes enumerating problems of common research in further experimentation and study; and certainly among all those problems, there are a great number that are of common interest to all the railroads of the country; in fact, to form a program for co-operative research in which all railroads would be equally interested, and upon which all would stand. In this work, co-operation should take the form of co-operation with established laboratories—those of the various universities of the country, as well as those like the one at Altoona.

Fifteen years ago the University of Illinois undertook adequately to provide for the training of men for railway service, and adequately to provide for the study of railway problems. Since then we have built up facilities for testing both in our locomotive laboratories and on the road, and are prepared right now to do a good deal of work in this field, especially in the motive power field.

I am authorized to say that if this Association, or any other railroad association, wants the assistance of the University of Illinois—wants us to come in on any such a scheme—we are not only ready to do so, but are anxious and willing to do everything in our power (applause).

Prof. Reubenkoenig

Purdue University

It seems to me that in bringing up this question of co-operative research the members of the American Railway Association have come to a realization of the needs of a closer co-operation between the railroads and the technical schools. I do not need to recall to you in this instance the work that has been done at Purdue University during the past 30 years, but I do wish to remind the members that we still have the air brake rack, the brake shoe machine and the drop test machine.

For several years efforts have been made at Purdue University to secure a building that will adequately house the priceless collection of all locomotives that have been accumulated through the tireless efforts of Dr. Goss. I am sorry to report now that nothing definite has been done towards this, and it may seem that there is no particular interest in this matter, but I believe a re-awakening of interest in the value of co-operative research will also carry with it a realization of the value of these historical locomotives as typical milestones in American railway progress.

Our efforts toward modernization of railway equipment at Purdue University have not been entirely without results. When our Schenectady No 3 emerges from the shops of the Monon at LaFayette, it will be practically a new locomotive as far as the type is concerned. There has been donated towards this cause approximately $8,000 worth of material. Although this will be a modern locomotive of the American type, it is not modern as far as the size is concerned.

Furthermore, there are now tentative plans for a transportation building at Purdue University. This building will take care of these old locomotives and at the same time afford provision for the installation of a modern locomotive testing plant. We hope to have there equipment of sufficient capacity to test a Santa Fe type locomotive. I have no doubt that a re-awakened interest in co-operative research on the part of railways will serve to hasten the development of these plans. There has always existed the closest co-operation between th railroads running through LaFayette, notably the Monon and the Big Four, and Purdue University.

I merely mention these instances of what is possible in the line of co-operation between the railroads and the technical schools. I wish to assure you that Purdue University will stand ready at all times to co-operate to the fullest extent in any work that may be required of us in the furtherance of an intensive program of co-operative research.

Other Discussion

C. B. Smith (B. & M.): I am speaking for our assistant general manager, L. G. Coleman, who was unable to remain over for the discussion on this subject and to say for him, as well as I may, that he is very much interested in the subject of co-operative research and would have expressed the opinion that if it were possible for the American Railway Association to take up this matter actively it would be strongly favored by the Boston & Maine. There are a large number of railway systems in the country which are not able to have such laboratory and research facilities as might be developed under the auspices of the American Railway Association

Such a research bureau should not be confined to the mechanical department. However, we of course can only speak for the Mechanical Division. The idea is that the American Railway Association could properly provide research facilities for more than one department. It is the feeling also that it is not necessary to establish a separate laboratory with full research facilities merely for railway purposes, but that we should make use, so far as it can be arranged, of the existing established laboratories and the other facilities of the technical institutions and private laboratories of the country, thus saving to the railways enormous expense for duplicate facilities.

It is hoped that some definite action may be taken expressing the opinion of this meeting that the Mechanical Division recommend to the general officers through its General Committee of the American Railway Association that it take this matter under careful and active advisement with the hope that something definite can be arrived at on the part of the Association. It is appreciated of course that it is a large subject and should be considered from many angles.

C. F. Giles (L. & N.): I had some conversation yesterday on the subject and one of the gentlemen related the following story, showing the importance that one of the large corporations in this country attaches to research work. They say that the president of this corporation conferred with his subordinates and officials and asked them to recommend to him an engineer or a chemist that had the ability to conduct a research department for his concern. They recommended a certain man who was asked to carry out the work. This man stated that he would need $3,000,000 with which to carry on the experiments and do the research work. The request was granted immediately. The president then asked the man what he would expect in the way of a salary. The man replied "it doesn't make any difference what sort of a salary you give me just so you give me enough to do this research work." The man has not only expended the $3,000,000 but has exceeded it.

I am merely relating that to show the importance that some of the big concerns in this country with whom we have dealings attach to this kind of work.

Chairman Purcell: I might say that the General Committee, as well as the fuel conservation committee, has had this subject under consideration for some time.

C. B. Smith (B. & M.): I move it be the sentiment of this meeting that the General Committee of the Mechanical Division be requested to take up actively with the officers of the American Railway Association the consideration of the establishment of a proper co-operative research bureau, and push this matter through to a conclusion acceptable to the Association.

R. L. Kleine (Penn. System): Do you not think it would be better to refer the matter to the General Committee without instructions as to what action they should take? I would like to ask Mr. Smith about that.

Mr. Smith: I would say in answer to Mr. Kleine's question that I think the feeling of our assistant general manager is that something definite should be done at this meeting, and while it is not the purpose of that motion to be mandatory in any sense it is simply to bring out at this session, if it is our will and pleasure, that the General Committee make a definite move on the question. That is all I intended to convey.

(*The motion was seconded and carried.*)

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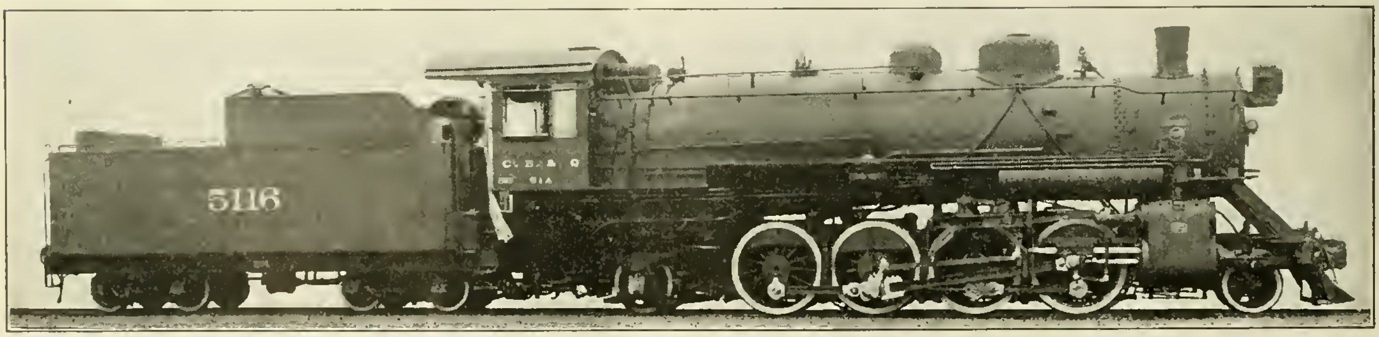

Burlington Mikado Type Locomotive Built by Baldwin Locomotive Works

Report of the General Committee

Outlining Action Taken Since the Previous Annual Meeting on Matters Referred to the Division

The membership of the division at the present time includes 214 railways, representing 400 memberships in the American Railway Association, and in addition thereto, 152 railroads, associate members of the American Railway Association.

The railroads, members and associate members of the American Railway Association, have appointed 834 representatives in the Mechanical Division.

In addition there are 1482 affiliated members and 106 life members in the division.

The last session of the division was held June 14-21, 1922. Since that time the General Committee has taken on several important subjects. This action is outlined in the following report and the approval of the division is requested.

Proceedings of the 1922 Annual Meeting

The proceedings of the 1922 annual meeting, together with action taken by the division during the year 1921, when no annual meeting was held, has been printed and distributed to the members.

Annual Meeting 1923

On account of the unusual conditions prevailing during the past years it was considered best to hold a strictly business meeting this year without exhibits of railway machinery and devices. The committee has arranged this three day business session of the division and has provided a program which should result in great benefit to the member roads.

Letter Ballots 1922

Recommendations from committees received at the 1922 annual meeting and ordered submitted to letter ballot of the members were sent to the members in a separate circular containing the recommendation from each committee and the result announced by a circular to the members.

Manual of Standard and Recommended Practice

The changes made in the Manual of Standard and Recommended Practice, as the result of action taken on recommendation of reports considered at the 1922 annual meeting and approved by formal letter ballot, have been taken care of by issuing revised loose-leaf pages to be inserted in the Manual.

Interchange Rules

The recommendations of the Arbitration Committee and the Committee on Prices for Labor and Materials, approved at the 1922 annual meeting, were incorporated in the Rules of Interchange for 1922, effective January 1, 1923. In addition, as necessity arose, this committee has approved revisions of the detailed rules which have been issued as supplements to the Rules of Interchange.

Loading Rules

The recommendations from the Committee on Loading Rules, considered at the annual meeting for 1922 and approved by letter ballot by the members, were incorporated in a revision of the loading rules for 1922, issued effective January 1, 1923.

Maximum Load Markings for Freight Cars in Lieu of Nominal Capacity

At the meeting of the General Committee held January 11, 1923, a resolution was adopted that the recommendation from the Committee on Car Trucks contained in its 1919 report and approved by letter ballot and by the executive committee of the American Railway Association should be made effective. This recommendation was transmitted to R. H. Aishton, president of the American Railway Association, under date of January 13, 1923. At the direction of Mr. Aishton a conference was held in New York City, at the office of the association, on May 10, 1923, between representatives of the Transportation, Traffic and Mechanical Divisions to consider this matter. This conference adopted resolutions directing that the recommendations above referred to for marking freight equipment cars to show load limit in lieu of nominal capacity be made effective. This matter is now before the Board of Directors for action, together with report relative to the possibility of increasing the loading on *B* axles having 4¼-in. by 8-in. journals by making a slight increase in the condemning limit for journal wear.

Mechanical Inspection Department

The Mechanical Inspection Department of the division has throughout the year continued its investigation covering repairs to foreign cars and billing therefor on a considerable number of railroads. The conditions disclosed by these investigations have been carefully considered by this committee and a sub-committee appointed to draw up regulations governing inspection and repairs to foreign cars and billing therefor under the A. R. A. Rules of Interchange. These regulations have been approved by the General Committee and transmitted to the Board of Directors for their approval. It is the opinion of the General Committee that these regulations will materially aid in correcting such wrongful practices as have been found by the Mechanical Inspection Department.

With the approval of the Board of Direction of the association the number of inspectors was increased to 12 effective January 1, 1923.

Joint Inspection of Standard Material

A joint committee of the Purchases and Stores Division and the Mechanical Division has been making a study of the subject of joint inspection of standard materials. The final report from this committee has not yet been received.

Investigation of Power Brakes and Power Brake Systems

The Committee on Safety Appliances, assisted by the Committee on Brakes and Brake Equipment, has been handling matters for the Association in connection with the investigation of power brakes and power brake systems before the Interstate Commerce Commission.

Extension of Effective Dates of Rules and Regulations

As occasion has arisen during the year this committee has, upon recommendation from the proper committee of the division, extended the effective dates of certain provisions of the rules and regulations of the division. These extensions have been covered by circulars issued to the members.

American Engineering Standards' Committee

An invitation was received by this committee to arrange for participation of the Mechanical Division in the work of the American Engineering Standards' Committee. This invitation was declined.

Terms of Office for Chairman and Vice-Chairman

At the June, 1922, Convention the following resolution was unanimously adopted:

> Resolved, That the officers of the Mechanical Division of the American Railway Association shall be elected annually instead of every two years, in order that a greater number of members may enjoy the honor of being officers of the division.

Section 7-B of the Rules of Order of the Mechanical Division provides that the chairman and vice-chairman of the division shall be elected by written or printed ballots alternately every two years. The candidate receiving the majority of the vote cast is to be declared elected and shall hold office for two years, or until his successor shall be elected. It is, therefore, recommended by this committee that section 7-B of the Rules of Order of the division be revised in accordance with the proposed form shown below to provide for the election of the chairman and vice-chairman annually instead of biennially:

Present Form	Proposed Form
The chairman and the vice-chairman of the division shall be elected by written or printed ballots alternately every second year, the candidate receiving a majority of the votes cast shall be declared elected and shall hold office for two years or until his successor shall be elected.	The chairman and the vice-chairman of the division shall be elected by written or printed ballots *each year*, the *candidates* receiving a majority of the votes cast shall be declared elected and shall hold office for *one year* or until *their successors* shall be elected.

Ryerson & Son Scholarships

On account of the lack of interest in these scholarships by the members of the division they have been discontinued by Joseph T. Ryerson & Son, the donors thereof.

Disposition of Bonds of American Railway Association Master Mechanics' Association

At a meeting of the committee held November 8 and 9, 1922, it was decided that all monies of the American Railway Association Master Mechanics' Association be turned over to the American Railway Association for such disposition as it may see fit to make.

Bolt and Screw Thread Standardization

The matter of bolt and screw thread standardization has been referred to the Committee on Locomotive Design and Construction for investigation and report.

Joint Committee on Fuel Conservation

Vacancies in the Mechanical Division representation on the Joint Committee on Fuel Conservation on account of members having left railroad service have been filled as follows: A. G. Trumbull, chief mechanical engineer, Erie Railroad, New York, in place of Wm. Schlafge; R. D. Hawkins, superintendent motive power, Atlantic Coast Line, Wilmington, N. C., in place of J. Hainen.

Campaign for Heavier Loading of Equipment

A joint committee composed of representatives of the General Committees, Transportation, Traffic, Mechanical, and Freight Claim Division, was appointed to formulate a plan of campaign to bring about the heavier loading of freight equipment which is being carried out under the supervision of the Car Service Division.

Upon request of the board of directors, a special committee consisting of representatives of the Car Service, Mechanical and Transportation Divisions, was appointed to analyze the National Security Owner's Car Pooling Plan and related subjects. The report of the special committee was reviewed jointly by the General Committees, Mechanical and Transportation Divisions, and submitted to the board.

Life Members

The following members have been made life members during the year:

Date Joined	Name	Title and Railroad
1903	Curry, H. M	General Mech. Supt., Northern Pacific
1901	Deverell, A. C	Locomotive Stoker Co.
1903	Flory, B. P	Supt., M. P., N. Y., O. & W.
1903	Kehrman, J. F	M. M., Mississippi River & Bonne Terre
1903	Kleine, R. L	Asst. to C. M. P., Pennsylvania System
1903	Kucher, T. N	M. M., Toledo, Peoria & Western
1903	McCullough, W. A.	Gen. Road Master, Atlantic Coast Line
1903	Murphy, C. W	Morgantown & Kingwood
1903	O'Hearne, J. E	Denver, Colo.
1903	Pearsall, D. M	Supt. M. P., Atlantic Coast Line
1903	Reading, R. K	Supt. M. P., Pennsylvania System
1903	Russum, T. H	Supvr. P. C. M., Baltimore & Ohio
1903	Torrey, F. A	La Grange, Ill.
1903	Trumbull, A. G	Chief Mech. Engr., Erie Railroad
1903	Yergens, W. F	M. M., Erie Railroad

The Secretary has been advised of the death of 21 members:

Name	Railroad or Company	Died
Arp, Wm. C	Pennsylvania Lines	June 16, 1922
Bridges, E. A	Durham & Southern Ry	....
Chamberlin, J. T	Medford, Mass	Dec. 12, 1922
Charpiot, S. A	San Diego, Cal	June 6, 1922
Deveny, W. D	Supt. Shop, A., T. & S. F. Ry	Aug. 22, 1922
Jacobs, L. M	Lubricating Expert, The Texas Co	Oct. — 1921
Marden, J. W	Waltham, Mass	May 27, 1922
Mills, Wm	Coach Foreman, Grand Trunk Ry. System	....
Needham, E. F	Decatur, Ill	May 12, 1922
O'Dea, P. J	General Inspector, Erie R. R	—— 1923
Pearce, J. S	M. M., Norfolk & Western Ry	Sept., 1919
Perkinson, T. F	M. M., Baltimore & Ohio R. R	July 10, 1922
Place, T. W	Waterloo, Ia	Oct. 9, 1922
Porter C. C	Manager. Sugar Land Ry	....
Quayle, Robt	Retired G. S. M. P. & M., C. & N. W. Ry.	Sept. 13, 1922
Queenan, Wm	Asst. S. S., C., B. & Q. R. R	Nov. 28, 1922
Ryan, Patrick	M. M., Louisville & Nashville R. R	March 2, 1921
Schrader, J. R	D. G. C. F., New York Central R. R	Aug. 11, 1922
Smith, F. J	M. M.. Chicago Great Western R. R	June 23, 1923
Stoll, W. J	Chief Interchange Inspector, Toledo, O	....
Williams, E. A	Glen Ridge, N. J	April 29, 1922

Suitable committees will be appointed to prepare obituaries for these deceased members to be included in the proceedings of this meeting.

Committee on Nominations

The committee recommends that no ballot be taken this year for members of the Committee on Nominations. The present Committee on Nominations is composed entirely of past presidents of the former Master Car Builders' and Master Mechanics' Association and past chairmen of the Mechanical Division. The Committee on Nominations consists of the following:

F. W. Brazier (Chairman), assistant to general superintendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power & equipment, Central Railroad of New Jersey; W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific.

The report is signed by J. Coleman (Chairman) general superintendent car equipment, Canadian National Railways; John Purcell, (Vice-Chairman), assistant to vice-president, Atchison, Topeka & Santa Fé; C. E. Fuller, superintendent motive power and machinery, Union Pacific; J. S. Lentz, master car builder, Lehigh Valley; H. L. Ingersoll, assistant to president, New York Central; J. J. Tatum, superintendent car department, Baltimore & Ohio; Willard Kells, superintendent motive power, Atlantic Coast Line; W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific; H. C. Oviatt, general mechanical superintendent, New York, New Haven & Hartford; C. F. Giles, superintendent machinery, Louisville & Nashville; T. H. Goodnow, superintendent car department, Chicago & North Western; J. T. Wallis, chief of motive power, Pennsylvania system; A. Kearney, superintendent motive power, Norfolk & Western; C. E. Chambers, superintendent motive power and equipment, Central Railroad of New Jersey, and L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

Discussion and Action

A motion was carried that the action of the General Committee eliminating the ballot for members of the committee on nominations be approved.

A motion was carried that the recommendation of the General Committee for a change in Section 7-b of the Rules of Order to provide for election of officers annually instead of bi-annually to become effective immediately, be approved.

A motion was carried that the report of the General Committee be approved as a whole.

The Union Pacific, through a holding company known as the Kansas City Industrial Land Company, has acquired 919 acres of land in the North Missouri river bottoms, Kansas City, Kan. It is understood that this land, which cost approximately $440,000, will be used in the development of a new industrial district.

Valuation of the railroads of Colorado as assessed for this year is $160,816,910, compared with $160,487,820 for 1922. The Colorado & Southern, the Chicago, Burlington & Quincy, the Atchison, Topeka & Santa Fe and the Denver & Rio Grande Western were valued the same for each year while the Union Pacific value was increased $750,000 over 1922.

Founders of Master Car Builders' Association

It is Doubtful If the Wonderful Record of Achievement of the M. C. B. Can Be Equalled

By F. W. Brazier
New York Central

I DESIRE to take but a few moments of your time briefly to review what this association has accomplished in its existence of over 50 years and the debt we owe to the old master car builders of the different railroads of this country and Canada, who laid the foundation upon which this association has stood all these years. Like a solid rock, it stands today the leading mechanical association of the world. Its rules of interchange which govern the movement of practically all the passenger and freight equipment in the United States, Canada and Mexico are binding on every subscribing company and are the means by which the interchange of cars is expedited and serious delays reduced to a minimum.

A Record of Accomplishment

It is a legislative body that makes rules and adopts standards which must be lived up to by every road and private car line operating cars for interchange. It was the old master car builders who got together, years ago, and foresaw the need of having standard parts of cars made uniform so as to reduce the number to as few as possible, thereby reducing the stock necessary to carry in order to promptly make repairs. For illustration to show how this was brought about:

In 1882 we had 56 kinds of axles, which in 1918 was reduced to......	5
In 1882 we had 58 kinds of journal boxes, which in 1918 was reduced to	5
In 1882 we had 26 kinds of couplers, which in 1918 was reduced to....	2
In 1882 we had 27 kinds of brakeheads, which in 1918 was reduced to..	1
In 1882 we had 20 kinds of brake shoes, which in 1918 was reduced to	1
Total..... 187 Reduced to.........................	14

The safety appliance standards with which cars are today equipped, are the result of the efforts of these old master car builders. The federal government recognized the benefits to be derived through the adoption of these safety standards and the Safety Appliance Law was accordingly enacted.

What greater compliment can be paid to the old master car builders than that not only the federal laws on safety appliances are the result of their achievement in voluntarily making the cars safe for trainmen, but that all the great insurance companies take the M. C. B. Rules as a basis for settling all claims for fire damage to equipment.

During the last few years, conditions have arisen which resulted in the taking away of the title of "Master Car Builder" on some roads but the work is going on just the same, only under the supervision of a man with a different title.

There are a number of different associations doing fine work in their line, namely, the Travelling Engineers, Master Blacksmiths, Storekeepers, General Foremen, Painters, Master Boilermakers, Electricians, Air Brake Men and others who hold conventions where papers are read, treating on matters having an educational value to their members; the information gained cannot help but be the means of getting better results. A man who attends these meetings should become a student of his work.

Educational Value of Exhibits

In the past we have had at our conventions wonderful displays of up-to-date machinery, tools and parts of cars and locomotives. Locomotives and machinery have been shown in actual operation. These exhibits, without doubt, had a wonderful educational value for the shop forces and gave them new thoughts and ideas which would be put into practice upon their return home and thereby be the means of effecting permanent and substantial economies in operating cost which, under present operating conditions, is something not to be passed over lightly.

Today, the man who succeeds is the man who studies his line of work and keeps in touch with what is going on outside his own door. We have some splendid railway magazines which portray to us the latest railroad news so there is no excuse for anyone seeking information not finding it if he really wants it.

Would to God that today with all the unrest in this country—brought about largely by self-seeking political radicals preaching government ownership, the Plumb Plan, etc. (which means plums for the advocates and politicians)—that we could have a Lincoln that would rise up and lead the people into the right pathway that would bring about peace, contentment and prosperity to all the railroads of the country. The old master car builders were eminently successful in their line of work. Why? Because there were fewer politicians or factions to please. They worked for the good of the cause and the public received the benefit.

Pioneers of M. C. B. Association

In looking over the pioneers of this association, we find a long list of able men who, in their day, assisted in laying its foundation and are in a large measure responsible for its success. Today we have only 10 men left who have been in active service in excess of 30 years as members of this association, (I mean the old master car builders) and I desire to mention a few.

One—a past-president, is the oldest member in active service, has been a member for 45 years, has been in the service of his railroad for 58 years and is a member of our General Committee. I refer to our past-president, John S. Lentz, of the Lehigh Valley.

I also want to mention another past-president who has served his company over 50 years, been a member here over 33 years and is yet in service; a man who has been one of the leading master car builders of the country—John J. Hennessey, of the Chicago, Milwaukee & St. Paul.

We also have our retiring chairman, who has been a member 33 years, who has worked faithfully in his position to represent the Canadian railroads and has greatly helped to keep the standards of this association the same in Canada as in the United States—a wonderful record.

The other names on the list I desire to mention are George Rommel, Samuel Porcher, J. B. Michael, D. B. Middagh, J. Doyle, W. D. Holland and F. W. Brazier.

Presentation to Retiring Chairman

Mr. Coleman, the officers and members of this association desire to express to you their appreciation of the manner in which you have presided at its meetings and the personal interest you have manifested in all its affairs. Your name will now be added to the list of past-presidents as one, whom, we of the Master Car Builders' Association all honor. I have had the pleasure of your acquaintance for over 30 years; we have worked and played together and I know you as a friend and as one of our leading master car builders. Upon me has been conferred the very great honor of presenting to you, this past-chairman's badge and in so doing I feel highly complimented. May you wear it and feel that it carries with it the earnest wish of each one that your pathway may be strewn with flowers and your life be one of contentment, health and happiness

Chairman Coleman: Permit me to express my appreciation. I am thankful that our friend Mr. Brazier didn't say some things about me that he knows; he said good things; this is a time in life when you like to hear good things—while you are living; sometimes you hear the bad things while you are living but have got to die before the good ones are said.

I want to thank you sincerely for this tribute that I will always remember; I hope to be able to wear this badge for many years to come when I come here and assemble with a family of the greatest mechanical geniuses in the world. You are recognized all over the world as the leader in your line of work. It is a compliment, and a big one too, to be selected among a family of friends like this to preside at your meeting and I do sincerely thank you from the bottom of my heart.

Report of the Committee on Nominations

The terms of office of the chairman, vice-chairman and seven members of the General Committee expire June, 1923. In accordance with action taken by the General Committee and recommended in its report to the association this year as the result of a resolution adopted at the 1922 annual meeting, the term of chairman and vice-chairman of the division is changed from two years to one year, which will make it necessary to elect both a chairman and vice-chairman of the division at the 1923 annual meeting.

In accordance with Section 7 (a) of the Rules of Order of the division which provides that officers of the division shall be elected at the regular meeting of the division held in June of each year, the Committee on Nominations nominates the following for the offices of chairman and vice-chairman:

For Chairman—Term expiring June, 1924:

John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe.

For Vice-Chairman—Term expiring June, 1924:

T. H. Goodnow, superintendent car department, Chicago & North Western.

As the terms of seven members of the General Committee expire in June, 1923, the Committee on Nominations nominates the following to serve until June, 1925, as members of the General Committee:

C. E. Fuller, superintendent motive power and machinery, Union Pacific.

H. L. Ingersoll, assistant to president, New York Central.

Willard Kells, superintendent motive power, Atlantic Coast Line.

J. S. Lentz, master car builder, Lehigh Valley.

H. C. Oviatt, general mechanical superintendent, New York, New Haven & Hartford.

J. J. Tatum, superintendent car department, Baltimore & Ohio.

W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

The committee also nominates J. Coleman for member of the General Committee to fill the unexpired term of T. H. Goodnow, who is nominated for the office of vice-chairman and whose term as member of the General Committee expires in June, 1924. The committee also nominates C. H. Temple, chief of motive power and rolling stock, Canadian Pacific, to fill the unexpired term of W. H. Winterrowd, who has left railroad service and whose term expires in June, 1924.

The report is signed by F. W. Brazier, chairman, assistant to general superintendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power and equipment, Central Railroad of New Jersey, and W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific.

Election of Officers

W. O. Thompson (N. Y. C.) reported for the election tellers as follows:

For chairman, term expiring June, 1924—John Purcell, 173 votes.

For vice-chairman, term expiring June, 1924—T. H. Goodnow, 169 votes.

For members of the General Committee, terms expiring June, 1925—C. E. Fuller, 157 votes; H. L. Ingersoll, 168 votes; Willard Kells, 140 votes; J. S. Lentz, 166 votes; H. C. Oviatt, 171 votes; J. J. Tatum, 171 votes; W. J. Tollerton, 165 votes.

For members of the General Committee, terms expiring June, 1924—J. Coleman, 168 votes; C. H. Temple, 167 votes.

Mr. Purcell: I want to thank you for the honor you have bestowed upon me in electing me chairman. I realize the responsibilities of the office together with the amount of work which is attached to it, but I feel that with your assistance we will handle the work promptly and to the entire satisfaction of all.

Mr. Goodnow: I appreciate coming into office and during the tenure of office will try to do my best; you know, however, that as new men enter the ranks somebody has got to take their places. Some of those sitting in the rear have got to move forward and help out.

As chairman of the Committee on Committees, if I continue in that capacity this year, I hope we can get some new blood into the committees—it is awfully hard for the committees when you know individuals here and there but don't know how active they may be; if you want a job, just send your name to me and I will see that you get it. I am serious in that question; we want you to get a new enthusiasm; we want to get some good timber.

Appreciation to Past-Chairman Coleman

A rising vote of thanks was given the retiring chairman, Mr. Coleman, for the very efficient manner in which he handled the affairs of the association during the past year.

C. F. Giles (L. & N.): I want to refer back to the remarks of Mr. Goodnow on the subject of the younger members of this association taking more interest in the affairs of the association as well as participating in the discussions during the convention. That has been a subject of discussion with the members of the General Committee for several years, especially after the last meeting in Atlantic City in 1922, when it was apparent that very few of the members on the floor took very much interest, or participated in the discussion.

Now, I am delighted to observe during this meeting that there has certainly been a wonderful improvement in that respect.

Speaking of Mr. Goodnow, I have been working with him now for about 11 years as a member of the General Committee and on other committees, and whoever steps into his shoes as a member of any of these committees to take up the work that he is compelled to lay down, partially at least, has got to go some. He has been one of the best and most untiring workers that we have in the association, and it has been a question of the willing horse.

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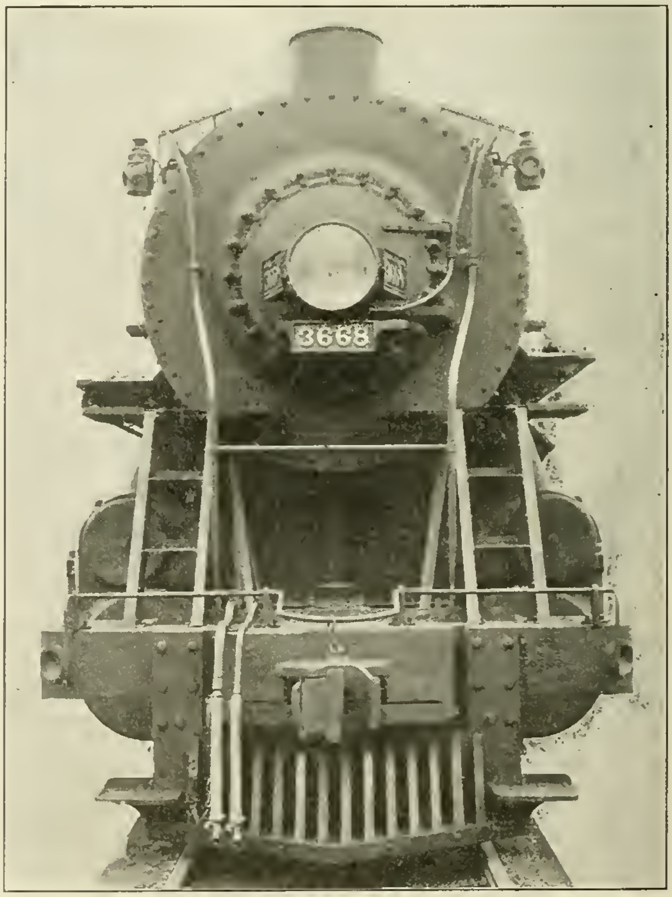


Front View of Southern Pacific 2-10-2 Locomotive

Miscellaneous Business of the Meeting

Large Registration—The Division Recommends That the Railroad Centenary Be Observed

The registration at the close of the meeting was 584 railroad men and 87 miscellaneous; a total of 671. A resolution was adopted by the association strongly favoring a Railroad Centenary Celebration of the hundredth anniversary of American railroads.

Safety Appliances

C. E. Chambers (C. R. R. of N. J.):

The committee on Safety Appliances has no written report this year. This is because nothing in particular has transpired since last year. At that time I made a report to you that the investigation on power brake and appliances was under way in Washington: this was carried to completion in February last. At present there is nothing new before the committee other than a possible revision in the Safety Appliance Standards in the near future.

(A motion was carried that the report be accepted and printed in the proceedings.)

Loss and Damage From Rough Handling

Chairman Coleman: There is a gentleman here from the Claim Section who wanted to have the privilege of the floor for about five minutes. I want to introduce to you Joe Marshall, special claim prevention officer, A. R. A..

Mr. Marshall: I want to say a few words in the interest of freight claim prevention, but before I say them I want to offer the thanks of the freight claim men for the great co-operation we have received from your secretary, Mr. Hawthorne, in our work and also from the individual mechanical men on all the railroads throughout the country. Each one of them is doing good work.

I want to call your attention to a few of the high spots on the claim account and I have some pictures here to show you.

Mr. Marshall here showed several pictures illustrating various charts used by the Claim Section and indicating the extent of loss and damage from rough handling. The fact was pointed out that in response to inquiry a considerable number of the roads gave six or more miles an hour as a safe impact speed, whereas the best friction draft gear will go solid at four miles an hour, and that evidently there is reason for further educational work along this line. Mr. Marshall suggested that the Mechanical Division appoint a committee on rough handling to back up the work of the freight claim man.—Editor.

Co-operating Associations

The privilege of the floor was extended to the following Associations:

Air Brake Association.
American Wood Preservers' Association.
American Railway Tool Foremen's Association.
Association of Railway Electrical Engineers.
Chief Interchange Car Inspectors' & Car Foremen's Ass'n.
International Railway Fuel Association.
International Railway General Foremen's Association.
International Railroad Master Blacksmiths' Association.
Railway Accounting Officers' Association.
Traveling Engineering Association.

And the various sections and divisions of the American Railway Association.

Resolutions

The Committee on Resolutions, C. E. Chambers (C. R. R. of N. J.) made the following report:

"Resolved, that the Mechanical Division of the American Railway Association extend its sympathy to Mr. Samuel M. Vauclain account serious illness of Mrs. Vauclain and a wish for her speedy recovery, and the thanks of the Association for his extremely interesting and instructive paper on the Development of the Steam Locomotive, and that a telegram be sent Mr. Vauclain by the Chairman."

(The resolution was adopted.)

Mr. Chambers continued:

"Whereas, Mr. R. H. Aishton, president of the American Railway Association, favored us with his attendance and timely address.

"Whereas, Mr. W. B. Storey, president of Atchison, Topeka & Santa Fe, was in attendance and gave us much food for thought and practice in his address,

"Whereas, Mr. C. H. Markham, president of Illinois Central, personally met with us and favored us with a splendid talk full of appreciation of the workings of the Mechanical Division and the mechanical departments of the railroads as a whole,

"Whereas, Mr. E. F. Carry, president of The Pullman Company, met with us and read his most splendid paper on Development of Railway Cars,

"Whereas, Mr. W. W. Atterbury, vice-president of the Pennsylvania Railroad, favored us with a splendid message of appreciation full of suggestions, and

"Whereas, Sir Henry Thornton, K. B. E., president of Canadian National Railways, showed his keen interest in the railways of the United States and Canada by sending to us his message,

"Be it resolved, that the thanks of the members of the Mechanical Division be extended the gentlemen above mentioned and copy be printed and sent to them individually by the secretary of the Division."

(The motion was seconded and carried.)

Mr. Chambers: "Resolved, that the appreciation of the members of the Mechanical Division of the American Railway Association be extended to the Hotel Managers' Association of Chicago for their kindly interest by furnishing accommodations to the members of the association and their families. Also to the Chicago Association of Commerce, and especially Mr. Bowman, for providing a hall in which to hold its annual meeting."

(The motion was seconded and carried.)

Mr. Chambers: "Resolved, that the Mechanical Division of the American Railway Association show its appreciation of the continued interest of the executive members of the Association by adopting a schedule of the American Railway Association presented to us by President Aishton, and that each member goes to his own road determined to meet every suggestion and that the 'note be paid in full on or prior to October 1, 1923.' "

(The motion was seconded and carried.)

Mr. Chambers: "Resolved, that the Mechanical Division extend its thanks and appreciation to the officers and secretary of the division for the able manner in which they have handled the annual meeting and to the committees in charge of the various reports which have been so fully covered and to the members who have participated so generously in the discussions, thereby bringing out the information so much desired, realizing that all of this has taken place at a time when each member, due to the labor disturbances for the past year, has been so fully engaged otherwise."

(The motion was seconded and carried.)

Railroad Centenary

The following was also presented by the Committee on Resolutions:

Secretary Hawthorne (Reading): To the executive officers of the American Railway Association. The Mechanical Division of the American Railway Association, assembled in convention at Chicago, on this date, June 22, 1923, taking pride from the beginning of developments and achievements of American railroads of which it is part, noting its problems and looking solicitously to its future welfare, suggests the proximity of the hundredth anniversary of the American Railroads; expresses the belief that this event will afford an invaluable opportunity for the railroads to quicken the pride of railway men in the substantial and effective method of giving an exhibition of progress and recommends the Executive Officers to give serious consideration to the holding of a centennial celebration of international interest, representing the combined energies of all American railroads.

This body stands ready and willing to assist and co-operate in any action taken towards this ending.

Mr. J. J. Tatum (B. & O.): *I move that the resolution be adopted.*

(The motion was seconded and carried.)

GENERAL NEWS

The American Short Line Railroad Association is to consolidate all of its offices in Chicago on the first of July at 1832 McCormick building. At the present time, the purchasing agency is located in the Railway Exchange building and the traffic and labor departments in the Transportation building.

The American Boiler Manufacturers' Association at its annual convention at Hot Springs, Va., this week, unanimously adopted the following resolution offered by W. H. S. Bateman, of the Parkesburg Iron Company: *Resolved*, That this Association go on record in upholding the railroads of the United States in the fight which they are making for their very existence, and that we as a body emphatically are opposed to Government ownership; and will use our best efforts individually to encourage public sentiment in sympathy with the railroads, and will at all times endeavor to counteract the influences which are constantly working in opposition to the railroads of our country.

Robert W. Hunt, president of Robert W. Hunt & Co., Chicago, was the recipient of the Washington award which is presented annually by the Western Society of Engineers, acting jointly with the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers. This award was established by John W. Alvord, consulting engineer, of Chicago, in 1916, and was presented to Mr. Hunt for "his pioneer work in the development of the steel industry and for a life devoted to the advancement of the engineering profession." This is the second time that this award has been made, Herbert C. Hoover being the first recipient.

Scottish Locomotives for India

According to the Times (London) Trade Supplement, the firm of William Beardmore & Sons, Dalmuir, Scotland, has received orders for 17 heavy Pacific type locomotives for the Indian State Railways. The North British Locomotive Company also claims to have obtained "a large number" of contracts for its Glasgow works. The Scottish locomotive builders seem optimistic and are said to expect to receive further extensive orders in the near future.

French Foundryman Studies American Methods

Emile Ramas, administrator-director of the French Metallurgical Society and president of the Foundrymen's Association of Paris, France, is now visiting the United States studying the manufacture of chilled car wheels for the purpose of extending their use in France. In the course of his investigations he has been the guest of George W. Lyndon, president of the Association of Manufacturers of Chilled Car Wheels, in Chicago, and of the American Foundrymen's Association at Cleveland, Ohio.

Canadian Shopmen Seek Increase

Notice has been served on the Railway Association of Canada by the Railway Employees' Department of the American Federation of Labor that negotiations looking to wage increases are requested. The shop employees are now working under a contract made a year ago which reduced wages and made the new rates continuous until such a time as either party might desire a change—in which case a conference was to be called on a notice of 30 days. The shopmen have now given that notice.

A 24-Hour Locomotive Run

Hauling a special train of 10 cars carrying Shriners on their return from Washington, locomotive No. 411 of the Missouri-Kansas-Texas, starting from St. Louis, Mo., on June 10 at 4:25 p. m., was run through to Austin, Tex., 975 miles, without being detached from the train and arrived at destination on schedule time at 5 p. m. This locomotive, an oil burner, consumed on the trip 7,335 gallons of fuel. The rate of speed figures out 39½ miles an hour and the fuel consumption at 7½ gallons per mile.

Pilots on Canadian Locomotives

The Board of Railway Commissioners for Canada has issued an order amending the Rules Relative to the Inspection of Locomotives and Tenders as applied to locomotive pilots. The amendment consists in striking out the last paragraph of the rules prescribed by General Order No. 289 and inserting in place thereof the following: "Pilots.—All locomotives in road service, excepting engines operating in strictly international service on the lines of the Boston & Maine, Maine Central, Rutland, New York Central, and Great Northern railway companies, shall be equipped with pilots projecting not less than 24½ in. from the back of the upright which the pilot is built on, to the nose of the pilots; the minimum height from the rail to be 3 in. and the maximum 6 in. Pilots shall be securely attached, adequately braced and maintained in a safe and suitable condition for service. All such locomotives shall be fully equipped by December 31, 1925."

Training of Oxy-Acetylene Welders

The American Welding Society has issued an outline of a course for the training of oxy-acetylene welders. This report was prepared by a committee and combines the experience of experts of the Federal Board of Vocational Education, the American Welding Society and the National Research Council. For the information of the person who is selecting candidates, the text includes a discussion of the qualifications which the candidates for training should possess. For the information of the instructor, the text includes the fundamentals in gas welding, together with a detailed statement of content, classified under type welding jobs arranged in the order of difficulty. Copies may be secured from the American Welding Society, 29 West Thirty-ninth street, New York.

Adjustment of Brake Power on Tank Cars

Complying with requests received from a majority of the owners and operators of tank cars for an extension of the effective date for complying with the requirements of the tank car specifications for the adjustment of brake power on existing cars, the general committee of the Mechanical Division, American Railway Association, has extended the time limit which had been set at July 1, 1923, to July 1, 1924. The reasons for allowing the extension of time are the general business conditions which have prevailed for some time and the fact that a large number of tank cars, scattered throughout the country, are stored on railroad sidings, making it impracticable for the owners to complete the work of adjustment within the time limit originally set.

British Railway Places Heavy Equipment Orders

The London & North Eastern, according to Modern Transport (London), has recently ordered the following equipment:

800 covered goods wagons from the Metropolitan Railway Carriage, Wagon & Finance Company, Ltd., Birmingham.

750 mineral wagons of 12 long tons' capacity from Clayton Wagons, Ltd., Lincoln.

750 mineral wagons of 12 long tons' capacity and 500 open goods wagons of the same capacity from the Midland Railway Carriage & Wagon Company, Ltd., Birmingham.

500 open goods wagons from Charles Roberts & Company, Ltd., Wakefield.

300 mineral wagons of 18 long tons' capacity from the Hamilton Wagon Company, Ltd.

30 goods brake vans from the Birmingham Railway Carriage & Wagon Company, Ltd., Birmingham.

In addition, the company has ordered 10,635 freight cars, 272 passenger train cars, two twin sleeping cars, six single sleeping cars and 78 locomotives from its own shops.

Needed: More Goggles

Accidents to the eyes of workmen in American industries aggregate the astonishing number of 200,000 a year, according to a statement issued by the National Committee for the Prevention of Blindness, 130 East Twenty-second street, New York City; and in one state, Pennsylvania, out of twelve million dollars awarded as compensation for permanent injuries since the Workmen's Compensation Act was put in force, more than 40 per cent went for compensation for loss of eyes. This sum, about $5,000,000, was greater than the combined compensation paid for loss of legs, arms and feet and for permanent disability from other injuries. The committee says that there are still innumerable plants where goggles ought to be worn, but are not worn; and many workmen who have goggles keep them in their pockets, unless they are watched. Legislation is not a sufficient means of prevention in this matter, because the workman who has goggles and does not use them can be enlightened only by persistent education. These and other points in connection with eye dangers are to be the subject of a report soon to be issued.

Wage Statistics for March

The number of employees reported by Class 1 steam roads for March, 1923, was 1,816,479, an increase of 246,321, or 15.7 per cent, over the number reported for the same month last year, and an increase of 32,924, or 1.8 per cent, over the number for February, 1923, according to the monthly summary of wage statistics published by the Interstate Commerce Commission. The total compensation in March, 1923, was 17.9 per cent greater than in March, 1922. In this period the earnings per hour for straight time for the employees reported on an hourly basis decreased from 58 cents to 56 cents an hour. The overtime earnings decreased from 82 cents to 81 cents an hour. Taking the straight time, overtime, and other compensation together, these employees reported on an hourly basis were paid an average of 61.8 cents per hour in March, 1922, and 59.9 cents in March, 1923. But, owing principally to an increase in the amount of overtime worked, they averaged 227 hours per employee in March, 1923, as against 215 in March, 1922, with the net result that their average compensation per month increased from $133 to $136 in the same period.

French to Supply Siamese Railway Equipment

A French company recently obtained a contract for 10 new locomotives for the Siamese State Railways, on the basis of the lowest tender in competition with American, British, Belgian, and German concerns, according to Consul Brodie at Bangkok. The total amount budgeted being considerably in excess of the French tender, a portion of the surplus over and above the price quoted was diverted to the purchase of 4 additional locomotives, 2 from an American company, and 2 from a British concern. At the present time only British and German locomotives are in use on the Siamese State Railways, and the new contracts mark the introduction into Siam of the first American railway equipment of this character.

American exporters are at some disadvantage in obtaining orders for heavy railway equipment in Siam in competition with British and Continental European firms. The greater distance involved necessitates a heavier freight charge on American-made products. As there is no direct steamer service between United States ports and Bangkok, freight originating in the United States and consigned to Bangkok must be transshipped either at Hongkong or Singapore. Furthermore, the unfavorable exchange rate is another feature that affects adversely the Siamese market for American products.

Locomotive Building in New Zealand

The New Zealand government had contracted with British manufacturers for 45 locomotives, and almost all of them had been delivered when the last instalment was lost in the wreck of the steamer Wiltshire, according to dispatches from Wellington to the Times (London) Trade Supplement. The insurance claim in respect to that loss having been settled, the proceeds are being applied to the replacement of the lost engines and the purchase of additional ones. The British manufacturers who secured the first contract in competition with American, Belgian, Australian and German tenderers will supply the engines now required at a contract price of £5,225 per locomotive, which with freight, insurance, and other charges and cost of assembling and putting on rails in New Zealand will be increased to £6,245—a substantial reduction compared with the original contract price. The engines are to be delivered in New Zealand in July.

Construction of locomotives in the dominion itself is being carried out at the government's own shops at Addington, in South Island, and in the works at Thames, in North Island. The price of these locomotives is, however, higher than that of those being built in Great Britain. The contract price for the Thames engines, of which 16 have yet to be delivered, is about £11,000 each, while those being built by the government will cost in the shop £8,000 each. Engines under construction in the government shops will take two years to complete.

Scottish Concern to Build and Equip Portuguese Railway Shops

William Beardmore & Co., Ltd., of Glasgow, Scotland, recently cured a contract for the supply, construction and equipment of the general workshops of the Portuguese South & South Western Railway, at Barreiro. The workshops in question are for the construction, maintenance and repair of locomotives and cars. When completed, the establishment will comprise an erecting shop, foundry, machine shop, tool room, carpenters' shop, paint shop, paint mill and store, material store, boiler shop, forge and blacksmith shop, finishing shop, coppersmiths' shop, carriage and wagon shop, upholsterers' shop, timber shed, pattern shop, and will be the largest building of its kind in Portugal.

The present shops are to be demolished to make way for the new buildings, but the contract calls for the work of the railway being carried on in the old shops while the new shops are being built, and the transference of old plant and the installation of new plant being carried out in such a way that the repairs and upkeep of railway plant will not be interfered with. The buildings are to be equipped with modern electric overhead cranes, air compressor plant, and fire installation. Diesel motor and generator for the power station, mechanical coaling appliances capable of coaling two locomotives at one time, reinforced concrete water supply tank, dock pump, etc., will be provided. Rails, points and crossings have also to be provided, for direct access to the different shops and for the intercommunication between each shop and in order to facilitate the rapid handling of the work to be undertaken.

Proposed Electrification in Spain

Representatives of Morgan & Company of New York, Messrs. Rothschild of London and Messrs. Urquijo, the Spanish bankers of Madrid and Bilbao, have recently formed a company with a capital of 500 million pesetas (approximately $100,000,000 at par exchange), to carry out the long-discussed project for an electric line between Madrid and Valencia, according to a dispatch from Barcelona to the Times (London) Trade Supplement. The line will be about 220 miles in length and double-tracked.

The project includes the development of hydro-electric power necessary for the new line, as well as the working of several mines, and other schemes of an agricultural character. It is stated that the work will be put in hand as soon as possible, embodying the proposals of the engineers, Messrs. Vallejo and Membrilla.

The capital of the new company will enjoy a state guarantee of five per cent interest. Besides being the first electric trunk line to be constructed in Spain, the project is one of the most important of its kind that has been launched in the country for many years. The new railway will open up a new country rich in minerals and in agricultural produce but hitherto devoid of communications.

Of the Trans-Pyrenean railways which are being constructed under the Franco-Spanish Agreement of 1904, the line from Ripoll to Puigcerdá is the only section at present in working order. The Minister of Public Works has now been authorized to ask for tenders for its electrification. The line is about 40 miles in length, with two long tunnels of a total of 3.7 miles. There are eight stations, some of which are not yet complete. The line rises to a height of 3,900 ft. in the tunnel under the Pyrenees; eventually it will connect with the French lines at Aix-les-Termes and will shorten the journey between Barcelona and Toulouse by 75 miles.

Increase in Wages on Many Roads

The Pennsylvania Railroad has made an advance of two cents an hour in the wages of various classes of employees in the central region, including elevator operators, watchmen and laborers. At Gadsden, Ala., it is announced that the 700 employees of the Gadsden Car Works have gone to work, after a suspension of one week, under a new contract with their employers in which "all labor troubles have been smoothed over." Since the strike of last year, the men have been working without a general agreement.

The striking shopmen of the Central of New Jersey, of whom it is said that 1,200 have remained out, have at last announced that a formal vote has been taken to give up the strike. The shops at Elizabeth, N. J., were already well manned; but at Ashley, Pa., it is said that the break-up in the brotherhood will result in considerable numbers of men going to work in the shops.

The Southern Pacific has made a general increase in the wages of shopmen; skilled mechanics, 5 cents an hour; helpers, 2 cents an hour. The number of men affected is about 13,000; and they were represented in the negotiations by the officers of the Southern Pacific Shop Crafts' Protective Association, an organization confined to the employees of this road. The annual addition to the payrolls will be about $750,000.

The Chesapeake & Ohio has increased the pay of shopmen 2 cents an hour. About 7,000 men are affected and the annual payrolls in this department will be increased about $590,000.

The Illinois Central has received an application from the Brotherhood of Railway and Steamship Clerks for increased pay for storekeepers and assistants; chief clerks and other supervisory clerical positions, 9 cents an hour; for clerks, 9 cents and in some cases 10½ cents an hour; for inexperienced clerks an initial salary of $77.50 a month, to be advanced $10 after six months; janitors and watchmen, 14 cents an hour; office boys and messengers, 9 cents; freight handlers, 8 cents; common laborers, 10½ cents; telephone operators, 10 cents.

The Railway Employees' Department of the American Federation of Labor is negotiating with the Chicago & North Western, the Chicago, Milwaukee & St. Paul and the Southern Railway for increases in the wages of shop craft employees on these roads, said to number 54,000 men. The A. F. of L. representatives also ask for time and one half for overtime and for Sunday work.

The Louisiana & Aransas has advanced the pay of carpenters to 54 cents an hour; track and shop laborers to 31 cents an hour.

The San Antonio & Arkansas Pass has agreed with the United Brotherhood of M. W. employees and shop laborers to make a general increase in wages on the same general plan which is in force on other roads.

The Atchison, Topeka & Santa Fe has increased the pay of shop craft employees 2 cents an hour. This applies to blacksmiths, boiler makers, metal workers, electricians, car men, stationary firemen and oilers.

The Louisville & Nashville has made a general increase of two cents an hour in the pay of all classes of employees in the mechanical department, the increase having been put into effect on July 1.

Progress Made on A. R. A. Transportation Program

The Car Service Division of the American Railway Association has issued a second monthly statement of the progress made on the "Program to Provide Adequate Transportation," as approved by the members' meeting of the American Railway Association and of the Association of Railway Executives on April 5.

Total cars of revenue freight loaded for the 22 weeks to June 2 inclusive show a consistent increase above the estimated figures as well as far in excess of the total for same periods of the previous years for which we have record. Following is the cumulative loading by commodities and total for the first 22 weeks of 1923 compared with the corresponding period of previous years.

	1923	1922	1921	1920
Grain and G. pro.	883,352	940,008	829,567	722,549
Live stock	705,524	627,642	622,491	660,307
Coal	4,047,507	3,051,665	3,249,849	3,907,411
Coke	330,724	179,826	155,430	235,078
Forest products	1,590,451	1,169,603	1,079,305	1,352,981
Ore	536,183	195,651	246,439	546,572
Mdse. L. C. L. and misc.	11,874,072	10,441,841	9,388,703	10,395,989
Total	19,967,813	16,606,236	15,571,784	17,820,887

The new equipment put in service and on order is as follows:

Cars	Put in service January 1 to June 1, 1923	On order June 1, 1923
Box	27,862	45,709
Refrigerator	7,468	13,237
Coal	26,806	43,113
Stock	1,696	1,814
Flat	1,374	2,085
Others	454	1,121
Total	65,660	107,079
Locomotives	1,697	2,041

Other statistics showing progress are given in the report as follows:

ALL FREIGHT CARS AWAITING REPAIRS

	January 1, 1923		June 1, 1923
Heavy	164,041 cars or 7.2 per cent	Heavy	155,564 cars or 6.9 per cent
Light	51,970 cars or 2.3 per cent	Light	56,202 cars or 2.5 per cent
Total	216,011 cars or 9.5 per cent	Total	211,766 cars or 9.4 per cent

STEAM LOCOMOTIVES AWAITING REPAIRS

	January 1, 1923		June 1, 1923
Heavy	13,587 loco. or 21.1 per cent	Heavy	11,368 loco. or 17.8 per cent
Light	1,962 loco. or 3.0 per cent	Light	1,315 loco. or 2.1 per cent
Total	15,549 loco. or 24.1 per cent	Total	12,683 loco. or 19.9 per cent

RAILROAD FUEL STOCKS

	January 1, 1923		June 1, 1923
Tons in cars	2,443,460	Tons in cars	2,554,307
In stock piles	4,313,426	In stock piles	5,880,373
Total	6,756,886	Total	8,434,680

	Tons per car			Miles per car per day		
	1923	1922	1921	1923	1922	1921
January	29.0	27.6	30.1	25.8	20.4	23.2
February	28.2	28.3	28.4	24.8	23.2	21.3
March	27.9	27.7	27.2	27.0	24.4	20.9
April	27.8	24.4	26.9	27.9	21.3	20.6

Nationwide Investigation Into Apprentice System

Appointment of a committee to make a nationwide investigation of the apprentice system has been announced by the American Management Association, composed of many of the country's largest industrial enterprises. The committee, headed by L. L. Park, supervisor of welfare, American Locomotive Company, Schenectady, N. Y., was named by the Plant Executives' Division of the Association, of which Sam A. Lewisohn of New York, vice-president of the Miami Copper Company, is chairman.

Modernizing American apprentice systems is one of the aims of the committee, according to Mr. Lewisohn, who said: "Several states are planning modern apprenticeship laws and it is desirable that there should be uniformity in these measures."

Other members of the committee include: L. A. Wilson, director of the National Society for Vocational Education, Albany, N. Y.; Milton D. Gehris, vice-president, John B. Stetson Company, 1801 Germantown avenue, Philadelphia; E. W. Gressle, employment manager, the Warner & Swasey Company, Cleveland; Burt L. Fenner, McKim, Mead & White, New York; Franklin T. Jones, supervisor of training, the White Motor Company, Cleveland; Stanley Zweibel, director of service, Nordyke & Marmon Company, Indianapolis; Robert H. Spahr, department of engineering extension, Pennsylvania State College, Philadelphia; James P. Garvey, Works Training Division, Western Electric Company, Chicago; Walter S. Berry, director of training, Scovill Manufacturing Company, Waterbury, Conn.; L. S. Hawkins, director of the Department of Education, United Typothetæ of America, Chicago; I. B. Shoup, director of personnel and training, Marion Steam Shovel Company, Marion, O.; A. C. Lampman, supervisor of apprentices, National Cash Register Company, Dayton, O.; P. E. Wakefield, educational director, Carnegie Steel Company, Pittsburgh.

The findings of the committee will be embodied in a report, one of a series to be presented to the fall convention of the association dealing with the human factor in commerce and industry. It is the plan of the committee to touch upon such phases of the subject as will aid in the promotion of apprentice schools and of training courses in various types of industry along the most approved and successful lines.

Chairman Lewisohn also announces the personnel of the Plant Executives' Division, which includes representation from the steel, iron, brass, clothing, electrical and other trades, as well as railroads and other public utilities, as follows:

Elisha Lee, vice-president, Pennsylvania Railroad; John H. Goss, vice-president, Scovill Manufacturing Company, Waterbury, Conn.; E. K. Hall, vice-president, American Telephone & Telegraph Company; Robert B. Wolf, New York, past vice-president of the American Society of Mechanical Engineers; Charles R.

Hook, vice-president, American Rolling Mill Company, Middletown, O.; W. E. Hotchkiss, director of the National Industrial Federation of Clothing Manufacturers, Chicago; E. S. McClelland, personnel director of the Westinghouse Electric & Manufacturing Company, Pittsburgh; C. S. Ching, supervisor of industrial relations, U. S. Rubber Company, New York; Alfred L. Ferguson, vice-president, Consolidated Textile Corporation, New York; Leigh Best, vice-president, American Locomotive Company, New York; A. H. Young, manager of industrial relations, International Harvester Company, Chicago; George J. Anderson, industrial relations counsel, Curtis, Fosdick & Belknap, New York; E. G. Draper, treasurer, Hills Brothers Company, New York; J. M. Larkin, assistant to the president, Bethlehem Steel Company, Bethlehem, Pa.; Milton D. Gehris, vice-president, John B. Stetson Company, Philadelphia.

MEETINGS AND CONVENTIONS

General Foremen's Convention

The indications are that the 1923 convention of the International Railway General Foremen's Association, to be held at Chicago, September 4-7, will be the best in the history of the association. Superintendents of motive power of many roads are co-operating with the officers of the association and have already sent in the names of those who will represent them, and who have been assigned certain topics for discussion. From the present outlook, the exhibits will be more numerous than in former years. The Locomotive Stoker Company will have on exhibition a full working model of one of their stokers, which will be of interest in connection with one of the topics. The same is true of valve gears, models of which will be on exhibition.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroao Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V—Equipment Painting Division. V. R. Hawthorne Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting monthly, Hotel Iroquois, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting Hotel Sherman, Chicago, October 3, 4 and 5.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in each month, except June, July, August and September, Copley-Plaza Hotel.

New York Railway Club.—H. D. Vought, 26 Cortlandt St., New York, Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Fine St., San Francisco, Cal. Meetings second Thursday in each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in each month, except June, July and August.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Edgewater Steel Company has removed its offices from 316 McCormick building to 1335 Peoples Gas building, Chicago, Ill.

Joseph T. Ryerson & Son, Inc., has moved its offices from 910 Corn Exchange building, Chicago, to 1736 Illinois Merchants Bank building.

The Merchant & Evans Company, Philadelphia, Pa., has discontinued its Chicago plant and will manufacture all mixed metals at Philadelphia.

The O. K. Company, dealing in general railroad and steamship supplies, has moved its general sales office to 555 Railway Exchange building, Chicago.

E. W. Price, representative of the Laclede Steel Company, has been promoted to manager of sales in charge of the northern district, with headquarters at Chicago.

Robert Huff, representative at New York City of the McConway & Torley Company, Pittsburgh, Pa., has removed his office from 39 Cortlandt street to 2 Rector street.

The name of the Electric Steel Company, Chicago, has been changed to the Nugent Steel Castings Company. There is no change in management, ownership or personnel.

The Pittsburgh Machine Products Company, Oliver building, Pittsburgh, Pa., has been appointed district representatives of the Conveyors Corporation of America, Chicago.

The Colonial Supply Company, Pittsburgh, Pa., has been appointed exclusive distributor in the western Pennsylvania territory for the Latrobe Tool Company, Latrobe, Pa.

The Hisey Wolf Machine Company, Cincinnati, Ohio., has appointed R. L. Barker & Co., Chicago, as its exclusive representative in Indiana, Illinois, Wisconsin and Iowa.

The Boyden Steel Corporation has removed its offices from the Keyser building to larger quarters in the Standard Oil building, Franklin street and St. Paul place, Baltimore, Md.

The Consolidated Machine Tool Corporation of America has opened a district sales office in the General Motors building, Detroit, Mich., under the management of Roland A. Holmes.

J. R. Sexton, division engineer of the Erie, with headquarters at Huntington, Ind., has been appointed railway sales manager of the H. H. Robertson Company, with headquarters at Chicago.

S. P. Wright & Company, district representatives of the Conveyors Corporation of America, Chicago, has removed its Butte, Mont., office from 109 East Broadway, to 812 East Iron street.

Gibbs & Hill, consulting engineers, with offices in the Pennsylvania Station, New York City, have been retained by the Virginian Railway in connection with the electrification of that road.

P. W. Lawther, sales representative of S. F. Bowser & Company, Inc., with headquarters at Dallas, Tex., has been promoted to sales manager of the Texas territory, with the same headquarters.

The Hoosier Waste Renovating Company, Indianapolis, Ind., has been formed to engage in the reclaiming of oil waste. N. P. Link is president and L. T. Evans and M. W. Evans are vice-presidents.

W. E. Brewster, advertising manager of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., has resigned and E. D. Giauque, who has been Mr. Brewster's assistant, has been appointed to succeed him as advertising manager.

Frederick A. Guild, former New York representative of the Galena Signal Oil Company, died on May 14, at his home in Greens Farms, Conn., at the age of 77. Mr. Guild retired from active service about five years ago.

H. B. Crantford, representative of the railway sales division of the Electric Storage Battery Company, with headquarters at Chicago, has been promoted to manager of railway signal sales, with headquarters at Philadelphia, Pa.

Higgins & Co., Chicago, representatives of the American Valve & Meter Company and the St. Louis Frog & Switch Company, have been appointed general sales agents throughout the United States for the Cook Standard Tool Company.

William Henry Andrews, chairman of the board of directors of Pratt & Lambert, Inc., Buffalo, N. Y., died at his summer home, Watch Hill, R. I., on June 19, after an illness of about a year and a half. Mr. Andrews was born in 1860 at Thomaston, Maine.

The Federal Machinery Sales Company, Chicago, the Laughlin-Barney Machinery Company, Pittsburgh, Pa., and the Elliott & Stephens Machinery Company, St. Louis, Mo., have been appointed sales representatives for the Oilgear Company, Milwaukee, Wis.

The Truscon Steel Company has moved its Detroit, Mich., office to temporary quarters in the Krolik building, 316 E. Jefferson street. Permanent quarters will be located in the new Truscon building now under construction at the northwest corner of W. Congress and Wayne streets.

F. H. McGuigan, Jr., regional engineer for the Northwestern, Central Western and Southwestern regions of the United States Railroad Administration, with headquarters at Chicago, has resigned to become assistant to the president of the Railway Car Manufacturers' Association, New York City.

Clyde M. Carr, retired president of Joseph T. Ryerson & Son, Inc., died on June 5 in Chicago after an illness of several weeks. A photograph of Mr. Carr and a sketch of his career appeared in the March issue of the *Railway Mechanical Engineer*, at the time Mr. Carr retired from the presidency of the company.

The Standard Tank Car Company, Inc., Sharon, Pa., has removed its New York City office from 233 Broadway to Suite 1222 in the Canadian Pacific building, 342 Madison avenue. This company reports that it completed 750 new cars during the month of April, the largest output in this company's history.

William E. Manning, vice-president and general sales manager of the Youngstown Sheet & Tube Company, died on June 15 at Youngstown, Ohio. He was born at Youngstown in 1870, and had been with the above company since 1901. Mr. Manning was also president of the Continental Supply Company and the Youngstown Steel Products Company.

E. R. Riley, district manager of the Alexander Brothers Belting Company, a subsidiary of Armour & Co., with headquarters at Chicago, has been elected vice-president of Warren Corning & Co., with the same headquarters. This company has moved its offices to 908-10 Fisher building and will be distributors of the Fairbanks Company's valves and the Dart Manufacturing Company's unions.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will give all its employees an opportunity to participate in the purchase of a new issue of 20,000 shares of common stock, to be paid for on the deferred plan at $53 a share (par vale $50). Each employee may subscribe for one to twenty shares of stock and pay for it in ten consecutive monthly instalments.

E. H. Hall, formerly superintendent of the car department of the Chicago, Great Western, with headquarters at Oelwein, Iowa, has been appointed special representative of the Robert M. Lucas Company, Chicago, manufacturers of flexible corrosion-proof cements for railroads for the territory west of the Mississippi river to the Pacific coast. Mr. Hall's headquarters will be in Chicago.

L. N. Selig, assistant to the president of the General American Tank Car Corporation with headquarters at East Chicago, Ind., has been appointed acting director of purchases, succeeding C. H. Coyle, vice-president and director of purchases, resigned. R. M. McFarland, storekeeper with headquarters at East Chicago, has been promoted to assistant purchasing agent with the same headquarters.

F. E. Lister has been appointed service engineer of the Franklin Railway Supply Company, Inc., New York City. Mr. Lister was formerly in railway service. In 1908 he joined the staff of the Railroad Gazette, New York, as associate editor, where he remained for three years. Since 1921, Mr. Lister has been engaged in engineering and sales work as a manufacturers' representative in New York City.

Willard T. Sears, research and experimental engineer of the Niles-Bement-Pond Company, New York, died recently at Montclair, N. J. Mr. Sears had been with the company for over twenty years. Prior to this he was connected with the Pennsylvania Steel Company for a number of years. He was a member of the class of 1887 of Massachusetts Institute of Technology. Mr. Sears was an inventor and developer of a number of machine tool devices.

Frank H. Clark, who was president of the Elvin Mechanical Stoker Company in 1917 when the stoker was being developed, and who subsequently became vice-president of the Bradford Draft Gear Company, New York City, has been elected vice-president of the Elvin Mechanical Stoker Company in an executive and sales capacity, with headquarters in New York. Mr. Clark will remain also as director and vice-president of the Bradford Draft Gear Company.

The Amsler-Morton Company, Pittsburgh, Pa., and 2039 Railway Exchange building, St. Louis, Mo., has been appointed agent of the Uehling Instrument Company, Paterson, N. J., for eastern Missouri and southern Illinois. H. R. N. Johnson, who formerly represented the Uehling Instrument Company, has joined the W. P. Nevins Company, 120 South Ninth street, Minneapolis, Minn., which company is now the Uehling representative in Minnesota and the Dakotas.

S. Bert Bennett, who was formerly assistant road foreman of locomotives of the Lehigh Valley, and Alex. D. Lawrence, engineman on the Boston & Albany, have been appointed service engineers of the Franklin Railway Supply Company, Inc., New York. William A. Bradshaw, formerly in the motive power department of the Central of New Jersey, has been appointed an inspector, and G. R. Grove, formerly with Hunt & Co. as inspector of new locomotives, is now mechanical inspector for the Franklin Railway Supply Company.

Ross F. Hayes has resigned as general sales manager of the Curtain Supply Company to engage in the railway supply business with office at 2 Rector street, New York City. He is now eastern representative of the Henry Giessel Company, Chicago, manufacturers of water coolers for service on railway passenger cars and locomotives, also representative of the Protecto Manufacturing Company, Chicago, manufacturers of metal bound weatherstripping for railway cars. Mr. Hayes is also representing several other manufacturers of steam and electric railway equipment.

The Whiting Corporation, Harvey, Ill., has opened a district sales office at 1526 Jefferson County Bank building, Birmingham, Ala., in charge of W. R. Hans as district manager. This office will handle sales in Alabama, Georgia, Tennessee and Northern Mississippi for the Whiting Corporation and its subsidiaries, the Grindle Fuel Equipment Company and the Swenson Evaporator Company. The Whiting Corporation has opened a district sales office at 624 Penton building, Cleveland, Ohio, in charge of R. P. Dryer as district manager. This office will have charge of the sales in Ohio.

W. A. McWhorter, general manager of the Bradford Draft Gear Company, New York, died at his home in Chicago on June 9, after an illness of two days. Prior to his connection with the Bradford Draft Gear Company, Mr. McWhorter was located in the South, as assistant master mechanic of the Georgia Railway & Power Company, superintendent of equipment of the Birmingham Railway, Light & Power Company and in the sales department of the Galena Signal Oil Company, with headquarters at Atlanta, Ga. He left the last named company in 1916 to take up work with the Bradford Draft Gear Company.

The Palmyra Packing Company has been incorprated in New York, with general offices and factories at Palmyra, N. Y., to manufacture a complete line of asbestos, flax, rubber and duck packings for locomotives and shop machinery. The officers of the company are John N. Todd, president, who was for fifteen years, until last October, general sales manager of the Garlock Packing Company; Frank W. Coats, vice-president, formerly vice-president of the Crandall Packing Co.; Samuel H. Hunt, treasurer, a capitalist, of Palmyra, and Charles McLouth, secretary, an attorney at Rochester, N. Y. The manufacturing and sales organization is composed of expert packing makers and experienced packing salesmen.

The B. F. Sturtevant Company, Hyde Park, Boston, Mass., has bought the plant of the Wisconsin Engine Company, makers of Corliss pumping engines at Corliss, Wisconsin. The new plant covers nearly ten acres and the buildings have approximately

150,000 ft. of floor space. A full manufacturing and engineering staff will be maintained and closer co-operation given to western customers. Harry W. Page has been appointed general manager and will be in charge of the Wisconsin plant. Mr. Page is a graduate of the University of Wisconsin, and for the past six years, has been assistant general manager at the main works of the B. F. Sturtevant Company, Hyde Park, Boston.

John Edgar Rhodes, for the last eight years secretary-manager of the Southern Pine Association, died on June 2 in Touro Infirmary, New Orleans, La., after an illness of about two months. He was born at Kent, Ohio, on July 9, 1874, and began his career in newspaper work. He subsequently served as private secretary to an officer of the Northern Pacific, secretary of the Minnesota Logging Company and then returned to newspaper work. In 1898 he was appointed secretary-manager of the Northern Pine Association. Ten years later he became connected with the Weyerhaeuser timber interests. In 1912 he became publisher and editor of the Tacoma (Washington) Tribune and when that paper was sold was appointed secretary-manager of the National Lumber Manufacturers' Association with headquarters in Chicago. Since 1915 he served as secretary-manager of the Southern Pine Association.

Graeme Ross has been appointed manager of the Kansas City branch of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., to succeed F. F. Rossman, who has resigned to become vice-president of the Mobile Light & Railway Company, Mobile, Ala.; E. L. Doty, district service manager of the Buffalo branch office, of the Westinghouse Electric & Manufacturing Company, has been appointed engineering assistant, service department, with headquarters at East Pittsburgh; J. A. Atkinson has been appointed Buffalo service manager; C. W. Jones has been appointed general foreman of the controller department at the East Pittsburgh works; C. A. Fike has been appointed general foreman of the coils and insulation department at East Pittsburgh works; J. H. Hartman has been appointed general foreman of the storekeeping department at the East Pittsburgh works, and W. S. Oswald has been appointed general foreman of the railway motor department at the East Pittsburgh works.

Horace S. Clark, assistant manager of the Pacific district of the Westinghouse Air Brake Company, has been appointed Pacific district manager, with headquarters at San Francisco, Cal., to succeed C. P. Cass who has resigned to devote more time to the Westinghouse Pacific Coast Brake Company of which he is president. E. R. Fitch has been appointed Southwestern district engineer of the Westinghouse Air Brake Company with headquarters at St. Louis, Mo., and Lawrence Wilcox, mechanical expert at Chicago, has been promoted to representative and transferred to the Columbus, Ohio office. S. T. Reid succeeds Mr. Wilcox in Chicago.

W. W. Martin, of the general offices at Wilmerding, Pa., has been elected an assistant auditor. Mr. Martin has been connected with the auditing department since 1906 and was chief clerk prior to his recent promotion. P. B. McGinnis has been appointed representative, with headquarters in Chicago, where he previously served as mechanical expert and H. R. Hood, of the Wilmerding office, succeeds him as mechanical expert.

Prof. Dr. Hans Goldschmidt, inventor of the Thermit process, died suddenly in Baden-Baden, Germany, on May 20, 1923, after a stroke. Prof. Goldschmidt was born in Berlin, Germany, on January 18, 1861. After having been graduated from the "gymnasium" of Altenburg, he studied chemistry, physics and natural sciences at the universities of Berlin, Leipzig, Heidelberg, Strassburg and at the Institute of Technology at Charlottenburg. He received the degree of Ph. D. from the University of Heidelberg in 1886.

In 1887, Prof. Goldschmidt entered the firm of Th. Goldschmidt, Essen Ruhr, Germany, in joint partnership with his brother, Dr. Karl Goldschmidt. The attention of the latter was applied mainly to the business management of the company, while Prof. Hans Goldschmidt devoted himself to scientific research. Under their joint guidance, the firm grew to international importance, with agencies and allied companies throughout the world.

Prof. Goldschmidt's most important invention was the Thermit process, now used extensively all over the world for welding iron and steel sections, and for producing metals and alloys of high purity.

Prof. Goldschmidt visited this country frequently and was president of the Goldschmidt Thermit Company, now Metal & Thermit Corporation, from 1904 to 1916.

The surplus Steel Exchange, Inc., has been formed for the purpose of presenting an outlet for surplus stock material of steel products. A commission will be charged only on sales actually made, as the exchange will not buy material but act solely in the capacity of agent. The officers of the new company are: Robert D. McCarter, president; George E. Dix, vice-president; William L. Cooper, treasurer, and Edward Michaud, secretary and general manager. The offices are at 7 Dey street, New York City. Robert D. McCarter is a partner of the firm of McCarter & Cooper, consulting engineers. He was formerly identified with the General Electric Company and the Westinghouse Companies, having been consulting engineer of the European Westinghouse Companies, and president of the Russian Westinghouse Electric Company. George E. Dix began his connection with the steel industry in 1907, with the Carnegie Steel Company, at the Waverly warehouse. He went to the Midvale Steel & Ordnance Company in 1916, as assistant to the general manager of sales, and during the last four years was with the Consolidated Steel Corporation as assistant to the vice-president. William L. Cooper was associated with the R. W. Hunt Company for fifteen years, having been European manager during a part of that time. He is a partner of McCarter & Cooper. Edward Michaud is an experienced steel man, having seen service with the Carnegie and Midvale Companies and the Consolidated Steel Corporation.

A. W. MacLaren, general traffic manager of Morris & Co., with headquarters at Chicago, has been appointed vice-president in charge of sales of the Chicago Bearing Metal Company, with the same headquarters. He entered railway service in 1898 in the accounting department of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, and in 1899 was promoted to chief clerk in the general passenger department with the same headquarters, which position he held until 1902, when he was promoted to secretary to the president, with the same headquarters. In 1905, when the Cleveland, Cincinnati, Chicago & St. Louis was consolidated with the New York Central, he was promoted to assistant to the vice-president in charge of traffic of the New York Central lines, with headquarters at Chicago, and in 1907 was transferred to New York as assistant to the vice-president. He held this position until 1910, when he resigned to become general traffic manager of Morris & Co., with headquarters at Chicago, which position he has held until his recent appointment.

A. W. MacLaren

The Electric Storage Battery Company, Philadelphia, Pa., has organized two separate departments within the railway sales division to handle the car lighting and signal, and car control battery business of the company, respectively. William H. Palmer, Jr., was made manager of the railway sales division with headquarters at Philadelphia, to fill the vacancy caused by the resignation of Harry B. Marshall, who left the company to engage in private business. Mr. Palmer has been associated with the Electric Storage Battery Company since August 1, 1894, with the exception of a few years, when he served with other interests closely identified with the storage battery industry. Thomas L. Mount has been appointed manager of the car lighting department and H. B. Crantford, manager of the railway signal department, with headquarters at Philadelphia; both will serve under Mr. Palmer, the manager of railway sales division. Mr. Mount has been associated with the development of railway car lighting by electricity for the past 18 years. He was employed by the Consolidated Railway Electric Lighting & Equipment Company, successively as draftsman, machinist, foreman and on the road installing, maintaining and operating some of the first axle lighting equipments using the Manchester type of Exide batteries. Later he became a member of the sales staff and eventually vice-president of the Consolidated Railway Electric Lighting & Equipment Company, in charge of sales and engineering. In 1919 he entered the service of the engineering department of the Electric Storage Battery Company, and later was transferred to the railway division in connection with car lighting equipment sales. Mr. Crantford has been in the railway sales department from 1919 until 1923 at Chicago. Prior to that he was engaged in automatic signal and interlocking installation and maintenance for the General Railway Signal Company. He served as signal maintainer and foreman on the Northern Pacific and on the Chicago, Milwaukee & St. Paul. He also served as supervisor of signals, telegraph and telephone for the electrified zone of the latter company.

E. H. Talbot

Elisha Hollingsworth Talbot, founder of the original Railway Age, and for twelve years its active manager and publisher, died in New York City on May 22 at the advanced age of 83 years. He was born at McConnelsville, O., August 9, 1839, and was educated at Iowa State University. In early life he engaged in a great variety of literary, political and newspaper activities, being at one time secretary to United States Senator James Harlan and later to Congressman James F. Wilson. These activities covered some 20 years, 1855-1875, and included two years as a member of the Illinois legislature. He was admitted to the practice of law by the Supreme Court of Illinois in 1868. In 1876, after extended experience as a newspaper publisher and editor, Mr. Talbot established in Chicago a weekly publication devoted to railways—their financing, construction, operation, management and relations with their employes and the public. When this project took form in 1876, the mileage of railways in the United States was less than 75,000, while that in the states west of Chicago was less than 27,000. At that time the railways were incomplete, disjointed and engaged in destructive competition, and an era of insolvencies, foreclosures and amalgamations was at hand. It required courage to launch a railway publication in this new field at that time and vision to see the vast program of railway expansion which soon materialized. But Mr. Talbot had the courage and vision and found the necessary means and supporters. Under the name of the Railway Age his idea materialized into an aggressive publication with himself as president and manager and Horace R. Hobart as editor. Mr. Talbot retained control of the Railway Age until September 1, 1891, when he sold it to Harry P. Robinson and Hugh M. Wilson. Among the notable enterprises started by Mr. Talbot in connection with the Railway Age was the publication of the Biographical Directory of Railway Officials and the organization of the first extensive exposition of railway appliances in America, which was held at Chicago in 1883. Mr. Robinson, after a short time, sold out his interest and Mr. Wilson acquired full control; and, in 1908, sold the paper to the Railroad Gazette, and it was combined with the Gazette under the name of the Railroad Age Gazette. In 1910 the name was changed to Railway Age Gazette and in 1918 the present name, Railway Age, was adopted. Since retiring from railroad journalism, Mr. Talbot had been interested in various publications and had kept up his interest in Mexico, which began in the days of his early activity, when (1885) he conducted a party of Mexican editors and congressmen on a tour of observation throughout the United States. He had been planning to go to Mexico only a short time before his death, expecting to make an extensive tour to get material for a series of magazine articles.

TRADE PUBLICATIONS

Twist Drills and Reamers.—The Latrobe Tool Company, Latrobe, Pa., has issued a catalog of 112 pages listing and illustrating its line of high speed twist drills and reamers.

Stokers.—The type K stoker for operating boilers up to 200 hp. at high capacity and efficiency is fully described and illustrated in a four-page folder issued by the Combustion Engineering Corporation, New York.

Ground Form Gear Cutter.—A neatly arranged, 12-page booklet outlining the principal features of its ground form gear cutters has recently been issued by the Brown & Sharpe Manufacturing Company, Providence, R. I.

Threading Machinery.—Pipe and nipple threading and cutting machines, bolt threading and nut tapping machines, chaser grinders and automatic die heads are described and illustrated in catalog No. 26 recently issued by the Landis Machine Company, Waynesboro, Pa.

Material Handling Equipment.—The Link-Belt Company, Chicago, in its Book 690, presents profusely illustrated descriptions of various installations of its material handling equipment for foundries. The equipment includes complete mechanical sand handling and conditioning facilities, mold conveyors, casting conveyors, etc.

Hoists.—Bulletins Nos. 76-C and 76-D have recently been issued by the Sullivan Machinery Company, Chicago, in which its single and double drum air turbine hoists, types HA and HDA respectively, are described in detail. These "turbinair" hoists are designed for general hoisting and hauling purposes, spotting freight cars, etc.

Gasoline Motor Coaches.—A folder has recently been issued by the Service Motors, Inc., Wabash, Ind., in which are illustrated a number of its model 55 motor coaches as they have been built for a number of steam railways. In addition to the specifications of the model 55 coach, it gives considerable data as to the cost of operating this equipment, which has been obtained from a number of users.

Yale Trolleys.—A folder containing detailed descriptions of the plain and geared types of the new Yale steel plate roller bearing trolleys and a description of the new cast-iron trolley has recently been issued by the Yale & Towne Manufacturing Company, Stamford, Conn. Details of interesting tests to which the new steel plate trolley has been subjected and a complete list of its material handling equipment are also included in this folder.

Boilers.—The Lebanon Boiler Works, Lebanon, Pa., has issued Bulletin 23-A which is a 23-page booklet containing a complete illustrated description of the Uniflow improved return tubular boiler; also illustrations of typical Uniflow installations and tables showing the absorption efficiency of fire tubes, horsepower ratings, CO_2 losses, etc. In addition, an interesting comparison of the Uniflow boiler with the ordinary horizontal return tubular boiler is given.

Doors for Industrial Buildings.—Details of construction and operation of Wilson rolling steel doors, rolling wood doors, horizontal folding doors and fireproof air chamber doors are fully described and illustrated in catalog No. 36 recently issued by the J. G. Wilson Corporation, New York. Typical installations of each type of door are shown, also unretouched photographs of fireproof air chamber doors before and after fire and cold water hose stream test at Underwriters' Laboratories, Chicago.

Prevention of Foaming.—An instruction booklet entitled "Foaming, Its Cause and Prevention," written particularly for the benefit of enginemen and firemen, has been issued by the Bird-Archer Company, New York. The text sets forth in simple terms the principle on which Bird-Archer anti-foaming compound operates to prevent foaming and explains clearly the reasons for the simple instructions given for its successful use. Copies will be furnished for distribution to enginemen and firemen on request.

EQUIPMENT AND SHOPS

Locomotive Orders

The Atchison, Topeka & Santa Fe has ordered 30 2-8-2 type locomotives from the Baldwin Locomotive Works.

The Union Railroad has ordered 10 heavy 6-wheel switching locomotives from the Lima Locomotive Works.

The Central Vermont has ordered 16 Consolidation type and eight 0-8-0 type switching locomotives from the American Locomotive Company.

Locomotive Repairs

The Missouri Pacific is having 100 locomotives repaired at the shops of the Morgan Engineering Works, Alliance, Ohio.

Freight Car Orders

The Ford Motor Company has ordered 1,000 box cars from the Standard Tank Car Company.

The Phelps Dodge Corporation has ordered 66 concentrate cars of 60 tons' capacity from the Mt. Vernon Car Manufacturing Company.

The Sinclair Refining Company has ordered five tank cars of 6,000 gal. capacity and 10 tank cars of 8,000 gal. capacity from the Standard Tank Car Company.

The Atchison, Topeka & Santa Fe has ordered 50 express refrigerator cars of 40 tons' capacity from the General American Car Company. This company is also inquiring for four private cars.

The Florida East Coast has ordered 10 caboose cars and 200 ventilated sheathed box cars from the Mt. Vernon Car Manufacturing Company and 200 steel flat cars from the American Car & Foundry Company.

The Virginian Railway has ordered 25 120-ton gondola cars from the Pressed Steel Car Company, in addition to the 1,000 placed with the same builder as was reported in the May issue of the *Railway Mechanical Engineer*.

Freight Car Repairs

The Western Maryland will rebuild 2,000 steel hopper coal cars of 50 tons' capacity in its shops at Baltimore, Md.

The Chicago, Burlington & Quincy has placed an order with the Pullman Company for repairs on 600 coal cars.

Machinery and Tools

The Northern Pacific has ordered a 48-in. car wheel borer.

The Southern Pacific has placed an order for a 40-ton crane.

The Michigan Central has placed an order for a 6-ft. radial drill.

The Pullman Company has ordered two 48-in. car wheel borers.

The New York, New Haven & Hartford has placed an order for a 36-in. planer.

The Illinois Central has ordered a 90-in. driving wheel lathe, also a 48-in. car wheel borer.

The Chicago, Burlington & Quincy has ordered one 200-ton locomotive hoist from the Whiting Corporation.

The Delaware, Lackawanna & Western has ordered one 70-ft. 231-ton locomotive transfer table from George B. Nichols & Brother.

The Chicago, Rock Island & Pacific has ordered one 50-ft., 200-ton locomotive transfer table for its Forty-seventh street shops in Chicago, from George B. Nichols & Brother.

The New York, Chicago & St. Louis will install a 45-ft., 173-ton transfer table at its Stony Island shops, Chicago, which has been ordered from George B. Nichols & Brother.

The Baltimore & Ohio has recently contracted with the Chesapeake Iron Works, Baltimore, for the construction and delivery of a 50-ton freight-handling gantry crane, for use in its Oak street yard, Baltimore, Md.

The Atchison, Topeka & Santa Fe has ordered one 63-ft., 215-ton locomotive transfer table from George B. Nichols & Brother. This road has also placed an order for a 36 in. planer, two 2,000-lb. steam hammers and one 1,100 lb. steam hammer.

The Central of New Jersey has placed an order for a 6-ft. radial drill. This company also ordered two 4 ft. radial drills from Joseph T. Ryerson & Son, Inc., and one 25-ton electric gantry crane from the Milwaukee Electric Crane & Manufacturing Company.

Shops and Terminals

Western Pacific.—This company will construct additions to its car and locomotive shops at Sacramento, Cal., at a cost of approximately $225,000.

Southern.—This company will construct a new planing mill at Princeton, Ind., and will remodel the old mill and boiler shop at that point, at an estimated cost of $275,000.

Toledo Terminal.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a cinder handling plant at Toledo, Ohio.

Texas & Pacific.—This company plans the construction of a new roundhouse and engine terminal at Dallas, Texas. Land for the project has already been purchased.

Union Pacific.—This company will construct a new six-stall roundhouse at Topeka, Kan. This company also plans the construction of a new machine shop at Topeka.

Missouri Pacific.—This company has awarded a contract to H. W. Underhill & Co., Wichita, Kan., for the construction of a 120-ft., one-story enginehouse and repair shop at Wichita, Kan.

Chesapeake & Ohio.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a 30,000 gal. capacity water treating plant at Peach Creek, W. Va.

The Carnegie Steel Company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of an electrically operated cinder handling plant at Duquesne, Pa.

Denver & Rio Grande Western.—This company has awarded a contract to Battey & Kipp, Inc., Chicago, for construction of additions to the shops and enginehouses at Denver, Colo., and Salt Lake City, Utah.

Michigan Central.—This company has awarded a contract to Ellington Miller Company, Chicago, for the construction of an extension to its roundhouse at West Detroit, Mich., to cost approximately $80,000.

Ft. Worth & Denver City.—This company will construct temporary shops at Childress, Tex., to replace buildings recently destroyed by fire. The location and construction of permanent shops will not be considered at this time.

Atlantic Coast Line.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of two 500-ton three track, reinforced concrete automatic electric locomotive coaling plants, at Florence, S. C., and Rocky Mount, N. C.

Chicago & North Western.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 150-ton concrete coaling station at Stambaugh, Mich., and one to the Howlett Construction Company, Moline, Ill., for the erection of a 250-ton frame coaling station at Belle Plaine, Iowa.

St. Louis-San Francisco.—This company has awarded a contract to T. S. Leake Construction Company, Chicago, for the erection of new shop buildings on Tyler avenue, St. Louis, Mo., which include a 20-stall roundhouse, machine shop, car plant and two wash-rooms. The improvement is estimated to cost $500,000. This company has also awarded contracts to John M. Olsen, of Springfield, Mo., for the construction of shop buildings at East Thomas, Ala.; terminal facilities at East Thomas, Ala.; and shop buildings at Enid, Okla.

PERSONAL MENTION

General

M. A. Smith has been appointed assistant superintendent of motive power of the Pittsburgh & Lake Erie with headquarters at McKees Rocks, Pa., succeeding D. J. Redding, promoted.

C. C. Peters, road foreman on the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., and H. B. Wells have been appointed fuel supervisors, with headquarters at Chicago.

D. J. Redding has been appointed superintendent of motive power of the Pittsburgh & Lake Erie, with headquarters at Pittsburgh, Pa., in charge of the motive power department, succeeding L. H. Turner, assigned to other duties.

S. Zwight, mechanical superintendent of the Northern Pacific lines east of Paradise, Mont., with headquarters at St. Paul, Minn., has been promoted to acting general mechanical superintendent, with the same headquarters, succeeding H. M. Curry, who has been granted leave of absence. T. J. Cutler, general master mechanic of the lines, from Mandan, N. D., to Paradise, Mont., with headquarters at Livingston, Mont., has been promoted to acting mechanical superintendent of the lines east of Paradise, with headquarters at St. Paul, Minn., succeeding Mr. Zwight.

The following appointments have been made in the fuel department of the Boston & Maine: W. E. Small, chief fuel inspector; A. J. Whelan, inspector fuel service; W. F. Maher, inspector fuel service; J. J. Tobin, inspector fuel service; W. E. Chase, chief fuel supervisor; J. E. Barber, fuel supervisor, Portland division; J. R. Annis, fuel supervisor, Portland division; N. L. Wiggin, Jr., fuel supervisor, Interdivision runs; C. C. McCutcheon, fuel supervisor, covering all Southern division, except north of Concord; J. L. Emery, fuel supervisor, Fitchburg division; F. J. McShalley, fuel supervisor, Berkshire division; W. E. Colby, fuel supervisor, W. N. & P. division; W. G. Gray, fuel supervisor, White Mts. and Passumpsic division; Thomas Bell, fuel supervisor, Connecticut river division, and Southern division, north of Concord.

Paul W. Kiefer, whose appointment as assistant engineer of rolling stock of the New York Central was announced in the April issue of the *Railway Mechanical Engineer,* was born at Delaware, Ohio, on February 13, 1888. He studied engineering at the Central Institute, Cleveland, Ohio, and entered the employ of the Lake Shore & Michigan Southern, now part of the New York Central, on December 15, 1904. After serving as machinist apprentice, piecework inspector, machinist, locomotive construction inspector, foreman locomotive construction inspector and draftsman, he was appointed locomotive designer in the equipment engineering department (locomotive). While in this department he also served as leading draftsman and traveling inspector, later being placed in charge of the dynamometer car on locomotive capacity and tonnage rating tests. He then became chief draftsman and on July 16, 1920, he was appointed assistant engineer in the equipment engineering department (car). For the past 10 years Mr. Kiefer has made a special study of locomotive and car designs.

O. S. Jackson has been appointed superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., succeeding C. E. Fuller, who has resigned. Mr. Jackson entered railway service in 1889 in the mechanical department of the Erie at Huntington, Ind. From 1897 to 1905 he served in the mechanical department of the Cleveland, Cincinnati, Chicago & St. Louis, being appointed general foreman on the Chicago, Indianapolis & Louisville during the latter year. He was promoted to master mechanic in 1909, and in 1913 was appointed superintendent of motive power of the Chicago, Terre Haute & Southeastern, with headquarters at Terre Haute, Ind. A year later he was promoted to general superintendent in charge of the mechanical and transportation departments, with the same headquarters. Mr. Jackson was appointed assistant superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., in September, 1921, which position he held at the time of his recent promotion to superintendent of motive power and machinery.

Hugh Pattison, who during the past two years has been employed by the Illinois Central in connection with the electrification of that road, has been appointed engineer of electric traction of the Virginian Railway. Mr. Pattison graduated from the Johns Hopkins University as an electrical engineer in 1892. The first work that he did upon leaving college was the wiring and installation of electrical apparatus on naval vessels at the Navy Yard in Norfolk, Va. At this place he held the position of foreman. He became assistant engineer with Sprague, Duncan & Hutchinson, consulting engineers of Baltimore, in 1893. Shortly afterward he became associated as engineering assistant with Frank J. Sprague, vice-president and technical director of the Sprague Electric Company in New York. This association continued until 1903, during which time Mr. Pattison assisted in equipping and operating multiple unit control on the Boston Elevated and Brooklyn railroads. In 1905, Mr. Pattison joined the Westinghouse, Church, Kerr Company as an engineer, and from that time until 1911, during the electrification of the Pennsylvania tunnel into New York, Mr. Pattison was assistant engineer of electric traction for George Gibbs, consulting engineer. A little later he had charge of the electrification of the West Jersey & Seashore Railroad, from Camden to Atlantic City. An experimental single phase electric railway on the Long Island Railroad was also built by him and numerous locomotive tests on the West Jersey & Seashore Railroad were carried out under his supervision. Mr. Pattison was appointed engineer in charge of the Chicago Association of Commerce Committee in the study of smoke abatement and the electrification of terminal railroads in Chicago in 1911. After completing his work in Chicago, he was retained by the Westinghouse Electric & Manufacturing Company and was engaged in making special engineering studies under the direction of F. H. Shepard. He resigned this position when he entered the employ of the Illinois Central.

Master Mechanics and Road Foremen

O. G. McPhail, formerly master mechanic of the Atlanta, Birmingham & Atlantic at Atlanta, Ga., has been appointed master mechanic of the Cumberland & Manchester, with headquarters at Barbourville, Ky.

J. Matheson has been appointed acting master mechanic of the Seattle division of the Northern Pacific with headquarters at Seattle, Wash., succeeding B. P. Johnson who has been assigned to other duties.

M. J. McGraw has been appointed master mechanic of the Seaboard Air Line with headquarters at Jacksonville, Fla., succeeding H. Y. Harris, assigned to other duties.

G. V. McGlinch has been appointed master mechanic of the Michigan Central, with headquarters at Bay City, Mich., succeeding J. O. Goodwin, deceased. Mr. McGlinch has heretofore served as road foreman of engines.

B. P. Johnson, master mechanic of the Northern Pacific, with headquarters at Seattle, Wash., has been promoted to acting general master mechanic of the lines from Mandan to Paradise, with headquarters at Livingston, Mont., succeeding Mr. Cutler.

Car Department

Samuel Lynn has been appointed master car builder of the Pittsburgh & Lake Erie, with headquarters at McKees Rocks, Pa.

J. T. St. Clair has been appointed acting engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, succeeding E. Posson, who has been granted leave of absence for six months.

Obituary

Joseph O. Goodwin, master mechanic of the Michigan Central, with headquarters at Bay City, Mich., died recently at his home. Mr. Goodwin was born in 1871 and entered the service of the company in 1887 as a locomotive fireman. Subsequently he was promoted to engineman and in 1914 was appointed road foreman of engines, receiving his appointment as master mechanic in 1919.

Railway Mechanical Engineer

Volume 97 August, 1923 No. 8

Shop Management Competition

In our July number we announced a shop management competition to close on September 15. The competition was inspired by the discussion on shop management which took place at the meeting of the Mechanical Division at Chicago in June. Industrial organizations have found that it paid well to give considerable attention and go to quite some expense to provide special training or coaching for their supervisory officers and foremen in the principles of management. Several foremen's clubs were started on the Pennsylvania Railroad last year, the purpose of which was not to discuss matters concerning craftsmanship, or even methods of shop operation; the discussions largely concerned the principles for successfully directing the activities of the workmen and dealing with the human element. Facilities and methods are of course important, but as one of the speakers said at the Mechanical Division meeting, better results can be obtained by a well organized and enthusiastic group of workers with poor facilities than by a group of indifferent workers with the very latest and most up-to-date facilities and equipment. There are a lot of books published and articles written on the principles of successful management. What we want, however, is examples of the way in which some of these principles have been applied with success. We are not so much interested in the theoretical side of the question, but we are tremendously interested in giving our readers concrete pictures and applications of simple principles which have been found to give real results. Two prizes are offered, a first prize of $75 and a second prize of $50 for the two best articles of this kind. They will be judged upon the practical value of the suggestions that are made. Articles which do not receive a prize but which are published, will be paid for at our regular space rates.

How Is Your Terminal Operated?

One of the strongest assets of an enginehouse foreman is ingenuity—the ability to meet emergencies effectively. Almost never provided with a plant adequate for the maximum service required at certain seasons, or perhaps even during the daily peaks, he must use such facilities as are available so effectively that trains are despatched without delay under widely, and sometimes suddenly, fluctuating transportation demands. In many cases this requires the daily solution of new problems presented by temporary conditions which may change over night.

But notwithstanding the satisfaction which comes from waging a winning fight against constantly shifting odds, every foreman no doubt recognizes the fact that most effective results are obtained where the element of chance is reduced to a minimum—where forces are organized and work planned to anticipate future conditions as far as this is possible. Here is a field for the exercise of the ingenuity of the officers of the mechanical department from the roundhouse foreman to the head of the department, so that something like a permanent return may be obtained. What kind of organization of your enginehouse forces have you found to give the best results? Are your men all specialists, or do they work in gangs, taking any assignment that offers within their craft? Is your running repair work all emergency work, or are you prepared for it in advance? Have you been able to supplement the facilities at your disposal with any particularly effective devices that did not require an A.F.E.?

The *Railway Mechanical Engineer* will pay a first prize of $50 and a second prize of $35 for the two best articles in answer to any one, or all of these questions, containing the most constructive suggestions (1) for expediting the turning and despatching of locomotives (2) for simplifying inspection and repairs (3) for keeping engine failures at a minimum when heavy seasonal business does not permit much time in the hands of the mechanical department. We are not so much interested in the results obtained from the operation of the best laid out and best equipped engine terminals in the country as we are in the means by which you have materially improved any one or all of the three above named phases of engine terminal operation. Neither are we primarily interested in the literary merits of the articles submitted. The articles may be of any length, although from 1,000 to 1,500 words is suggested as about the maximum required. The articles must be received at the office of publication prior to October 15. Should any articles other than those awarded the prizes be published, they will be paid for at space rates.

The Apprentice Competitions

The two apprenticeship competitions, one for regular apprentices and the other for college men who are serving as apprentices, which were announced and commented upon in our June and July issues, close September 1. It is not too late for you to prepare your contribution and get it to us by that date. Our hope is that we shall receive a large number of constructive criticisms or suggestions from apprentices, both regular and special, which will encourage the managements to give still greater attention to the whole question of recruiting and training men for the mechanical department. The best modern apprenticeship systems have been fostered and developed by men of rare vision, who have had a keen sympathy for the young men. On the other hand, it is, of course, unfortunate that so few roads have gone into this question to the same extent as has the Santa Fe, for instance. A number of roads have taken this question up during the past year or two and a very considerable amount of progress has been made in improving the methods of training on these roads. We have the feeling that greater results could sometimes be accomplished if those in charge of developing the apprenticeship methods had a better understanding of how the young men viewed these things and as to just what their reactions were. Here is a splendid opportunity for the young men to have their say and to be helpful, by giving those in charge a frank statement of how they look at the situation and how they think the methods may be improved.

Measuring Shop Output

On another page of this issue is Mr. Westbrook's article which was awarded first prize in the Erecting Shop competition. One of the most interesting features of this article is the output meter used for giving an intelligent comparison of shop production month by month. There can be no adequate control of shop operations without a knowledge of what is being accomplished, and the mere statement that 30 locomotives were turned out at a certain shop in one month as compared to 25 locomotives in another month by no means proves the operation in the former case to have been more efficient. What was the relative number of men employed? How many man-hours of labor were required? Did light or heavy repairs predominate? Were the locomotives old and small with few accessories, or were they large modern locomotives equipped with all the latest labor and fuel saving devices? It is plain that without some means of reducing these varying factors to some common denominator no accurate comparison of shop output month by month can be made and the shop superintendent will not know whether his organization is getting good results or needs to be toned up.

Reference to the article will show how this problem of measuring shop output has been met at the Grand Trunk shops, Battle Creek, Mich. In the first place, it will be noted that a distinction is made between large and small power, thereby making it unnecessary to give the same credit for Class 3 repairs to a heavy Pacific type locomotive as to a small six-wheel switcher. A point system is used in conjunction with the standard classification promulgated by the Railroad Administration, based on a careful and extended study of the relative number of man-hours of labor required for each class of repairs on both heavy and light power.

Without stealing too much of the author's thunder, it may be said that the output meter shows for each month the total number of locomotives repaired and the class of repairs given in each case; also, the points made, number of men employed and hours worked. The product of the last two figures gives the total number of man-hours per point and monthly percentage of gain or loss can be readily calculated. The output meter described can doubtless be adapted, with possibly a few minor changes, to any shop not already using some such method of measuring shop output.

The Problem of Boiler Repairs

One of the serious problems confronting some, if not most of the railroads, is that of maintaining locomotive boilers in condition for safe and efficient operation. Modern boilers are large, with large areas of tubes and sheets exposed to the corrosive action of poor feedwaters. Flue sheets, side sheets and other firebox sheets must be patched or renewed frequently. Federal requirements call for staybolt cap removal every 18 months, new flues at least every three years and lagging removal for hydrostatic test every five years. Obviously, this work cannot be done without the use of a large force of men trained in repairing boilers.

It is a well-known fact that for years the boilermakers', and to an even greater extent the blacksmiths', trades have been attracting fewer and fewer young men to serve apprenticeships and become all-around journeymen in these trades. With an increasing demand for their services, experienced boilermakers have been able to demand and receive considerably greater wages than are paid by the railroads, and these men have gradually drifted out of railroad service. On July 1, 1922, the strike of railroad shopmen was called and in practically all cases the boiler shop employees left en masse. Some of them have since returned but a large proportion undoubtedly secured employment elsewhere at their trade or entered new trades. The latter alternative was followed, particularly in the Middle West where energetic young men with some mechanical ability were greatly needed for specialized jobs in the automotive industry.

Faced with a total disorganization of boiler repair forces in July, 1922, and the practical impossibility of employing an adequate number of skilled boilermakers since, the railroads found the question of boiler maintenance a most serious one. Some railroads frankly admitted their inability to cope with the situation and sent heavy boiler repair jobs to the locomotive builders who were in a better position to handle them. Other roads deferred heavy boiler repairs as much as consistent with safety until their boiler shop forces could be built up to handle the work. New men were employed in the boiler departments and while lacking in experience, they were as a rule commendably willing to work and learn. With the aid of a skeleton organization of foremen, inspectors and gang leaders who remained faithful to the railroads, these new men were developed along specialized lines until some railroad boiler shops are now getting better production than before the strike. It is true that all around boilermakers cannot be developed in a short period of training no matter how intensive, but such a training can develop specialists in the different branches of boiler work, each of these men being able to handle his own specialty better than boilermakers with wider and more general experience. On the whole it appears that the best if not the only immediately available solution of the boiler maintenance problem confronting the railroads is in the careful selection and development of specialists in the different branches of boiler repair work.

Production Methods in Car Repairs

In the discussion on modern repair track facilities during the Mechanical Division meeting at Chicago, attention was directed to the fact that the railroads had been very slow to adopt the station to station method of making heavy car repairs regularly used in contract shops. It is encouraging to note at the present time that considerable interest is being displayed in this method and that it has been adopted at a number of points, notably at the Readville shops of the New York, New Haven & Hartford as described elsewhere in this issue. In itself, however, it does not exhaust the possibilities of improvement in the cost of making heavy car repairs that are suggested by contract shop operation.

During recent years a large number of heavy repair or rebuilding operations have been performed for the railroads in contract shops. The outstanding fact with respect to these contracts is that they cover the performance of identical operations on a large number of cars of the same series. This means much in reducing the cost per car to a minimum. New material can be purchased and fabricated in quantities; the fixed facilities such as hoists, staging, bull riveters, etc., can be located and adjusted to best facilitate the particular operations to be performed; the number and size of gangs can be adjusted to obtain a perfect balance; special hand tools may be provided to fit the specific requirements of a single series of cars, and the gangs, organized for the repetition of certain specialized operations, are able to develop a facility of performance entirely impossible when no two successive operations are alike.

Contrast this with the usual run of heavy car repairs as handled at the railroad car shop or repair track. Cars are taken into the shop without regard to series, just as they become available by chance arrival at the home shop. Even where some attempt is made to accumulate a run of cars of a single series, each car is likely to be subjected to individual treatment based on a detail inspection, so that there is considerable variation both in the kind of material and the nature of the track work required for the different units, and the continuity of the run on any one series of cars is not likely to be long enough to suggest the development of special tools or appliances adapted to facilitate the operations encountered exclusively on this single series.

There can be no doubt but that the railroad is handicapped in developing as high a degree of specialization as is done in the contract shop because it must take care of all cars that require immediate attention irrespective of the class or even of ownership. But if a railroad can call in the cars of a single series in sufficient numbers to meet the requirements of a contract shop, would it not be equally possible to make the same arrangement with respect to the operation of at least a part of its own heavy car repair facilities? This might call for the setting aside of a part of a given shop to be organized to handle a single class of cars until that series has all received the needed heavy repairs or rebuilding, or a single shop might be devoted entirely to this class of work, leaving the other shops to take care of the current run of miscellaneous heavy repair work. The advantages of thus organizing heavy repairs are so far-reaching in their effect on the cost per unit that they should receive the careful consideration of every railroad.

What Our Readers Think

C., M. & St. P. Method of Center Sill Stress Analysis

Chicago.

To the Editor:

In your February issue you published an article by Wendel J. Meyers in which the author comments on the methods of calculating the stresses in the C., M. & St. P. gondola cars described in your November, 1922, issue. It is gratifying to note the interest taken by engineers in such articles and any investigation or analysis tending to broaden the knowledge of the art of car design should be encouraged.

The method of analyzing some of the stresses employed by Mr. Meyers, however, does not represent the actual condition. He attempts to prove that the center sills are subject to higher stress at the bolster than shown by the calculations published in the description of the cars, by assuming the center sills as a beam with fixed ends, the distance between the bolster being a free span. This is an unwarranted assumption as the ends of a car are by no means rigid. The flat car or all steel hopper car, for example, has a weak side sill construction and in most designs the end sill adds but little to the rigidity of the underframing. A center sill, therefore, in the usual design of cars cannot be considered as a beam with fixed ends.

It is not necessary to make any auxiliary assumption to prove that high stress exists at the bolster or elsewhere in the center sills. The fact is that the end load or end shock, which is assumed in this case to be 250,000 lb., is actually several times greater when cars are subjected to rough handling in switching service.

An end shock of 250,000 lb. is recommended by the A. R. A. as a minimum end load for freight cars, based on a 15,000-lb. fiber stress or a factor of safety of four if the ultimate strength of the steel is 60,000 lb. per sq. in. It is obvious that the 250,000-lb. end shock is only an assumed load, but through experience it has been ascertained that cars meeting the A. R. A. requirements give a reasonable service without going to an unduly heavy design.

It is a well-known fact that end loads or end shocks are to some extent dissipated by the framing members of the car and in wood cars with spring draft gears, the car repairer sees real evidence of what dissipated energy means in the form of destroyed car members. The function of the friction draft gear is to dissipate the end shock and its ability to perform this work depends upon the capacity of the gear. The car structure will also dissipate a portion of the end shocks but due to the nature of steel, the percentage of the energy absorbed is small until the elastic limit has been reached. A vivid idea of the extent to which each individual car can dissipate a blow from end shock can be obtained in a hump yard when a car is sent down the hump to the classification tracks at a speed of two miles an hour or more, if the clattering is observed when the string of cars successively transmit the blow from one to the other down the track. To assume that the entire end shock is dissipated within the car structure itself is erroneous and would result in unduly heavy center sill sections at the bolster and too weak construction at the center of the car.

In publishing these articles describing C., M. & St. P. designs there was not the slightest intention of producing something new which heretofore has not been done, but rather more effectively to illustrate our construction. To make a statement, as the author of the article in your February issue did, that the field of research in car design has hardly been touched, is an insult to a number of capable car designing engineers who for years have minutely studied the details of car construction. However, if this article and others like it would induce experienced car engineers to write on various subjects pertaining to car design, the efforts of the C., M. & St. P. would be well worth while. L. K. Sillcox,

General Superintendent Motive Power,
Chicago, Milwaukee & St. Paul.

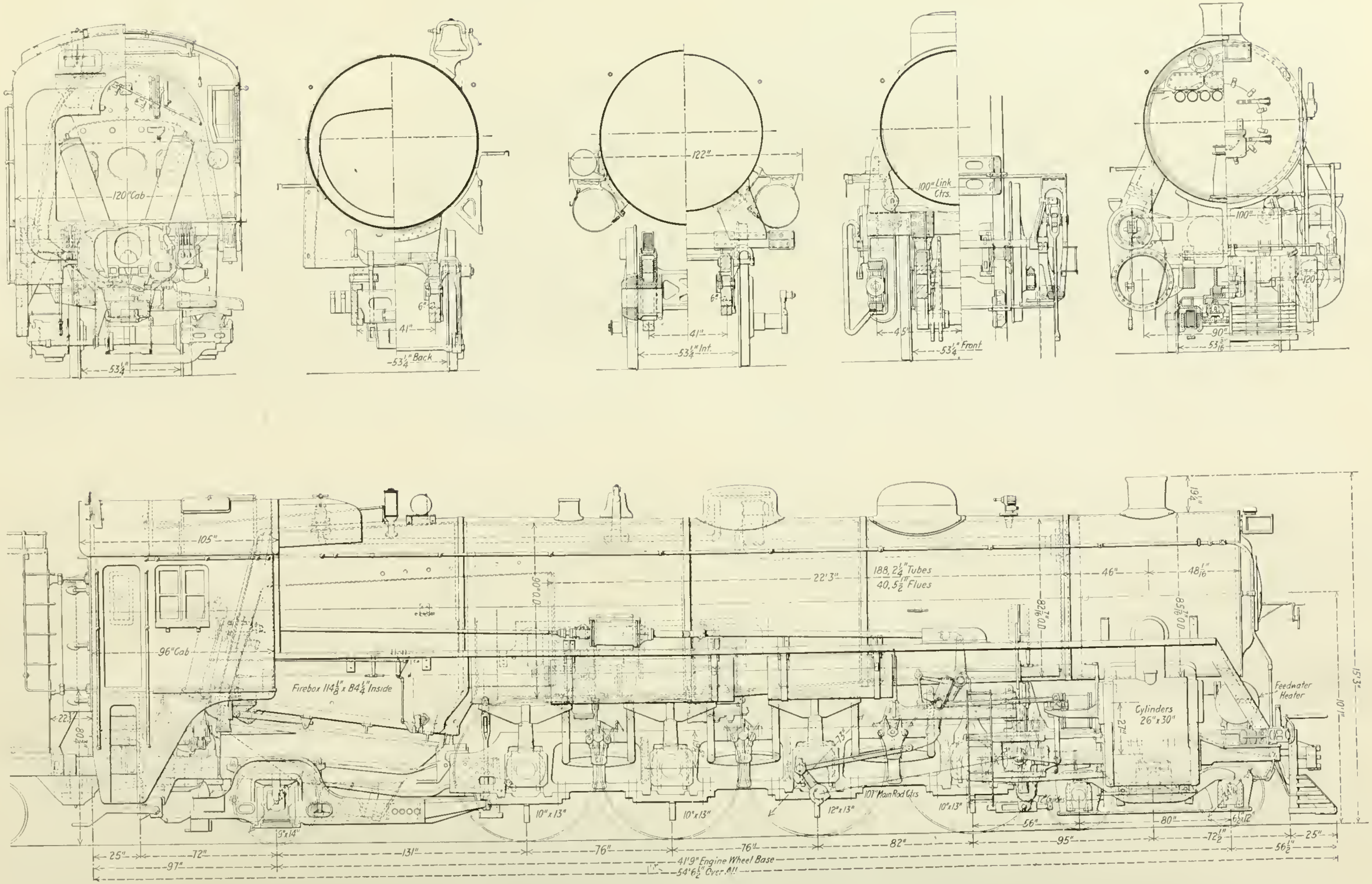
New Books

Automatic Screw Machines. 354 *pages, 6 in. by 9 in., illustrated, bound in paper. Published by Brown & Sharpe Manufacturing Company, Providence, R. I.*

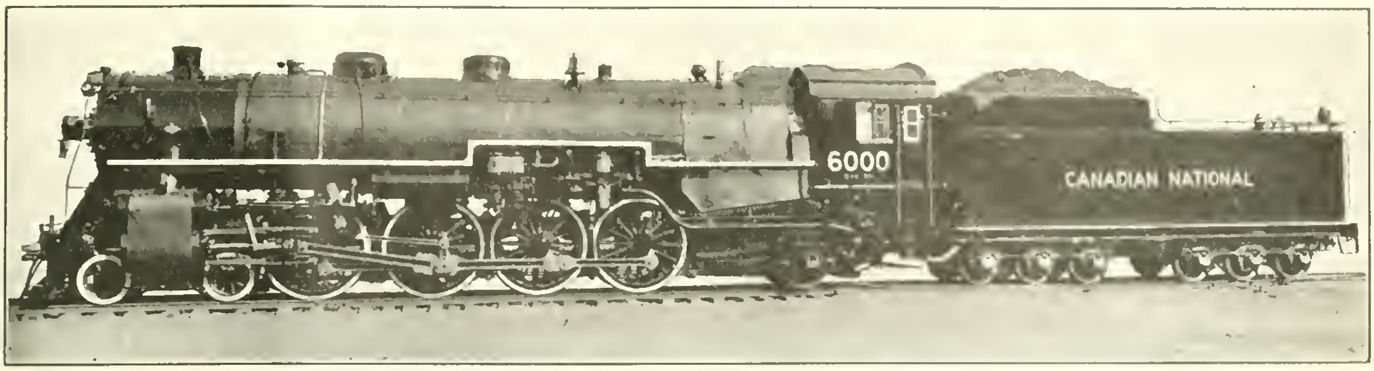
This is a very complete and up-to-date book on the construction and use of automatic screw machines together with automatic turret forming machines and automatic cutting-off machines. It has been prepared for the use of superintendents, foremen and operators of such machines and is a companion book of a series which includes several previous treatises on other types of machine tools. The setting up of the machines is described in detail and complete instructions are given on the use of the standard tools. A chapter on designing cams and many useful tables makes the book of special interest to the operator.

Locomotive Catechism. *By Robert Grimshaw, 958 pages, 5½ in. by 7¾ in., 468 illustrations, bound in cloth. Published by the Norman W. Henly Publishing Company, New York.*

This is the thirtieth edition of a book which for a number of years has been considered the standard authority in its class. It is written in a simple and easily understandable manner such as will appeal to firemen, engineers, trainmen, switchmen, shop hands and enginehouse men for whom it has been prepared. The text follows the form of examination questions and answers, of which there are some four thousand. Considerable new matter has been added in this addition and the old matter carefully revised. The chapters, of which there are 89, are short and conveniently headed for ready reference and cover the various details, such as boilers, cylinders, valve gear, running gear, superheaters, air brakes, etc. The book tells not only what to do, but also what not to do and is specially helpful for a person preparing for an examination for promotion.



Croess-Sections and Elevation of Canadian National Mountain Type Locomotive



A Well Designed Mountain Type Locomotive of Medium Weight

Canadian National Mountain Type Locomotive

Increasingly Heavy Passenger Traffic Requires Adoption of 4-8-2 Type Locomotives for Eastern Canada

By C. E. Brooks

Chief of Motive Power, Canadian National Railways

PROMINENT among the locomotives which the Canadian National Railways are acquiring during 1923, are the 16 Mountain type being built by the Canadian Locomotive Company, Kingston, Ontario. A large number of the details used in the construction of these locomotives are of Canadian National standard design and common to all their large modern power. However, there are many new features necessarily introduced in the building of a new type with the dimensions and power of the mountain type.

These locomotives are known on the Canadian National as the U-1-a class, road Nos. 6,000 to 6,015. They have a total weight (without tender) of 339,000 lb., the weight on the drivers being 226,770 lb. The tractive power is 49,600 lb. and the factor of adhesion is, therefore, 4.5. The cylinders are 26 in. diameter by 30 in. stroke and the driving wheels, 73 in. in diameter.

Features of the Boiler and Other Attachments

The boiler which carries 210 lb. pressure is of the straight-top radial-stayed type with a conical bottom, the largest course being 90 in. in diameter. The firebox is 48¼ in. by 114⅛ in. inside, and the combustion chamber is 48½ in. long. The boiler horsepower is 96.4 per cent of the cylinder horsepower.

There are 188, 2¼-in. tubes and 40, 5½-in. flues, 22 ft. 3 in. long, the flues being electric welded into the back tube sheet as per Canadian National standard.

A feature of Canadian National practice in crown staying, which has been followed on these boilers, is the alternation of successive groups of four transverse rows of crown stays; *i.e.*, four rows of button head crown stays are succeeded by four rows of plain heads and so on alternately. This arrangement provides against the possibility of a boiler explosion in the event of a burnt crown sheet, by reason of the sheet giving first at a point where stayed with plain head stays and pulling down over some of these stays, at the same time being held on either side by the button head stays, the pressure being relieved through the holes where the sheet comes over the plain heads.

In view of the size of these locomotives and in order to take advantage of every means for efficient operation, they have been equipped with mechanical stokers and feedwater heaters, the boiler feed apparatus on the left hand side consisting of a pump in connection with the feedwater heater and on the right-hand side a Hancock type EA lifting injector of 3,500 gal. capacity.

The grates are of Canadian National standard design, the rocking grate bars being of cast steel and operated by Franklin power grate shakers.

The superheater used is the Robinson, one of the standard superheaters in England but comparatively new on Canadian roads. It embodies many interesting features, prominent among these being the maintaining of steam in the superheater units at all times, this being calculated to lengthen the life of the units.

The ash pans are of the Canadian National standard hopper type, the location of the door hinges being such that the doors close of their own weight. An attachment, which is Canadian National standard practice and is known as the ash pan sludge, is worthy of note. This consists of an 1¼-in. pipe from the delivery pipe of the injector to the ash pans, with a valve operated from the cab, and a branch extending into each hopper. The arrangement is specially valuable as it permits the direction of hot water into the ash pans to thaw them out when the locomotive arrives at a terminal in freezing weather with pans partly filled.

Engine and Running Gear

The frames, with a single forward section, are of carbon steel thoroughly annealed, rigidly braced with cast steel crossties and fitted with taper bolts throughout. The rear end is fitted with a Commonwealth cast steel cradle casting.

The equalizing system is of the usual type, the engine truck forming one system of equalization while the four driving wheels on each side are equalized with the trailing truck, thus forming the other two systems, this arrangement giving a three point suspension. The equalization places approximately 57,300 lb. on the engine truck, 226,770 lb. on the drivers and 54,930 lb. on the trailing truck.

The driving wheels are 73 in. diameter with 66 in. centers of cast steel. The axles are 10 in. diameter at the journals except the main journals which are 12 in. diameter, and due to weight consideration and in keeping with modern practice, are hollow bored.

The driving boxes are of cast steel with bronze bearings and those for the front pair of drivers are of the Franklin lateral motion type, designed to compensate when taking curves for the long wheel base necessary on such large modern engines. Franklin adjustable driving box wedges and Franklin hard grease cellars are used throughout. A comparatively new feature in connection with the driving boxes and worthy of particular mention, is the application of the Franklin driving box spreader. This is a permanent casting fixed at the bottom of the box, prevents any spring to the sides of the box and makes the removal and repacking of grease cellars a simple, as well as a quick operation.

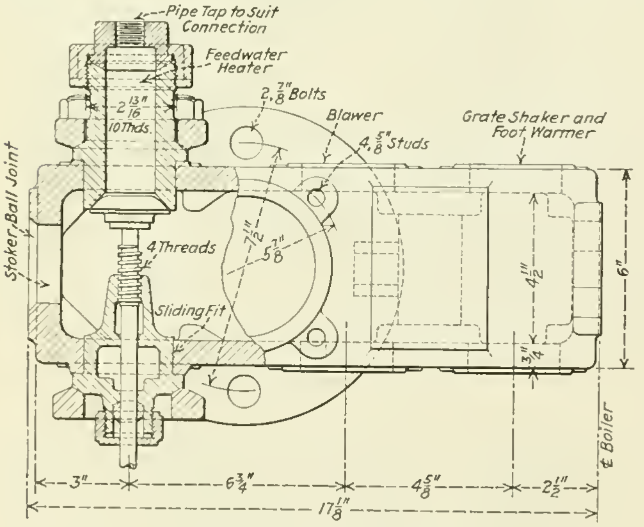
The crosshead is fitted with the Rogatchoff adjustment, a feature which permits the adjustment of the shoes to take up the wear.

The crosshead guides and piston rods are of such length that the piston may be carried out clear of the front cylinder head without disconnecting the piston rod from the crosshead.

The engine truck is of the Commonwealth constant-resistance, four-wheel type, equipped with Preston hub slip liners and Armstrong oilers. The wheels are 34¼ in. diameter, and have spoked steel centers 28 in. diameter, common to all Canadian National modern passenger locomotives. The trailing truck is also of the Commonwealth constant-resistance type with 43-in. diameter wheels and 36-in. cast steel wheel centers.

Steam distribution is provided for by Walschaert valve gear of modern design. The diameter of the piston valve is 14 in. and the valve setting is as follows: Travel, 6½ in.; lap, 1⅛ in.; lead, ¼ in.; exhaust clearance, ¼ in.

The cylinders follow Canadian National standard design, being equipped with railway standard by-pass valves and four standard cylinder cocks to each cylinder, two being placed at the center of the barrel and connected with a drain pipe from the bottom of the steam chest, this pipe being covered by the cylinder jacket, the other two cocks being piped to the exhaust cavities which are drained from each quarter. All eight cylinder cocks are operated in unison by one set of levers. The cylinders also are equipped with railway standard relief valves. The bottom of the cylinder casting is arranged so that the engine truck center plate is checked into same, thereby affording ample provision to withstand the thrust which this part is subjected to.

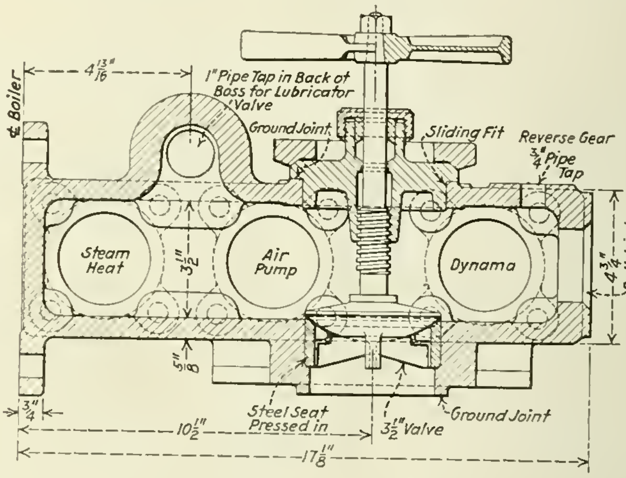


Left Hand Half of Turret—Partial Horizontal Section Through One of the Operating Valves

Cab and Piping Arrangement

The cab is of the railway company's standard short vestibule type. This type of cab makes it possible to have almost all the short stays in the sides of the firebox out clear of the cab, the few that remain inside all being F.B.C. flexibles.

Great care has been given to the piping layout and, as far as practical, it was laid out in the drawing room in advance of construction. The cast steel turret with eight outlets has been placed outside and 25 in. ahead of the cab, affording ample room for packing the operating valves which are all of one standard design. Six operating valves enter the turret horizontally from the rear with the valve seats and steam connections at the front, these connections being fitted with a coupling nut and a tail piece tapped to suit the several pipe sizes, thereby permitting the use of one size standard operating valve. These operating valves are fitted with extension handles carried into the cab and labeled. One feature of the valves and seats is that none of them are threaded into the turret, each one being secured with a cast-steel flange and four studs tapped into the turret walls, bosses being provided inside the turret so that studs do not go all the way through. This eliminates leaky threads in the turret as well as simplifying the removal of the valves when necessary. Not only has the turret been placed outside the cab, but the injector and stoker engine valves as well, these being attached to the ends of the turret. This arrangement renders the valves more accessible for packing and removes the great danger of scalding in case of a side-swipe or similar accident that would tend to burst a steam pipe inside the cab.



Right Hand Half of Turret—Vertical Section Through Main Valve

Other Features

The sand box is fitted with Hanlon sanders. World type safety valves are used, three in number, one muffled and two plain. The headlight equipment consists of a Pyle-National type K-2 turbo generator set and Keystone type No. 1412 cage, fitted with a 14 in. Golden Glow reflector and C.M.S. focusing device, the cage body being No. 16 gage copper. Canadian National standard separate number lamp case with sides oblique is used, this making for the maximum safety in operation by reason of the easier and more certain identification of locomotive numbers. The water level indication is procured by the most modern method and consists of the Canadian National standard water column welded directly to the back head of the boiler and fitted with the railway standard try cocks and water glass fittings, the water glass being fitted with a special guard. The steam heat reducing valve is of the World-Leslie type and the piston and valve rod packing is King metallic. The Franklin radial buffer and unit safety bar are used between engine and tender and between engine and tender on the steam heat line, Barco flxible joints are used.

The air brakes are Westinghouse No. 6 E.T. with 8½ in.

cross compound air compressor and S-5 governor. There are three main reservoirs, two on the right side and one on the left side with a total capacity of over 90,000 cu. in. The radiating pipe connecting reservoirs and compressor is so arranged as not to be visible, and is supported by cast-iron brackets under the running boards. This radiating feature has been of good service in overcoming condensation and consequent freezing during low temperatures. The air brake piping on these locomotives has been given careful study which has resulted in a piping layout that is easy of access and of a neat appearance.

Tender Design

The tank is of the water bottom type of Canadian National standard design and construction, somewhat modified for the application of the Duplex mechanical stoker. The tank has a water capacity of 10,000 Imperial gallons and a coal capacity of 17 tons. The tender frame is of the Commonwealth cast steel type. Commonwealth six-wheel tender trucks are used with 5½ in. by 10 in. journals. Flat side bearings are used, placed 52 in. apart both front and back.

The important dimensions, weights and proportions of these locomotives are shown in the accompanying table.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian National
Builder	Canadian Locomotive Company
Type of locomotive	4-8-2
Service	Passenger
Cylinders, diameter and stroke	26 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6½ in.
Outside lap	1⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Weights in working order:	
On drivers	226,770 lb.
On front truck	57,300 lb.
On trailing truck	54,930 lb.
Total engine	339,000 lb.
Tender	238,000 lb.
Wheel bases:	
Driving	19 ft. 6 in.
Rigid	12 ft. 8 in.
Total engine	41 ft. 9 in.
Total engine and tender	79 ft. 1¾ in.
Wheels, diameter outside tires:	
Driving	73 in.
Front truck	34¼ in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	12 in. by 13 in.
Driving, others	10 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	210 lb.
Fuel, kind and B. t. u.	Bitum. coal
Diameter, first ring, inside	80⅞ in.
Firebox, length and width	114⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	61 in.
Height mud ring to crown sheet, front	83½ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber length	48½ in.
Tubes, number and diameter	188—2¼ in.
Flues, number and diameter	40—5½ in.
Length over tube sheets	22 ft. 3 in.
Grate area	66.7 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	348 sq. ft.
Tubes	2,455 sq. ft.
Flues	1,276 sq. ft.
Total evaporative	4,079 sq. ft.
Superheating	810 sq. ft.
Comb. evaporative and superheating	4,889 sq. ft.
Special equipment:	
Brick arch	Yes
Superheater	Robinson
Feedwater heater	Elesco H 5
Stoker	Duplex
Tender:	
Style	Water bottom
Water capacity	10,000 imp. gal.
Fuel capacity	17 tons
Truck	6 wheel
General data estimated:	
Rated tractive force, 85 per cent	49,600 lb.
Cylinder horsepower (Cole)	2,556 lb.
Boiler horsepower (Cole) (est.)	2,470 lb.
Speed at 1,000 ft. piston speed	43.4 m.p.h.
Steam required per hour	53,200 lb.
Boiler evaporative capacity per hour	51,480 lb.
Coal required per hour, total	8,300 lb.
Coal rate per sq. ft. grate per hour	124 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	66.9
Weight on drivers ÷ tractive force	4.5
Total weight engine ÷ cylinder hp	128.6 lb.
Total weight engine ÷ boiler hp	133.1 lb.
Total weight engine ÷ comb. heat. surface	69.3 lb.
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	96.6
Comb. heat surface ÷ cylinder hp	1.91
Tractive force ÷ comb. heat. surface	10.13
Tractive force × dia. drivers ÷ comb. heat. surface	740
Cylinder hp. ÷ grate area	38.3
Firebox heat. surface ÷ grate area	4.72
Firebox heat. surface, per cent of evap. heat. surface	8.54
Superheat. surface, per cent of evap. heat. surface	19.86
Tube length ÷ inside diameter	138

Ljungstrom Turbine Locomotive Ordered for the Argentine State Railways

ACCORDING to an article in Engineering (London), the government of the Argentine Republic has placed an order for a turbine-driven locomotive of the Ljungstrom type for use on the state railways in that country. This latter order is a particularly interesting one, for not only is the locomotive of special design, but upon its performance will depend a further order from a large number of engines, the placing of which will be deferred until the first machine has been put to practical tests.

The new Argentine locomotive is to be built for the meter gage lines, and will use oil fuel, in the consumption of which the Ljungstrom Company has guaranteed to effect a saving of at least 50 per cent during the cold season and 40 per cent during the hot season as compared with ordinary locomotives doing similar work. Furthermore, in view of the difficulties of watering along many of the lines in the country, the condensing properties of the Ljungstrom locomotive show to great advantage. The total amount of water carried is 5.5 tons in the condenser and 5 tons in the feedwater tank, this being sufficient for a non-stop run of 500 miles lasting 20 hours. The actual water consumption for such a run with a train of 700 tons behind the tender will not exceed 4 tons; and the oil fuel carried, namely, 6.5 tons, will suffice for the same journey, the oil being taken to have a calorific value of 18,900 B.t.u. per pound. The general design of the locomotive will be similar to that very fully illustrated in the *Railway Mechanical Engineer* of October and November, 1922, pages 557 and 623, the air-preheating arrangements, the gearing and the arrangement of the condenser elements being, however, modified. The total weight of the machine in running order will be 120 tons and the maximum speed 41 m.p.h. The boiler car is carried on a leading truck followed by three fixed axles. The condenser car, with the turbine and gearing, is carried on four driving axles, followed by a pony truck. The total wheel base of the locomotive is 16.6 m., the rigid wheel base being 3.2 m. The driving wheels are 1,470 mm. diameter. The five axles under the boiler car are loaded with 11.5 tons each, and the driving and trailing truck axles with 12.5 tons each. The horsepower at the rim of the drivers is 1,750 boiler horsepower. A boiler heating surface of 100 sq. m. is provided, and a superheater surface of 57 sq. m. while the air-preheater, which replaces the more inefficient portion of the ordinary tube surface, has an area of 800 sq. m. The boiler works at a pressure of 300 lb. per sq. in.

Over a comparatively hilly route similar to that between Stockholm and Upsala, with a 500-ton load behind the tender, the average fuel consumption per 1,000 useful ton kilometers, will not exceed 8.9 kg. during cool weather and 10.7 kg. during hot weather, while for continuous service on such a route, when the condenser has not time for cooling and the air temperature is at 104 deg. F., the consumption will not exceed 11.6 kg. per 1,000 ton kilometers of useful load. The machine is being built by Messrs. Nydkvist and Holm of Stockholm.

Proceedings of the Air Brake Association

Report of the Papers and Discussions at the Thirtieth Annual Convention Held at Denver

IN the June issue of the *Railway Mechanical Engineer*, the proceedings of the opening session of the Air Brake Association convention, held at the Albany Hotel, Denver, Col., May 1, 2 and 3, were published together with the paper and discussion on Expediting Train Movement. Further proceedings of this meeting are given herewith.

Charging Freight Trains and Use of Release Position

By W. F. Peck

Baltimore & Ohio

A recent analysis of the factors surrounding an epidemic of stuck brakes on freight trains revealed the fact that insofar as operation is concerned, there was a considerable variance in the method used by enginemen in charging empty trains, and releasing brakes after slow-downs and stops, also, that trains were departing from water stations or other points where the engine was detached without waiting until all brakes had released. Where stops were made, whether the engine was detached from the train or not, it was the practice for the engineman to start on receiving a proceed signal from the train crew. The flagman, on being recalled to the train, might believe the brake on the last car had had time to release properly, while in fact it had leaked off, and brakes nearer the engine were still applied.

The purpose of the investigations forming the basis of this article, was to determine accurate data on: First, the quickest method of uniformly charging the empty or the partially charged brake system of freight trains of from 35 to 100 cars, to make the brakes available for use in the shortest possible time; second, the most effective method of releasing the brakes after ordinary service applications; third, the most effective method of releasing the brakes and recharging the system on the return of the engine to the train after having taken coal or water, and fourth, to establish certain fundamentals in regard to manipulation, which would automatically result in the best operation and increase the factor of train safety.

Numerous tests have been made to determine resultant cylinder pressures, and also the time required to apply the brakes with various reductions and types of triple valves. This information is available in the log sheet of every important demonstration; yet, similar data in regard to charging trains and releasing brakes does not appear available. The value of such information is emphasized where schedules are fast and trains frequent, since any attempt on the part of the engineman to depart before the brakes have had time to release may result in a break-in-two, or a burst wheel, due to over-heating. The demonstrations were made with these conditions in view.

The tests numbering 271, were made on the 100-car test rack of the New York Air Brake Company, at Watertown, N. Y., with trains of 35, 50, 75 and 100 cars.

Charging 100-Car Empty Trains

In the first series of tests, extreme measures were adopted in charging the train. With the low pressure governor top cut out, and the high pressure top adjusted at 130 lb., the automatic brake valve handle was placed in full release position and left there until the 100th car auxiliary reservoir showed 60 lb. pressure. Gage readings were taken at one minute intervals.

In this test, the main reservoir pressure never fell below 106 lb., nor the engine brake pipe pressure below 90 lb. At the end of the first minute, there was 46 lb. pressure in the first auxiliary and 1½ lb. in the 100th car auxiliary. It required 9 min. and 20 sec. to charge the 100th car auxiliary reservoir to 60 lb. This may be considered the minimum time in which this, or a similar train, could be charged under the conditions prevailing. The brake pipe leakage was 9 lb. per minute from 60 lb. At the end of the test, the first car auxiliary was charged to 118 lb., and the first 50 cars were charged to over 70 lb. (feed valve adjustment).

The other extreme is represented in a test, in which the same train was charged with the brake valve in running position, other conditions remaining the same, except that the test was concluded when the 100th car auxiliary reservoir was charged to 50 lb. This required 19 min. 45 sec., at the end of which time the first auxiliary reservoir was charged to 61 lb. This test demonstrated the time required to charge the train in the manner cited, and resulted in the greatest uniformity of pressures throughout.

The Air Brake Association at the Thirtieth

The best results were secured with the following brake valve manipulation: Full release position 1 min., running position 2 min., kick-off to full release position for 5 sec., and left in running position thereafter. Governor was adjusted at 100-130 lb. Test was commenced with handle of brake valve on lap position. It required 12 min. 20 sec. to charge the 100th car auxiliary reservoir to 50 lb. Brake pipe leakage 8 lb. from 60 lb.

Charging 75, 50 and 35-Car Empty Trains

The following factors governed charging the 75-car train: Governor adjusted at 100-130 lb., low pressure top cut in. Brake pipe leakage 11 lb. from 58 lb. Initial position of brake valve handle, lap. Brake valve manipulation as follows: Full release position 1 min., running position 2 min., kick-off to full release position for 5 sec.; thereafter in running position. At the end of 11 min. 55 sec., the 75th car auxiliary reservoir was charged to 60 lb., first car auxiliary reservoir to 64 lb.

For the 50-car train the brake pipe leakage 8½ lb. from 60 lb. Brake valve was held 1 min. in full release, 1 min. in running position, 5 sec. kick-off to full release position, and running position thereafter. It required 5 min. to charge the 50th car auxiliary reservoir to 60 lb., first car auxiliary to 64 lb.

For the 35-car train, brake pipe leakage was 7 lb. from 60 lb. Brake valve was held 1 min. in full release position, 1 min. in running position, 5 sec. kick-off to full release position, running position thereafter. Under these conditions, it required 2 min. 50 sec. to charge the 35th car auxiliary reservoir to 60 lb., first car auxiliary reservoir to 64 lb.

Release Tests

Release tests were made following 10, 12, 15, 20, 25, 30 and 40 lb. brake pipe reductions from an initial brake pipe pressure of 70 lb. In all of these tests, the brake system was first charged as thoroughly as brake pipe leakage would permit. It was not found possible to stay in full release position one second for each pound of brake pipe reduction without overcharging and consequent reapplication of brakes.

On the 100-car and 75-car trains, the release of brakes in the middle, and slightly back of the middle, could be prolonged by reducing the initial time in full release position one-half.

Conclusions

Certain definite conclusions may be drawn from the results of these investigations, without going into detail.

First—Attempting to charge the train by comparatively short movements of the automatic brake valve handle from release to running position and back, will only result in the pressure banking up and overcharging the head end of train. The longer the train, the more serious the results will be.

Second—Long trains are neither charged nor brakes released *primarily* with the automatic brake valve in full release position (standard locomotive brake equipment), since the time which it is possible to stay in full release position is short when compared to the total time required to charge or release all brakes.

Third—Any system of releasing brakes, which results in brakes reapplying, due to overcharging the head end of train, is not considered practicable, because it is impossible to designate a uniform kick-off, which will release all of these brakes without liability of other brakes re-applying, as a result of the kick-off. Any overcharging of the head end of the train necessarily prevents the prompt functioning of the feed valve. In both charging and releasing brakes, it is absolutely necessary that there be no interruption to the flow of air into the brake pipe. Brakes which re-apply simply rob the system of compressed air, which must be replaced before charging or the release of the brakes is completed. When the use of full release position was carried to an extreme, it was observed that one-second kick-offs were of no avail, and that five seconds was too long.

Fourth—It is highly important that feed valves be maintained at their maximum efficiency, since there will be an interruption to the flow of air into the brake pipe if they do not function properly.

Fifth—In releasing brakes, trains of less than 60 cars should not depart before three minutes after the brake valve has first been placed in full release position; longer trains four minutes.

Sixth—Since one 8½-in. 120-ft. air compressor is practically equivalent to two 11-in. air compressors, the manipulation which is found good in one case must therefore be equally satisfactory in the other.

Seventh—Because the auxiliary reservoirs of 35-car trains charge so uniformly, it is possible and entirely practicable, to have a standard method of charging empty trains of from 35 to 100 cars, also releasing brakes after applications, with the exception described hereinafter.

Eighth—The quickest method of charging the system as uniformly as possible is to place the handle of automatic brake valve in full release position for one minute, move it to running position for two minutes and follow up with a five-second kick-off, and then leave in running position thereafter. There is no particular reason for the brake valve handle being left in running position two minutes except to draw attention of the engineman to the importance of uniformly charging the train through the feed valve. This provides ample time for the pressure in the brake pipe to equalize. This operation should be timed with his watch.

Annual Convention Held in Denver, May, 1923

Ninth—The best results will be secured in releasing brakes on trains of from 35 to 100 cars after service reductions ranging from 10 to 40 lb., by the following manipulation: Place the handle of the automatic brake valve in full release position for 15 seconds, move to running position for 30 seconds, and then make a three-second kick-off to full release position. An exception to this is made when making 10-lb. reductions on trains of less than 60 cars. In such cases, the brake valve handle should be left in full release position 10 seconds initially, instead of 15 seconds. Reductions of more than 20 lb. were intended to represent cases where the engine is cut off from the train for coal or water.

Discussion

In presenting the paper, Mr. Peck stated that the tests were made with a view to developing the proper charging of trains and use of the release position of the engineer's brake valve on level road and not on mountain grades. He explained that on the Baltimore & Ohio it was not on the heavy grades that the trouble from overheating wheels was encountered, but on level districts. The discussion, however, dealt largely with braking on heavy grades. A number of the members emphasized the importance, in grade work, of restoring brake pipe pressure in the shortest possible time and did not regard with favor any instructions as to the details of brake valve manipulation, since safety depended so largely on the ability of the engineman to exercise his judgment according to circumstances.

P. H. Langan (D. L. & W.) said that an investigation several years ago as the result of many break-in-two's in handling 100-car empty trains, developed the fact that the enginemen were holding the release position for about 12 seconds, going to the running position, then to the release position for the kick-off and back to the running position in a total time less than that required for the run-in of the slack to take place. The adoption of a 30-second release stopped the break-in-two's. After water stops, Mr. Langan advocated holding the brake valve in release position from three to four minutes, then going to running position, followed by a 15-lb. reduction before the kick-off.

In handling trains on grades, Mr. Langan expressed the opinion that safety required the longer period in the charging position, while on the level its use was justified because of the saving in time. He advocated requiring the trainmen to bleed off any sticking brakes which might result, as the train moved passed them. Mr. Langan explained that on the D. L. & W. a release after a full application of the brakes was not permitted on freight trains until the train had stopped. Mr. Peck said that on the Baltimore & Ohio the enginemen were permitted to release the brakes at speeds of about 15 miles an hour or above, which would not permit brakes which stuck following the release and recharging, to be bled off by the trainmen. It was suggested that permitting trainmen to bleed off brakes might result in continuing triple valves in service which ought to be removed for cleaning and repairs. It was also suggested that some means be developed for automatically controlling the use of full release position of the brake valve.

George H. Wood (A. T. & S. F.) described the result of a test in which the recharging of a 100-car train with one and two feed valves was compared. Following a reduction of 5 lb. from 60-lb. brake pipe pressure, the pressure was restored through the feed valves until it reached 64 lb. on the first car and 50 lb. on the last car of the train. With two feed valves this required 11 min. 2 sec., while with one feed valve it required 11 min. 58 sec. W. H. Clegg (Canadian National), said that the use of two feed valves had been found undesirable because it took the control of the train away from the engineman when the brake valve was in lap position, because the two feed valves permitted the operation of the brake with so much greater leakage.

Slow Operating Air Pumps

By the Pittsburgh Air Brake Club

W. W. White, Michigan Central

The first requisite in avoiding slow operating air compressors is to insure that they are properly repaired and thoroughly tested when overhauled in the shop. General repairs should be made only at shops where proper tools and facilities for making repairs are provided and where ample steam pressure and facilities are available for thoroughly testing compressors after they are overhauled.

When cylinders are bushed it should be known that the ports in the bushings line up with the ports in the cylinders and that by-pass grooves are cut in the low pressure steam cylinders of cross compound compressors. Before assembling the cylinders and center piece, it should be determined that the center piece is not distorted so as to bring the cylinders out of line, and after assembling it should be known that they are in proper alignment.

It is important that the bushings in the top head have a good fit their full length; that the reversing valve has a good bearing on its seat in the bushing; that the reversing valve chamber cap is a good fit on the top of the reversing valve bushing; that the main steam valve piston rings and the main steam and air piston rings have a full bearing and are not open at ring ends; that the top head gasket prevents leakage between cylinders and between ports; that there is no restriction in any of the steam and air passages and no leakage around air valves, seats and valve cages.

Having established by the shop test that the above parts are in proper condition and that the compressor will make normal speed, the cause for its slow operation when placed on the locomotive may be looked for outside of the compressor itself. However, if it works properly when first applied to the locomotive but later develops slow operation, it may be due to any one of the following causes: (a) Lack of lubrication; (b) air passages clogged; (c) leakage around air valves or cages; (d) badly worn rings in air cylinders; (e) reversing valve and seat badly cut or worn, and (f) main valve piston rings leaking.

The defects in the air end of the compressor are usually indicated by its reduced capacity at all speeds, or, by the capacity orifice test. If the compressor operates slow after correcting these defects, it is advisable to look elsewhere for the trouble.

Numerous cases of slow operating compressors have been found to be due to defects in the compressor governor.

A compressor bracket out of line has resulted in twisting the compressor and causing it to work slow when bolted in place. This has also resulted in broken lugs and cylinders.

It has been found that in some cases where the air compressor exhaust is piped into the cylinder saddle, the speed of the compressor will be reduced by working the engine hard, but at all other times the compressor operates properly. Sometimes in an effort to improve the steaming qualities of the locomotive, the nozzle opening has been reduced to a point that causes excessive back pressure. In one case this back pressure amounted to 45 lb. per sq. in. In considering such cases it is necessary to bear in mind the margin necessary between maximum air pressure required and the minimum steam pressure for proper operation, and that restricted passages or leakage in the compressor itself may not be manifest while the locomotive is standing, but would cause the compressor to slow down from a light exhaust back pressure resulting from working the locomotive.

Restrictions have been found in the air discharge pipe and in the pipe connecting the main reservoirs, due to dirt and carbonized oil.

If the dry pipe to the steam turret or compressor throttle breaks off or is very loose, the compressor usually operates slowly and works considerable water. In such cases the speed of the compressor is usually affected by the height of the water in the boiler, with high water the lubrication is washed out of the compressor, and it runs slow, whereas with one-half glass of water or less, the compressor will operate properly. In one instance the dry pipe was so close to the locomotive throttle valve that it was robbed of steam, causing slow operation of the compressor when the locomotive was working hard. The trouble was corrected by re-locating the turret dry pipe.

In another case, when drilling the hole in the turret for the compressor throttle the drill forced a thin piece of brass into the turret, which held on one side. After the locomotive was in service the current of steam swung the piece back over the opening, restricting the flow of steam to the compressor throttle and steam pipe. Another instance of insufficient steam supply was caused by the end of the turret valve breaking off and being carried into the end of the air compressor throttle.

A number of instances have been found where the lubricator air pipe had been improperly connected under the jacket, one such case resulting in steam from the lubricator passing to the air cylinder. In the latter instance the compressor worked properly until steam was turned on the lubricator.

Another cause of slow operating compressors is very high main reservoir pressure resulting from the governor being adjusted in accordance with a defective air gage.

It is necessary to make a study of the conditions surrounding each individual case of slow operation and proceed to locate the cause as indicated by the circumstances.

Discussion

A question was raised in the discussion as to what effect worn rings in the air cylinder would have on the speed of cross-compound pumps. While this condition in the single-stage pump is apt to cause an increase in its speed, the opposite effect seems to be produced in the cross-compound pump. The low pressure pistons of these pumps operate against about 40 lb. initial pressure in the high pressure cylinder and leakage past the rings of the high pressure piston would increase this pressure against the low pressure piston. It was brought out in the discussion, however, that there is considerable difficulty in determining the exact cause of slow operation, when the cause lies in the pump itself, because after the pump has been removed and dismantled, all of the parts, any one of which may have been responsible for the trouble, are restored to good serviceable condition. The consensus of opinion seems to be, however, that a large part of the trouble in the case of the cross-compound pump should be attributed to either worn or broken rings in either or both air cylinders.

Standardization of Repairs

By the St. Louis Air Brake Club

This subject has been brought up for consideration for the reason that there is a general and growing belief that the time has come for the standardization of repairs to air brake apparatus, and particularly that portion of the apparatus pertaining to car equipment. The adoption is recommended at this time of some decisive measure to prevent wrong methods of workmanship and the introduction of "kink devices" for performing the machine operations which can only properly be accomplished by special machines designed for the work to be performed.

When we look over the field of triple valve maintenance and repairs, we find many different devices offered for the purpose of truing up the bore of triple valve cylinders. While we may be impressed with the ingenuity of the ideas that appear in them, ranging all the way from a rotating sand paper block operated by an ordinary carpenter's brace to a series of segmental spring actuated blocks carrying corundum inserts and adapted to expand into the bore of a cylinder by centrifugal force, we cannot help but feel that the necessity for accuracy in the cylinder bore has not been given the consideration the job warrants.

It would seem obvious that the same methods employed for manufacturing these devices should be approximated in making the repairs. To put in practice or attempt to use inferior methods cannot possibly result in anything else than a poor job. The repair of a triple valve is a precision job and if the manufacturer is held down to definite tolerances in order that the valve may properly function over a reasonable period of time, it is just as important in making repairs that the valves be returned to an equal degree of excellence.

There are certain limits within which the average repair shop should keep in conditioning triple valves unless the production is sufficiently large to warrant the expense of the proper tools for the work.

It is fortunate that the test racks catch most of the poor work turned out by poor methods, but ofttimes the standard test rack simply complies with the A.R.A. rules and does not correct the inadequacies of a poorly equipped repair point.

We suggest that the Association formulate a proper procedure and proper tolerances for this work, and that this procedure be incorporated in the recommended practices and that the association endeavor to have this become a part of the A. R. A. rules.

Discussion

Considerable difference of opinion was expressed by the members as to how far it was advisable to repair triple valves at local points and to what extent it was advisable to send the parts to the manufacturers for repairs. C. B. Miles, who presented the paper for the St. Louis Air Brake Club, made it clear that the question was not one of where the repairs should be made, but of establishing tolerances, the observance of which would settle that question according to the circumstances in each particular case.

A motion was adopted calling for the appointment of a committee to investigate and recommend tolerances for triple valve repairs.

Other Papers

Papers were also presented on the following subjects: Air Brake Service Records and Maintenance Costs, by W. H. Clegg, Canadian National; Repair Tests for Feed Valves, by the Manhattan Air Brake Club; The Value of Laundering Air Compressors, by the Central Air Brake Club, and Recommendations for the Maintenance of Air Compressors, by the Dixie Air Brake Club. A talk was also given by George H. Wood, Atchison, Topeka & Santa Fe on The Relation of Train Control to the Air Brake. Mr. Clegg's paper and the paper by the Dixie Air Brake Club will appear next month.

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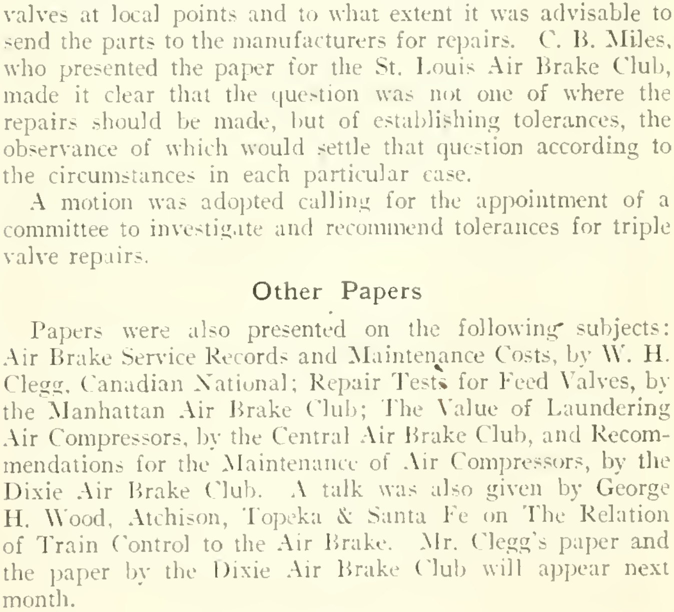


Prairie Type Locomotive With Lentz Poppett Valves for the Oldenburg Railway

Fuel Association to Study the Power Plant

Committee to Recommend Means for Reducing Waste in This Field; Proceedings of Cleveland Meeting

As the result of a paper by R. S. Twogood, describing the methods which have been instrumental in effecting a marked reduction in the amount of fuel consumed at the 125 stationary boiler plants on that system, the International Railway Fuel Association, at its fifteenth annual convention, held at Cleveland, Ohio, May 21 to 24 inclusive, authorized the appointment of a standing committee to formulate and recommend methods of general application to reduce the waste of fuel at such plants.

An abstract of Mr. Twogood's paper as well as several of the other papers and reports presented at the meeting, are given below. Others will appear in later issues.

Report on Fuel Stations

All modern installations are of the overhead storage, self-clearing type and usually with sufficient capacity to receive and store in eight hours the demands for at least 24 hours. Reinforced concrete is the generally accepted material used in the construction of the building itself. Drop spouts are universally used. The housing and details of the actual coal handling mechanism vary with the type and arrangement selected.

In 1914, the committee, after an analysis of the requirements to be met by the coal chute, suggested that the overhead hopper chute of three types would meet any situation. These types were: Gravity chute, with cars elevated by locomotive or stationary power; balanced bucket, in which the coal is dumped into a pit and raised by balanced buckets, and bucket conveyor, with the coal dumped into a pit and raised by a series of small buckets.

From the experience with storage bins designed primarily for capacity rather than for the quality of the discharged coal, the committee recommended that all receptacles for coal should be designed so as to avoid the probability of any clogging in the corners, suggesting that warped surfaces, especially at the openings, be given consideration. Another point made which has been subsequently stressed is the necessity for maintaining the point of delivery of the coal to the bin directly above the opening of the discharge of the fuel to the engine tank.

Recognizing the desirability of some device to measure the coal delivered to the engine, either by weight or bulk, the committee was not in position to recommend any definite plan or arrangement. In 1916 a report was made with illustrations of some of the arrangements in use to accomplish this measuring of the delivered fuel. There have been comparatively few such installations made, however.

The value of mechanically operated chutes is evidently being impressed upon all railroads using coal as locomotive fuel. In some instances, they are replacing comparatively modern gravity chutes, primarily because of the large reduction in the cost per ton of handling the coal from the car to the tender. As an example, an old style shovel chute through which about 16,000 tons of coal were handled per month, was replaced by a mechanical chute with an immediate reduction in the cost per ton for handling of 21 cents. Such a reduction would pay handsomely for the improvements made.

The following were members of the committee: W. E. Dunham, C. & N. W., Chairman; E. E. Barrett, Roberts & Schaefer Co.; C. F. Bledsoe, Ogle Construction Co.; W. S. Burnett; J. C. Flanagan, Fairbanks-Morse Co.; J. W. Krausch, C. B. & Q.; A. A. Meister, S. P.; J. C. Nellegar, Hardy, West Kentucky Coal Co.; L. J. Joffray, I. C.; W. T. Link Belt Co.; H. D. Savage, Combustion Engineering Co.; T. W. Snow, T. W. Snow Construction Co., and E. J. Summers, C. M. & St. P.

Discussion

In the absence of the chairman, W. E. Dunham (C. & N. W.), the report was presented by L. J. Joffray (I. C.). The need for a weighing device, if individual fuel records are to be of any value, was repeatedly brought up in the discussion. A few cases were mentioned where such devices are still in operation at coaling stations, notably the Canadian National and the Chicago Great Western. On the latter road, it was stated that with one exception every coaling station was so equipped. In the opinion of several members, however, the use of such devices at coaling stations is not likely to be effective as a means of checking up the performance of engine crews and getting their support, because they are still charged with the coal burned at terminals for which they are not responsible. It was suggested that what is needed is some simple means of quickly determining the amount of coal actually burned on the road. The use of volume measuring pockets has not yet met with success.

There was considerable difference of opinion as to whether the lowest cost of delivering coal could be obtained with the mechanical or the gravity type of station. On some roads it is claimed that the latter type is cheapest to operate, and that it is more reliable, because in case of failure of the winch for elevating cars up the incline, the operation can be continued by using a locomotive. But attention was called to the fact that gravity stations are confined to two tracks, whereas mechanical handling plants may serve more tracks, and that the question of engine delays should be taken into consideration in comparing the two types. In closing, Mr. Joffray said that the most favorable costs for gravity chutes are obtained from large units, but that in small units they are expensive and are obsolete.

The Other Ten Per Cent

By R. S. Twogood

Assistant Engineer, Southern Pacific Company

About 10 per cent of the total railway fuel consumption is for railway power, heating, shop, roundhouse, and pumping plants, coaling stations, and for other miscellaneous purposes. This 10 per cent amounts to about 17,000,000 tons a year. The percentage of waste of this item is high because very little attention has been given to the proper design and supervision of the average small boiler plant. The experience of the Southern Pacific during the last few years indicates that, as a very conservative figure, 25 per cent of this fuel can be saved by proper design and supervision.

In order to discuss this subject in detail it is necessary to make a general classification of stationary plants:

(a) Large electric generating plants.
(b) Large boiler plants.
(c) Shop boiler plants.
(d) Small heating, power and pumping plants.

Very few plants of Classes (a) and (b) are required by the railroads. Because of the high cost and the importance of operation of these plants, high class engineers and operators are necessary. Usually these plants have the many instruments required to permit the continuous checking of efficiency. A saving of one or two per cent of the fuel is worth going after. Savings of 10 per cent are hard to find.

The small heating, power, and pumping plants are the most neglected of all plants. Such plants are found everywhere. The percentage of fuel waste is high. There is almost no supervision. The plants never were designed; they were just built. They are difficult to check. For them, standards in design or operation simply do not exist.

As a rule, the smaller the plant the larger the percentage of needless waste. Especially in the railroad business, we are forced to operate a great number of small plants where the fuel waste is known to be very high. There are no standard test codes that can be used economically to continually check these small plants. The engineering profession, in its desire to build the comparatively few plants with high efficiency, has overlooked the tremendous waste of fuel in the thousands of small plants.

About four years ago the Southern Pacific organized a fuel conservation committee. This committee consists of a representative from each engineering department. The needs of each department are, therefore, taken care of without the duplication of equipment.

Our committee has made a great many tests of small plants in connection with our work on standardization. Atomization of liquid fuel, and drafting oil-fired furnaces have led to endless discussion. There are hundreds of oil burners on the market and every burner salesman claims a fuel saving of from 15 to 50 per cent over any other burner. The small boiler plant operator is at the mercy of these salesmen. The Southern Pacific operates about 125 boiler plants. The possible savings or loss due to the use of various burners in a large number of plants makes a study of burners very much worth while. A 150-hp. boiler was therefore equipped for testing. Before many tests had been made it was evident that the drafting was just as important as the burner. Therefore, in all of the tests the burners and drafting have been tested together. In seventy-five tests on the same boiler the net furnace and boiler efficiency has varied from 45.5 to 75.5 per cent. Many factors have been determined and certain burners have been put on the approved list. It is now possible to lay out a furnace with reasonable assurance that the plant will operate as desired.

Steam and air lines underground are soon forgotten. Most insulating material is porous. It is difficult to keep pipe covering dry underground, and wet pipe covering ceases to have much insulating effect. Compressed air is one of the most expensive materials used around the shop. Air lines should be given frequent soap tests. Therefore, except for very special cases, new steam and air lines are being installed above ground. The steam lines are well insulated, and the insulation weatherproofed where installed outdoors.

Fuel oil and water meters are gradually being installed in the larger plants. This permits of frequent evaporation check of plant and operators. Where such meters are installed a simple evaporation test is made at least once per month. These monthly tests are simple, inexpensive, give a frequent check of plant operators and keep the men on the alert to excel the other fellow.

In one plant the fuel saving in July as compared to May was over $11 per day, due to the increase in equivalent evaporation. The meters cost $650 installed. The savings paid for the meters in two months. The water meters have given some trouble; the hot boiler feed water is hard on the meters and they must be calibrated and repaired frequently.

A thorough inspection is made of every plant at least once a year. A division official accompanies the fuel committee during this inspection. The need of repairs or additional equipment is determined, and the work programmed for the year. In order to express the condition of a plant in simple form, and to compare one plant with another, a rating form has been worked out. To express the condition of a plant as "Excellent," "Good," "Fair," or "Poor" is not enough, because it does not show what must be done to improve the condition. For this rating, therefore, the important details of a boiler plant were listed, and each detail given a weight about in proportion to its importance. It is realized that a good fireman or engineer is an important element in any plant. However, no weight was given for the fireman or engineer because his efficiency is reflected in the details. Any rating must be as mechanical as possible so that a plant would receive about the same rating if made by several independent inspectors.

An analysis of this form shows why a plant rates as it does, and what must be done to raise the rating. Some items can be put up to the engineer for correction, but others are strictly up to the supervisor. Efficient plants are only obtained by the co-operation of all concerned. The rating of a plant is often used as an argument when requesting authority for expenditures.

To increase the incentive for fuel conservation, the ratings of plants are given wide circulation. A list of all plants on the system, showing the rating of each plant, with the highest ratings at the top of the list, is sent to each plant annually. Plants are also grouped by divisions, and averaged so that the standing of divisions can be determined. All plants receiving a rating of 80 or better are classed as Premium Plants and are issued a framed certificate, signed by the committee, showing the rating and the reasons therefor. The results have been very interesting. For the year 1921 there were 10 premium plants, the average rating of the 10 plants being 85.1. For the year 1922 there were 26 premium plants with an average rating of 87. So that there was not only an increase in the number of premiums, but also in the average rating of premiums. The average rating for the System for the year 1921 was 66.72, and for the year 1922 it was 70.24.

A plant may be in perfect mechanical condition; it may have the latest, most efficient equipment; but without a trained operator interested in his job, high efficiency cannot be expected. The education of the operator, then, is without doubt the most important single detail in connection with fuel conservation. Instruction is always given during plant inspections, but it is hard to see more than one of the three operators during a plant inspection. An inspector may adjust dampers, burners, etc., but the fuel that can be saved in two hours is small. The large fuel saving comes when the operator absorbs the instruction given him and continues the saving day after day. A fireman cannot be made in two hours; so continual savings cannot be expected unless the training is consistently followed up. Firemen instructors to stand watch with the regular operators several days at a time, make big reductions in the fuel bill. Personal instruction followed by carefully prepared printed matter will hold the fireman's interest. A loose-leaf instruction book on power plants is now being issued by the committee. It is being sent out a few sheets at a time. In the end it is expected to cover the latest standards in equipment and operation and the fundamentals of steam engineering.

This subject is of great importance to everyone of us, because each one must pay his share of the loss that increases the cost of producing every article requiring power. Small corporations cannot afford to undertake this problem; large corporations cannot afford to overlook it. But they do! It is, therefore, recommended that a standing committee be appointed to study this problem. It might also be advisable to co-operate with the American Society of Mechanical Engineers, so that advantage might be taken of the vast amount of work already completed by that society.

Discussion

On motion, the author's suggestion that a standing committee be appointed to study the problem and recommend methods for effecting fuel economy at railway power plants, was adopted by the association.

Value of Individual Fuel Performance Records

By L. G. Plant

Editor, Railway Review

The object of an individual fuel record is not to account for all the fuel used. That is a function for the auditor, and the fuel supervisor who is more concerned with the manner in which fuel is being accounted for than the manner in which it is actually used is wasting his own time and the company's money. What is desired, and all that can be expected of an individual fuel record, is a correct indication of relative fuel efficiency. To determine the relative fuel efficiency of enginemen and locomotives it is obviously essential to compare their performance under uniform conditions. This calls for a segregation of individual records by runs and locomotive types as well as by class of service. It also calls for elimination from the record of runs made under abnormal conditions. Distinctions in regard to runs and locomotive types are commonly observed by grouping the monthly performance records accordingly, but variations from the average speed and tonnage of each group are not easily accounted for.

Bearing in mind the object of an individual performance record, it may be stated that, in principal, it is better to base this record upon three trips conducted under normal operating conditions than upon 30 trips where unusual operating conditions obscure the real efficiency of the enginemen and locomotives. The elimination of those runs on which unfavorable operating conditions prevail can be made the basis for a very practical individual performance record by determining for each trip, the freight train ton-miles or number of passenger cars handled, the quantity of fuel used, the time between terminals and the fuel consumption per 1,000 freight ton-miles or per passenger car-mile.

Where the performance on all runs is included in the monthly fuel record some effort should be made to equate the individual averages to correspond to uniform operating conditions, since the real importance of these factors is neither understood by enginemen nor generally appreciated by those officers who are expected to make use of these figures. An equated fuel performance record is one in which the effect of unusual variations from the average time and tonnage are neutralized by an equation. It is possible to determine by actual test the effect upon fuel consumption of various reductions in tonnage or increases in the time between terminals and to apply a factor to each individual fuel record.

Experience has shown that men accustomed to handling locomotive fuel can estimate with surprising accuracy the quantity of coal required to fill the locomotive tender upon arrival at a terminal. Where a conscientious effort is made to estimate fuel issues, it is safe to say that the error will seldom exceed 10 per cent. Moreover, the estimated quantity may be either more or less than the exact amount of fuel, and such errors as occur tend to neutralize each other. It is not likely that the quantity of coal issued to the locomotive would be continuously over-estimated, any more than always under-estimated, if an honest and intelligent effort is made to report these quantities correctly.

Local officers should be required to investigate the performance of any engineer whose name appears at or near the foot of the fuel record more than two months in succession. There are but three contributing causes to consider. Either the engine crew is at fault and needs instructive supervision, or the condition of motive power is responsible and in need of repair, or there is some obvious discrimination in the fuel charges. Investigation along these lines will either terminate the deliberate overcharges or lead to the source of an actual fuel loss. It is a mistake to assume that the value of an individual fuel record is confined to its effect upon the enginemen. If full advantage is taken of these records they are of equal, if not greater, benefit to the officers directly responsible for fuel economy.

No treatise on the subject of individual fuel performance records would be complete without quoting Eugene McAuliffe, to the effect that the poorest individual record is better than none at all. What can be done toward making the individual fuel performance record a more sensitive, hence more effective instrument? Let us consider what could be accomplished with a group of "traveling fuel auditors" comprising from four to six young men, one of whom would be in charge of the group. Select an engine district at random, dividing the squad between two adjacent terminals and an intermediate coaling station. The two men stationed at each locomotive terminal would be required to personally inspect every locomotive on arrival and immediately preceding its departure. In each instance the quantity of coal, as well as its general character, would be carefully noted. The condition of the fire upon departure and arrival of locomotives would also be observed, together with other features that bear directly upon fuel efficiency. The time of departure and arrival of each locomotive, as well as extent of delays on road, the tonnage handled, etc., would be ascertained directly from the dispatcher's train sheets. From this information, an individual fuel performance record, complete in almost every essential detail, would be available. It is not suggested that these records be published daily, but that at the end of a two or three weeks' period, at which time the traveling fuel auditors would be dispatched to some other engine district. Not only the duration, but the sequence of visits by this "flying squad" would be unknown except to those directing this work.

It is not so important to know that an engineman is at the top or the foot of the fuel efficiency list, as to know why he is there. A check of locomotive performance, such as suggested, would disclose conditions on any district that would surprise the local fuel supervisor. It would develop facts regarding locomotive maintenance that would make any master mechanic sit up and take notice. It would reveal fuel losses due to poor dispatching and other operating causes that would startle the average superintendent. Enginemen could not question the accuracy of the fuel performance statement compiled in this manner.

This statement would be compiled by the traveling fuel auditors and posted prior to their departure. Upon succeeding visits to this district, the fuel consumption averages determined by a similar check of locomotive performance would be compared with the previous averages. One concrete example of improvement in fuel efficiency on a single district will do more toward establishing the value of a fuel department in the eyes of the management, than all the general averages ever concocted.

Discussion

The trend of the discussion corroborated the author of the paper as to the necessity of having detailed information both as to fuel consumption and operating conditions, if real economy in fuel consumption is to be effected. It was brought out that the various efforts to interest enginemen and firemen on the Southern Pacific in the economical use of fuel could not be carried out without the information furnished by individual fuel records. While the records themselves do not primarily interest the men, it is on the basis of the records that men are selected to represent the railroad at the convention of the association and at bimonthly fuel committee meetings on the various divisions.

A description of the Chicago Great Western system of checking fuel performance, developed that it was founded on the principle referred to by the author as "equated fuel performance." Potentials determined by road tests have been set up for each class of power and each service. These are shown on the train sheet and on a report compiled daily by the dispatcher each trip is rated by a comparison with the potential for the locomotive and service involved.

Proceedings of Boiler Makers' Association

Report of Papers and Discussions at the Fourteenth Annual Convention Held in Detroit

In the June issue of the *Railway Mechanical Engineer* there was a brief report of the fourteenth annual convention of the Master Boiler Maker's Association, held at Detroit, Mich., May 22 to 25 incl. Some of the more important papers and discussions thereon are given below.

Safe Ends on Superheater Tubes

As regards the life of superheater tubes and the number of safe ends that should be applied before cutting down for a smaller locomotive, it is the consensus of opinion of your committee: That great care should be exercised so that as nearly as possible there will be only one weld on each flue. This can be accomplished by applying a 5-in. safe end for weld No. 1; 6½-in. for No. 2; 7½-in. for No. 3; and 8½-in. for No. 4, thus cutting off each old weld before applying the new safe end. Welds on the front or large part of the flue are not desirable on account of applying units, etc.

We find it is the practice of some roads to weld on the large end after applying the limit of welds on the small end, while the practice of other roads is to apply only one weld before cutting down for a smaller boiler. This would seem to us a very expensive proposition if the locomotives are equipped with superheater tubes of the same length or nearly so.

We are also of the opinion that a safer weld can be obtained on a superheater tube than on a 2½-in. and 2¼-in. tube owing to the difference in the thickness of the metals.

This report was prepared by a committee consisting of J. P. Malley, chairman; H. Howard and Daniel S. Rice.

Discussion

H. Howard, Illinois Central: We will all admit that we cannot determine the life of a flue, definitely, on account of the water. If we have good water, they will last a number of years, and if there is bad water, the life is very short.

Andrew S. Green, Big Four: I do not believe you can put a 5-in. end on there, and the next time put a 6½-in. end, or your tube will be too short for the boiler. If you cut the ragged end off, it will be too short. You have to have more than 1 in. there. I do not think that will work at all. If you put a 5-in. end on there, as you say, and next weld with 6½-in., you must have more metal or the tube grows too short for the boiler. You will have to have 7 in. on there.

A. N. Lucas: I believe that the best method of safe-ending is, after the tubes have made their first run, without any beads, to apply a 5- or 5½-in. piece at the first safe-end, and when it has made the mileage and comes in, you cut the tube again for welding. That is an extra operation that you can do in the fraction of a minute, and then put the next safe-ends on the opposite end and you still have left, when you cut the tube, enough to go into the boiler—about 4 in. of the first safe-end, and that will give you a good safe-end into the front end and avoid any cracking of the tube. The next time the tubes are taken out, having made the mileage, you cut the tubes to the length for welding and cut off the original weld and put on a piece and it again goes into service with only three welds. On every third operation, you lose a weld. We run for 10 or 12 years with only two welds, most of the time, on a tube.

H. J. Wandberg: This report deals with the life of the superheater tube. Now the life of the tube depends somewhat on the number of pieces, and how we apply them. What I would like to know about all this is what the scrapping weight of the superheater tube is?

T. F. Powers: I want to disagree with the report to the extent that I do not believe it is possible, as Mr. Green says, to safe-end superheater tubes or any other kind of tubes, with only a waste of 1½ in. from one safe-end to another. As I understand this report, the first weld is to have 7½ in. or 1 in. waste. Our experience has been that to properly safe-end, and even with the most rigid economy, you have to figure on a waste of at least 3½ in. for each time the safe-end is applied. That is, if you adopt, to start with, the 5-in. safe end. The second safe-end, including the waste of the front end, in cutting off any waste necessary to cut back of the old weld must be 3½ in., and, if it is only 5 in. to start with, that makes 8½ in. I do not believe it is possible to have a variation of only 1 in. between the safe-ends.

T. W. Lowe, Canadian Pacific: We still continue to weld our safe-ends at the smoke box end, and I want to repeat that again, today, where we have the possibility of having a tube that will not carry a safe-end at all.

We do not have any trouble with reference to getting the superheater units to pass by the welds when we do weld on the smoke box end, and by welding on the smoke box end, we continue our standard of swaging at the back end, which is very helpful toward providing sufficient water space next to the back flue sheet.

Detecting Defective Boiler Sheets in the Shop

Our method of inspection of firebox steel in our shops before going to the layout bench is as follows:

Surface Inspection: In making the surface inspection, a close examination is made of both sides of the plates and all edges, and the plates are rejected when the following defects are found to be present:

Blister
Pitted
Slivers
Seams
Burnt
Bricked
Scabby
Cinder spots
Split
Dished

Piped
Scored
Imbedded scale
Cambered
Laminated
Roll marked
Bad edges, caused by shearing
Crop ends
Knifed

Snakes
If grinding has been done
Cracked
Wrong dimensions
Wrong gage
Not bearing proper stamping required, i. e., heat numbers, serial numbers, manufacturer's name or initial

Material inspectors in inspecting firebox and boiler sheets follow the following procedure, making their tests as listed:

Bend Test: In the case of boiler steel, a test specimen for bend test is cut traverse to the length of the sheet as rolled, at the top of the sheet. This test specimen is then bent cold 180 deg., for material one inch and under, around a mandrel having the same diameter as the thickness of the specimen, and for material one inch and over, around a mandrel having a diameter twice the thickness of the specimen.

In the case of firebox steel, a bend test specimen is cut from each sheet as ordered. The sheet as rolled is cut into the dimensions of the individual firebox sheets ordered, this test specimen being cut longitudinally. Before and after quenching, it must bend cold 180 deg. flat without fracture at the bent portion. The quenching is done at a bright cherry red, in water at 80 deg. to 90 deg. In the case of firebox steel, in addition to the bends before and after quenching, a nick bend is made on each firebox sheet from one end of the tensile specimen, and this nick bend test must not show laminations exceeding ¼ inch in length, seams, cavities of foreign interposed matter, such as cinder, slag, etc.

Tensile Test, Boiler Steel: One test piece cut longitudinally from each sheet as rolled is pulled in the testing machine and the following determined:

Tensile Strength
Yield Point
Elongation in 8 in.

In making the tensile tests, a check on the gage of the material is made, and also the fracture and edges examined for any defects, such as laminations, etc. To determine that all plates are represented by the test piece, where more than one plate is sheared from a single slab or ingot, each plate is match-marked so that all plates sheared from a single slab or ingot can be identified with the test pieces identifying them.

Firebox Steel: A tensile test specimen cut longitudinally from each sheet as ordered is pulled and the following determined from the test:

Tensile Strength
Yield Point
Reduction of Area
Elongation in 8 in.

In making the tensile tests, a check on the gage of the material is made, and also the fracture and edges examined for any defects, such as laminations, etc.

Chemical Analysis: Drillings are taken from the tensile specimens and submitted to the laboratory for chemical analysis to determine the following:

Carbon
Manganese
Phosphorus
Sulphur
Copper, when specified

Gage: All the plates are checked for gage and our specification states that the thickness of the plates shall not vary more than .010 in. under that ordered, the full dimension being controlled by the weights as specified.

Weight: The plates are weighed and all plates having the same width and thickness must conform to the permissible variation in weights as outlined in specification.

This paper was prepared by a committee consisting of John J. Keogh, chairman; John P. Powers and J. C. Keefe.

Discussion

J. F. Raps, Illinois Central: When a plate is on the bench, there may be a gas pocket found that will not be apparent unless they shear through it. We often place a sheet over the forge and heat it in order to expand the gas to determine whether or not a gas pocket is in it. That, I believe, was the intention of this paper and not to go into the inspection in the mill, but the inspection and testing of the plate after it is turned over to the shop.

J. A. Anderson, Industrial Works: The only system we use, in inspecting boiler plates when they come to the laying out bench, is to give them a thorough inspection with the eye, on both sides, to see that there are no visible defects. If there is any suggestion that there might be something wrong, we put the plate under a magnifying glass, and that will detect any small flaw. The plate is laid out and rolled and after it is rolled, that is the time to find the defects. After it is rolled, we find, sometimes, a small piece will roll out, showing that scale was present. Sometimes we find laminations after rolling. We scarcely ever find any defects before the plate is punched and rolled.

President Lewis: We have found occasionally that after sheets have arrived at the plant, notwithstanding the tests made at the mills, where the sheets have been defective, laminations and blisters in the inspection in the shop, and often by the man who is laying out the work.

John F. Raps: A great many times, in shearing a plate, we run into laminations or we find defects by rolling the plate. Sometimes we find a gas pocket. Again we have put in the sheets and found when they were in service a few weeks, that there was bulging on the sides of the sheet, and then it cracks an eighth of an inch, and there would be a gas pocket or lamination. You may find it necessary to chip it off with the hammer in order to show it up. Now, the intention of these topics is to find out if any member here is following out any system of inspection of these plates, or doing anything before applying them to the boiler, to determine whether there are laminations or gas pockets in them. We all give them visual inspection on the layout bench, but sometimes these things happen after they have been applied. If any one is following out some other system than has been mentioned, such as putting plates over fire and heating them in order to bring out the gas blisters, or any other method of inspection, let us hear about it.

Edward Hunt, Illinois Central: In making center punch marks on the layout bench you will often run into a blister. Sound the plate with a hammer to see the surface defects. Watch the laminations around the edge of plate and take a general view of it. Follow up the plate when it is sheared. Sometimes, you find laminations away from the original edge, after you have cut through it. Close observation is important, watching your surface and the thickness. Sometimes by cutting you can see defects.

Hammer Testing Staybolts

This report embodies the substance of individual reports by the other committeemen as well as information gathered by the chairman from various railroads through the country.

In making hammer tests, size and weight should be left entirely with the inspector. Every inspector and boilermaker has a hobby of his own and wants a hammer just a little different from the other fellow's. For this reason, it should be left somewhat to the inspector, as it is his touch or sound that detects broken staybolts, and not the size or weight of testing hammer.

As to whether staybolts should be hammer tested or under hydrostatic pressure, the Laws, Rules, and Instructions for Inspection and Testing of Locomotive Boilers, promulgated by the Interstate Commerce Commission, must be complied with first.

We believe it practical to hammer test staybolts while the boiler is under hydrostatic or air pressure. However, this cannot be successfully done on monthly inspection in roundhouse, or when engine is undergoing classified repairs. We believe, and recommend that staybolts should be hammer tested while boiler is empty. In the roundhouse, we believe this should be done just as soon as the boiler is emptied of the hot water and while the firebox is somewhat expanded. In back shop, when engine is undergoing classified repairs, the staybolts should be hammer tested and inspected from interior of boiler, and all defective bolts renewed. When repairs to boiler are completed and hydrostatic pressure applied, all staybolts should be hammer tested again while boiler is under pressure.

The report was prepared by a committee consisting of J. A. Holder, chairman; C. F. Petzinger and William G. Bower.

Discussion

Charles P. Patrick, Meadville Machinery Company: I want to say that the committee's report on hammer testing of staybolts is common sense and logical. Each man has his hobby, in regard to hammer testing. He has his sense of touch and he should use it, but I rise to make a motion that this association, since we have had so many broken bolts in combustion chamber engines, those equipped with flexible bolts, particularly, that we go on record that we hammer test flexible staybolts each time we test the other staybolts.

W. J. Murphy, Pennsylvania System: Mr. President, I think that is the rule now on all railroads, that you test all staybolts when you go into the firebox, hitting all the bolts in the firebox.

H. J. Wandberg, Chicago, Milwaukee and St. Paul: On our railroad, we hammer test all staybolts, whether flexible or not, but we have the end of our flexible staybolts marked with red so that we can distinguish them from the rigid staybolts. I think most railroads are carrying out that practice of testing all staybolts.

A. W. Schelton: On the Frisco System we have no flexible staybolts marked and every bolt is hammer tested once a month—all of them. We are of the opinion that we find almost as many flexible staybolts broken as we do rigid staybolts in our monthly tests. We find those broken bolts by going over them with at least 100 lbs. of steam, and then we cool the engine and go over the rest of the bolts.

Charles P. Patrick, Meadville Machinery Company: I want to make an explanation of my motion. Some railroads make tests on flexible bolts, but the law requires you to test those bolts only once a year under pressure, and so all are not tested. Now, in the company with which I am associated, we test our bolts every month. If any inspector knows that a combustion chamber is equipped with flexible staybolts and that he is not required to test them, he is liable not to do so each month, since the law requires taking off the caps every twenty-four months. We find broken flexible bolts under the hammer test. We find them broken every month. It is only a short time ago that we found four in one engine and four in another under the hammer test. Even if you do not do so usually, if you suspect the bolt is broken, from the hammer test, it will pay to remove the cap.

L. E. Hart, Atlantic Coast Lines: We have a class of engines equipped with flexible staybolts in the combustion chamber, and we hammer test them and find lots of them broken. We hammer test all of the bolts, and whenever we have the expansion stays in front, we find some of them broken.

A. N. Lucas, Oxweld Railroad Service: Is it not a fact that the federal boiler law and rules require us to test all bolts every month? According to the rule, the cap shall be removed every twenty-four months, but does it not say we should test the bolts every month?

E. W. Young, Chicago, Milwaukee and St. Paul: Rule No. 16 states: "Methods of testing flexible staybolts having caps. All flexible staybolts having caps over the outer ends shall have the caps removed at least once every two years and also whenever the United States inspector or the railroad company's inspector considers the removal desirable in order to thoroughly inspect the staybolts. The firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts. Each time a hydrostatic test is applied, the hammer test required by rules 21 and 22 shall be made while the boiler is under hydrostatic pressure not less than the allowed working pressure and proper notation of such test made on Form No. 3."

In order to overcome any mistakes we instruct our men, where it says, "Firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts," to examine flexible as well as rigid staybolts, and they cannot examine sheets without testing each and every staybolt. They will detect bulging or any other flaws when they examine the sheets carefully, and we instruct them to test all staybolts.

Charles P. Patrick: It is not in the rule to hammer test staybolts.

E. W. Young: No, but to overcome the trouble in the sheet, we must examine the bolts, and there you have the rule.

W. J. Murphy, Pennsylvania System: I have had some little experience in testing staybolts and here is what we have found in testing flexible staybolts. We have a medium sized hammer for testing the ordinary staybolts and about twice the size for testing flexible bolts. We have found that by using a larger hammer we get better results. The question came up as to whether you find flexible bolts broken or not, and I will tell you that you can find them by hammer testing them. Any good inspector will find broken flexible staybolts, but he will get better results with a larger hammer.

R. C. Young, Chicago and North Western: I would like to know if a flexible staybolt, when the boiler is not under pressure, is not in the same condition as other broken staybolts? It is loose, not bent nor separated, and there is not much success from testing flexible staybolts unless you have pressure on the boiler and tension on the bolts, because when there is no pressure in the boiler, it seems to me much the same as when a bolt is broken.

T. W. Lowe, Canadian Pacific: We find in the law, as agreed, that there is nothing in it which tells us that we cannot do something better than what the law suggests. Therefore, on the western line of the Canadian Pacific, where we use the flexible staybolts, in general, we find it very advisable to have water pressure to the extent of 140 lb. at every test, every thirty days' test—shop test or any other kind of test. This is done for the very reason, that you will not find broken flexible bolts otherwise. We have found, from our experience, in applying a test with 140 lb. pressure, that you find a greater number of broken staybolts than you ever expected to find.

Mr. Wallough (Omaha): I believe in this discussion, here today, you will find that the hammer testing of staybolts is very nearly a lost art. We do not have the old-timers on the job that we used to have and you find very few inspectors get on the job and find the flexible, or any other kind of staybolts, that are broken with the hammer test. When a man follows them up, he finds some more. I have done that, myself. I think when it comes down to broken staybolts, flexible staybolts in particular, that we ought to get together and find some other method so that we can determine whether they are broken or not. I understand there is such a move on, now.

H. V. Stevens, Atchison, Topeka and Santa Fe: I would like to ask the convention if they want to go on record to remove the brick furnaces on oil burning engines? There are screw bolts and there are detector holes throughout the bolt, and does this include the matter of hammer testing them every 30 days?

T. F. Powers, Chicago and North Western: I think that is specifically covered in a rule handed down by the Department of Locomotive Inspection. As I remember it, it says when bolts are applied back of the brickwork, having a hole all the way through, they do not have to be hammer tested.

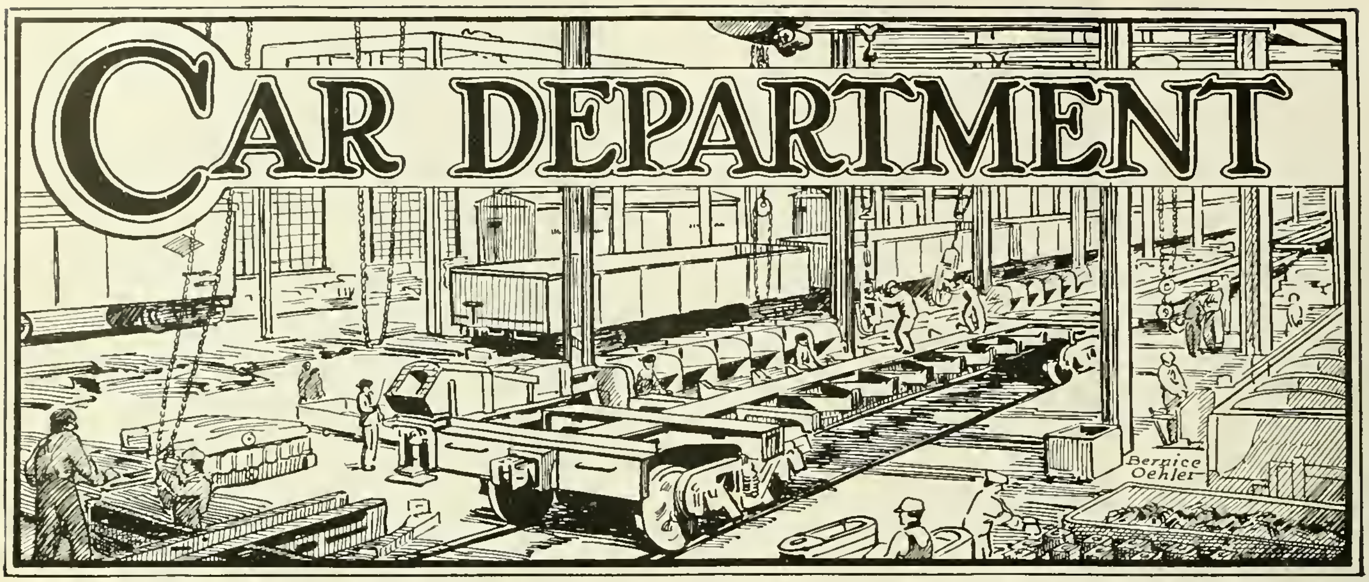
H. V. Stevens: Was not the motion that all screw bolts be hammer tested?

Chairman Lewis: I think this gentleman is justified in this question. Mr. Patrick includes every staybolt in the firebox, and I think that is well taken. We have a number of those bolts, as you suggest, Mr. Stevens, and if we had to hammer test them all, we would have to take out the grates. I think we should change the motion.

Charles P. Patrick: I will change my motion, Mr. President, and make it that we treat all flexible bolts just as we treat rigid bolts.

A rising vote on this motion resulted in its passage.

The Average mileage for freight cars per day for the month of January this year on all Class I railroads was 25.8, which exceeds the average for January in any year since these statistics were first published in monthly reports, in 1917. For last year the average was 20.4. For January, 1917, it was 25.3.



Unit System of Repairing Freight Cars

Good Results Secured at the Readville Shops with the Unit, or Station to Station, Method

THE Readville freight car shop of the New York, New Haven & Hartford, in common with other railroad shops throughout the country, was almost completely disorganized July 1, 1922, at the time of the strike. The average pre-strike force (230 men) and monthly output (221 cars) were both practically wiped out. By February, 1923, or in a period of eight months, the freight car shop organization had been rebuilt and the force expanded to 320 men, an increase of 39 per cent; the output had been built up to 362 cars, or an increase of 64 per cent.

A Fine Showing

This relatively greater increase in output than in the number of employees is especially creditable in view of the fact that the new men were largely inexperienced and had to be trained in their work by the limited number of foremen and leaders who remained loyal to the railroad. Readville is primarily a heavy repair shop, 50 per cent of the bad-order cars received at this point being practically rebuilt and 45 per cent given more or less extensive repairs. For example, probably not over 5 per cent of the posts and braces of the cars are saved. Practically all the sheathing and roofing is renewed. Fifty per cent of the posts and braces are cut up and re-used for jack posts and belt rail. New sills, reinforced ends and brake beams are applied; also new shoes for the posts and braces. An increase of 64 per cent in production, as against 39 per cent in force, is a good showing.

Unquestionably, one of the most important contributing factors in the good results accomplished at Readville has been the unit system, or station to station method of repairing freight cars, sponsored by H. C. Oviatt, general mechanical superintendent, and installed and enthusiastically supported by the local shop supervision under the direction of F. E. Ballda, superintendent of shops. Under the operation of this system, the output showed a practically continuous increase from July, 1922, to February, 1923, and has remained at a uniformly high level since that time. Approximately 350 freight cars a month are being turned out and this represents one way in which the New Haven is energetically attempting to improve its car equipment condition.

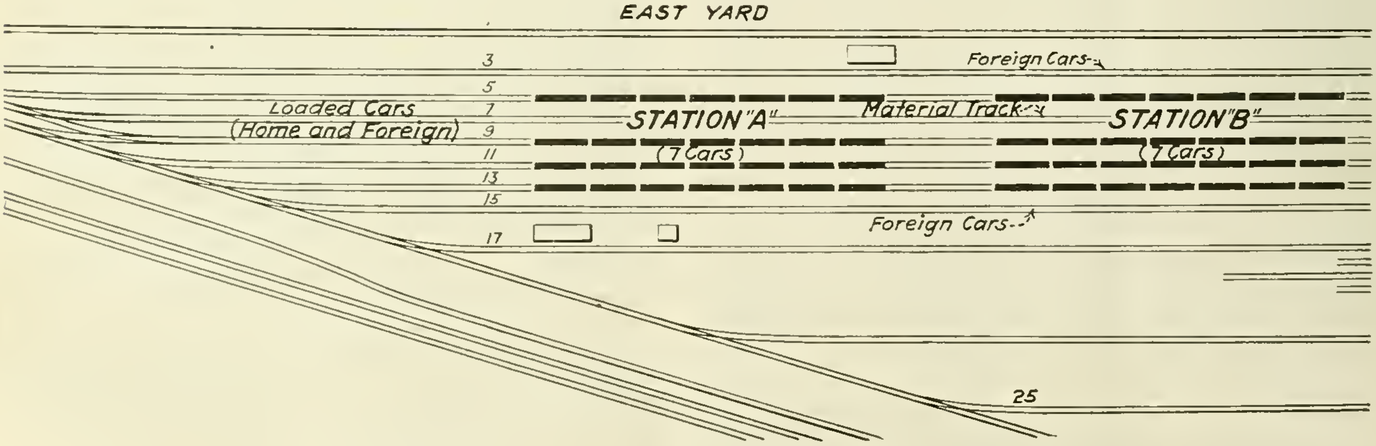


Fig. 2—General Layout of Readville Freight Car Shop and East and West Yards—Positions of Seven-Car Units at Various Stages of Repair Indicated

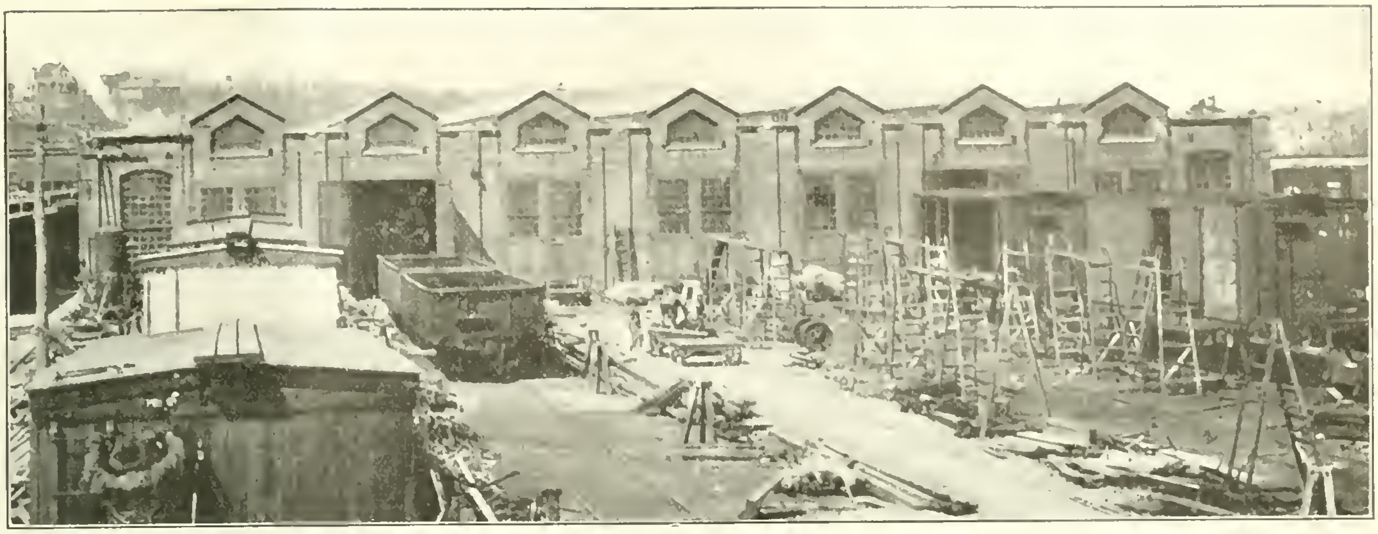


Fig. 1—The Freight Car Shop Proper Is a Substantial, Well-Lighted Brick Building. (View from East Yard)

A detailed analysis of the freight car output at Readville is given in Table I which shows both the types of cars handled and classes of repair given. Class 1 repairs shown in this table in all cases amount practically to rebuilding and involve not less than 200 man-hours of labor. Normally Class 1 repairs mean anything over 72 man-hours; Class 2 repairs, 36 to 72 man-hours; Class 3 repairs, 20 to 36 hours, and Class 4 repairs, less than 20 man-hours. Referring to the table, it will be noted that by far the great majority of the work is done on box cars, most of which receive Class 1 repairs. The number of Class 3 repairs in February, however, was unusually high (172) and this probably accounts for the record output of 362 cars in a short month.

Table I—Analysis of Freight Car Output at Readville Shop

	Type of car						
Kind of repairs	Box	Coal	Flat	Ballast	Refrig.	Caboose	Total
November, 1922—							
Class 1.......	93	...	4	...	11	4	112
Class 2.......	13	...	3	...	...	...	16
Class 3.......	46	28	6	...	...	...	80
Class 4.......	14	15	5	...	...	...	34
Total......	166	43	18	...	11	4	242
December, 1922—							
Class 1.......	93	...	5	...	10	8	116
Class 2.......	14	1	2	...	2	...	19
Class 3.......	50	32	8	1	3	...	94
Class 4.......	3	3	1	1	1	...	9
Total......	160	36	16	2	16	8	238
January, 1923—							
Class 1.......	123	...	1	...	5	13	142
Class 2.......	12	5	5	...	...	...	22
Class 3.......	57	47	7	1	1	...	113
Class 4.......	6	6	2	...	...	...	14
Total......	198	58	15	1	6	13	291
February, 1923—							
Class 1.......	148	...	1	...	...	6	155
Class 2.......	21	3	3	2	...	...	29
Class 3.......	90	64	18	...	...	...	172
Class 4.......	3	3	...	...	...	...	6
Total......	262	70	22	2	...	6	362
March, 1923—							
Class 1.......	166	1	2	...	8	6	183
Class 2.......	17	3	4	...	2	...	26
Class 3.......	81	46	7	1	4	1	140
Class 4.......	2	2	...	...	...	..	4
Total......	266	52	13	1	14	7	353
April, 1923—							
Class 1.......	125	1	35	...	2	4	167
Class 2.......	11	9	10	...	1	...	31
Class 3.......	85	66	10	...	1	1	163
Class 4.......	...	...	...	...	...	...	...
Total......	221	76	55	...	4	5	361

Table II—Specialized Gangs on Freight Car Work

Character of work	Number of men
Stripping cars	9
Air brakes	12
Truck and couplers	24
Steel cars and steel underframes	31
Superstructure and roofs	139
Painting	12
Foreign car repairs	73
Laborers	23

How the Unit System Works

The making of similar repairs to a large number of freight cars of the same type probably first suggested the possible economy in the unit system, or station to station method as it

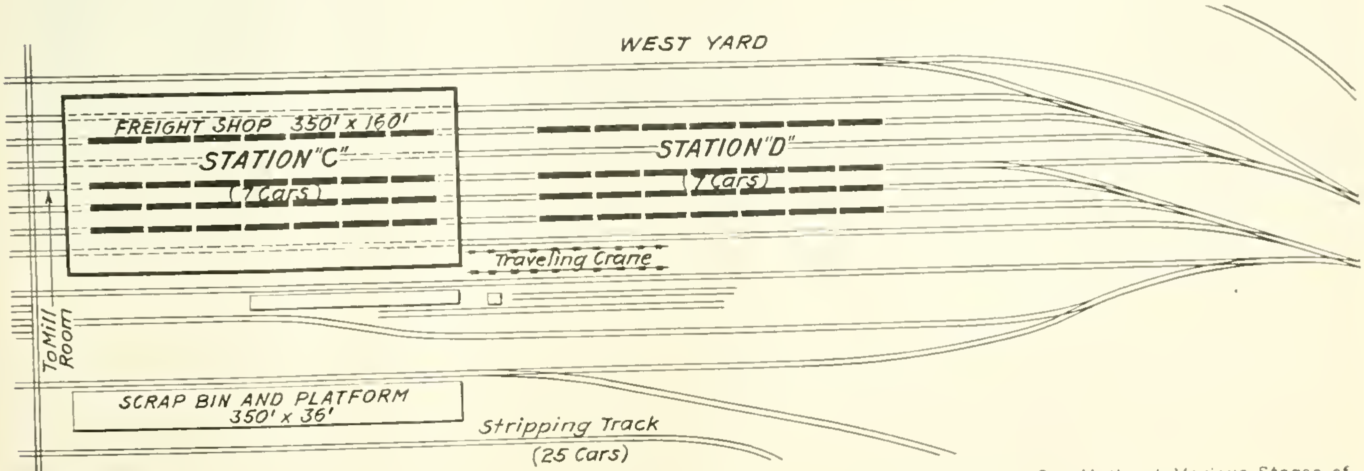


Fig. 2—General Layout of Readville Freight Car Shop and East and West Yards—Positions of Seven-Car Units at Various Stages of Repair Indicated

is sometimes called. Briefly, this system, as employed at Readville, consists of repairing the cars in units of seven, selected so far as possible by serial number, and advancing these units through the various stages of repair from stripping to weighing and stenciling, seven cars at a time. This enables specialized gangs to be used on various phases of the work which was a particularly important factor immediately following the strike because new men could be more quickly trained for special jobs than for all-around car repair work. (Table II shows the specialized gangs and the number of men in each.) In addition to specialization with the resultant speeding-up of the work and reduced cost, the unit system enables material to be handled in quantities directly to the points of application, saving time and labor. The entire operation of the shop is put on a more orderly basis with a favorable effect on output.

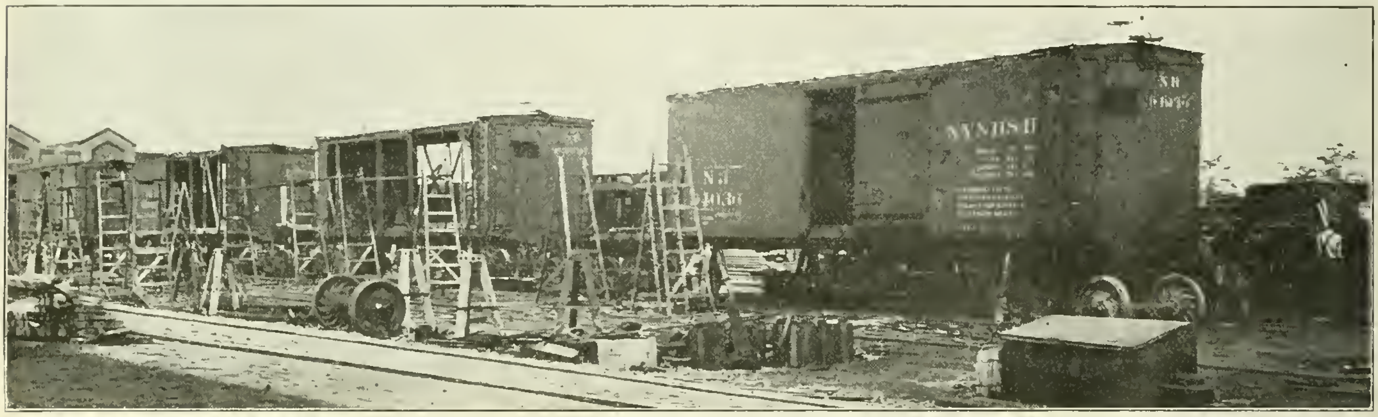


Fig. 3—Cars at Station "A" Receive Repairs to Trucks, Underframes, Couplers, Etc.

The general layout of the freight car shop and the east and west yards at Readville is shown in Fig. 2 with the four stations of repair indicated at "A," "B," "C" and "D." It will be noted that the freight shop, a brick building 160 ft. wide by 350 ft. long, is located between the East and West Yards, forming Station "C" in the order of operations. Tracks 3, 5, 7, 9, 11, 13 and 15 extend through the shop, Track 7 being kept clear for the delivery of material. A transverse track to the millroom, blacksmith shop and machine shop is indicated by the arrow. Track 25, known as the stripping track, extends west of the shop to a large vacant lot which is used as a dump for the burning of wood and debris from wrecked and scrapped cars. Any material having scrap value is readily segregated and moved back to the scrap bin and platform shown in Fig. 2 just north of the shop.

When a string of bad-order cars is received at Readville, it is run out on Track 25 to the dump and the cars stripped with the exception of ladders and grab irons which must be left for safety in movement. An important step taken at this time is the inspection for broken sills and ordering of necessary material in advance. The cars are then classified so far as possible by serial number and moved in units of seven to Station "A" in the east yard. Here the operation of stripping is completed and all repairs are made to trucks, underframes, couplers, etc., as shown in Fig. 3. This work is done by a special gang which, through careful instruction and training, has become expert on this particular phase of the work. It will be noted that only four seven-car units can be accommodated at Station "A," since Track 7 is held open as a material track and Tracks 3 and 15 are devoted to the repair of foreign cars. The section of the east yard between the ladder and Station "A" is used for making light repairs to loaded cars, both home and foreign. The way in which Track 7 is kept clear for handling material is plainly shown in Figs. 1, 3 and 4.

Each seven-car unit, as the work is completed on it at Station "A," is moved to Station "B" in the east yard where the floors are repaired, post and brace shoe pockets applied and all the superstructure repaired or renewed, as shown in Fig. 4. More men are used on repairing superstructure and roofs than on any other branch of the work, the division of men between the different specialized gangs being indicated in Table II.

From Station "B" the respective units are moved to Station "C" which is the freight shop. Here grain slides are repaired, the lining inside and out applied and ladders and safety appliances put up. Sheathing and roofs are applied in the shop; also doors, running boards and one coat of paint. This is to prevent damage from swelling in the event that cars are run out of the shop and exposed to dampness or rain, before final painting. Air brake work, such as cleaning and oiling cylinders, changing triple valves and making necessary brake adjustments, is also done in the shop. The work at Station "C" is illustrated in Fig. 5.

The last movement of the seven-car unit is to Station "D" in the west yard where a final inspection is given the cars, the second coat of paint applied and the cars stenciled and weighed. Air is provided in this yard for spraying the trucks, and if it is stormy, the cars are transferred to Track 15 inside the shop where the painting is done under cover. A string of cars completed and ready for service is shown in Fig. 6.

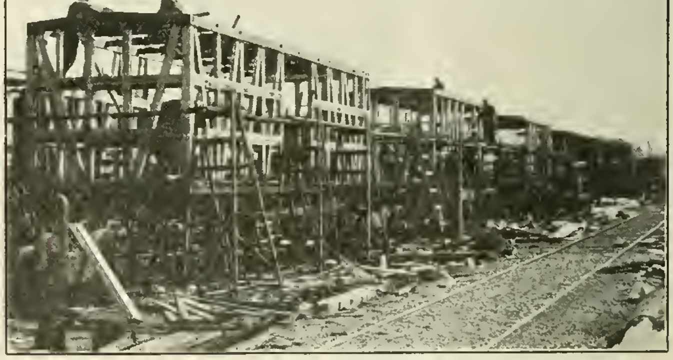


Fig. 4—Superstructure Work Is Done at Station "B"

Economy in Milling and Handling Lumber

An important advantage of the unit system is the saving in milling and handling of lumber used on the cars. The selection of seven-car units, as far as possible of the same series, gives longer runs on the same size stock in the millroom with resulting economy. Running boards are milled in carload lots of 22,000 ft. Posts, braces and sills are milled with fewer changes in machine set-up and with an important saving in the time of laying out these parts. Sheathing and roofing are not milled at Readville but are bought in 9-ft. and 5-ft. 2-in. lengths, respectively. Both the sheathing and roofing are cut off with a portable power saw after application to freight cars. The bottoms of all posts and braces, also side sills are creosoted, the creosote being applied with a brush.

Lumber, machined to the required size and shape for standard material, is handled on push cars over the standard gage track from the millroom and over material delivery Track 7, being piled as near as possible to the point of use. In the shop (Fig. 5) material racks are placed on both sides of each car of a size sufficient to hold 154 pieces of sheathing, the average car taking 150 pieces. Roofing racks are large enough to hold roofing for a single car. In general, there is no back movement of this material. It is handled by laborers and left in orderly piles where it can be reached by the repair men with the least possible effort. When a unit of seven cars has been advanced one station, the preceding station is cleaned and material piled in readiness for the next unit and there is no question as to the effect of this orderly handling of material in speeding-up car movement.

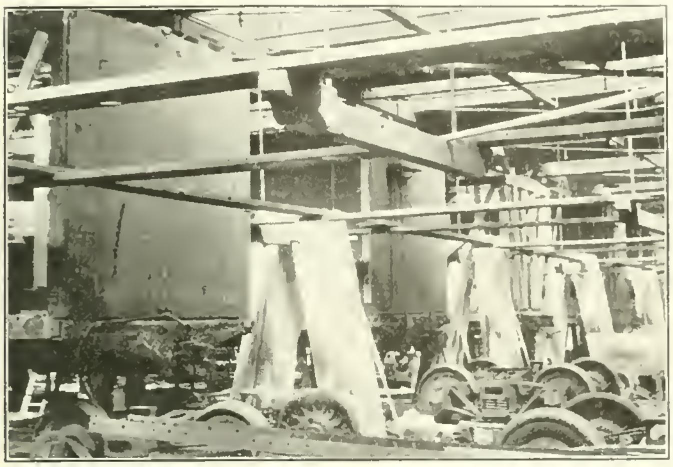


Fig. 5—A Feature of the Work at Station "C" (in the Shop) Is the Orderly Piling of New Sheathing and Roofing Within Easy and Convenient Reach

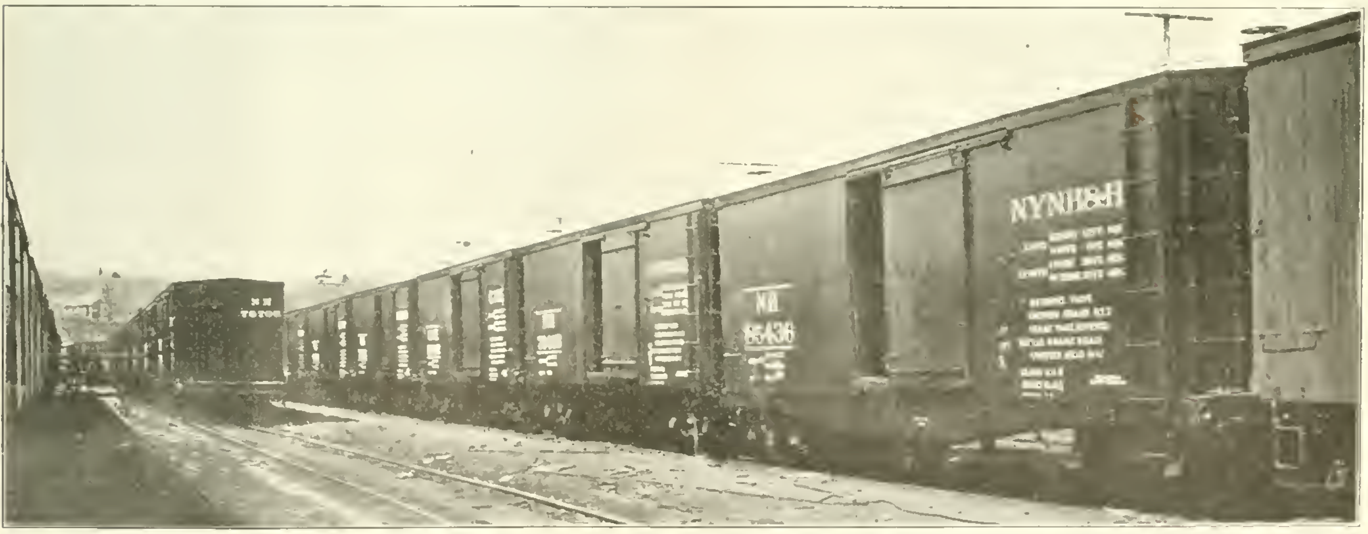


Fig. 6—At Station "D" the Seven-Car Units Receive a Second Coat of Paint; Are Stencilled; and Given a Final Inspection

In addition to the push cars, a tractor and trailer system is used at Readville to handle material, such as wheels, couplers and other heavy parts, proving a great time and labor-saver. This tractor, illustrated in Fig. 7, is particularly useful in view of the short-turning radius available. The front and back wheels track one another, being connected by crossed tie rods which cause the rear wheels to swivel the same amount and in the opposite direction to the front wheels, greatly decreasing the space required for turning. It is obviously difficult or impossible to back with this arrangement, but any number of trailers within reasonable limits can be loaded at the convenience of the material handling foremen and moved by power to their destination.

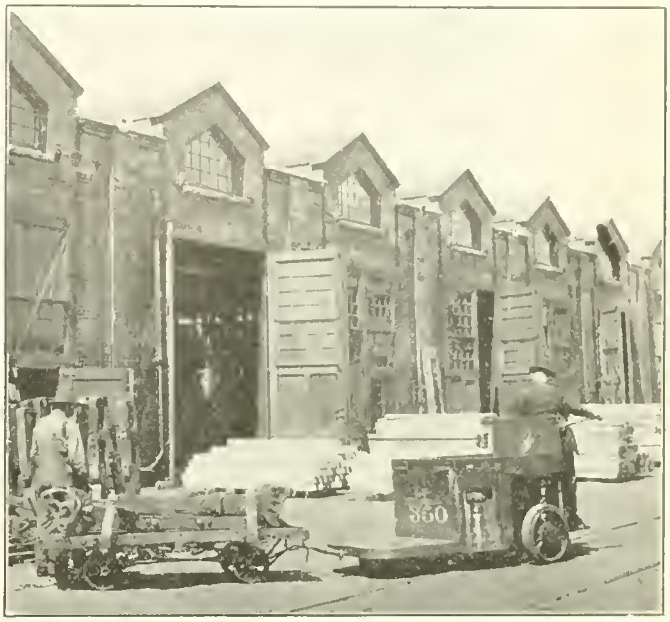


Fig. 7—An Effective Storage Battery Tractor and Trailer System Is Used

Machines in the Freight Car Shop

Adjacent to Track 15 in the shop is a rip saw and gage for rabbeting. In addition, cut-off saws enable considerable reclamation work to be carried on in this end of the shop. Old sheathing, defective at one end, is cut up so that the good portions are re-used. In addition, much hand sawing is eliminated in view of the accessibility of the rip and cutting off saws. Light caboose and refrigerator cars are repaired on Track 3 in the shop building.

In addition to air pressure for the operation of pneumatic tools in the east yard, oxygen and acetylene gas pipes are provided so that the cutting and welding torch can be used at any point in the yard. Air is provided in the west yard for paint spraying trucks and for a pneumatic hoist which proves extremely valuable in changing wheels on light repair cars. One end of the car is lifted at a time when the wheels can be readily changed. Track 17 is reserved for this work. Both home and foreign steel cars are repaired at Readville, although most of this work is done at the New Haven's steel car repair shops at Norwood, Mass.

Paint Spraying Pits a Good Investment

The underframes of steel cars, as well as the trucks, are spray painted, this work being usually done at two drop pits recently installed adjacent to the transfer table in the passenger department, as shown in Fig. 8. These pits greatly facilitate spray painting the trucks and underframes of cars and have already more than repaid the cost of constructing them. Both air and gas are piped to the pits, the trucks and underframes being painted in a fraction (one-tenth) of the time which would be required with a brush. Possibly one-fifth more paint is used but this paint covers many places which it would be difficult or impossible to reach with a brush. The pits are located between the transfer table and the paint shop and are also used for burning off old floors of passenger cars. This arrangement keeps the odor from burning out of the shop.

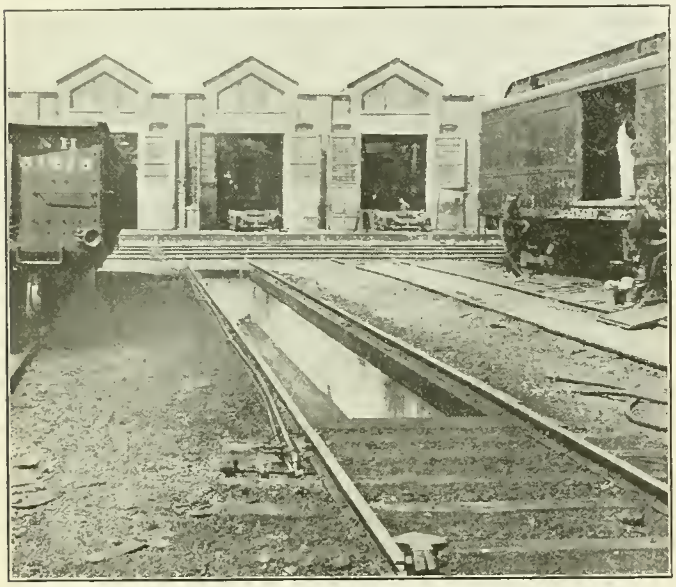


Fig. 8—Two Paint Spraying Pits Greatly Facilitates the Painting of Trucks and Underframes

Foremen Must Instruct New Men

There are three foremen, two assistants and three leaders in the freight car department at Readville. These men, therefore, have on an average 40 men apiece under their personal direction and the only means so far developed for instructing new men is by personal contact. Foremen's meetings are held once a week for the purpose of studying the progress of the work and ironing out any differences between the various foremen, also getting after material and parts which are delayed.

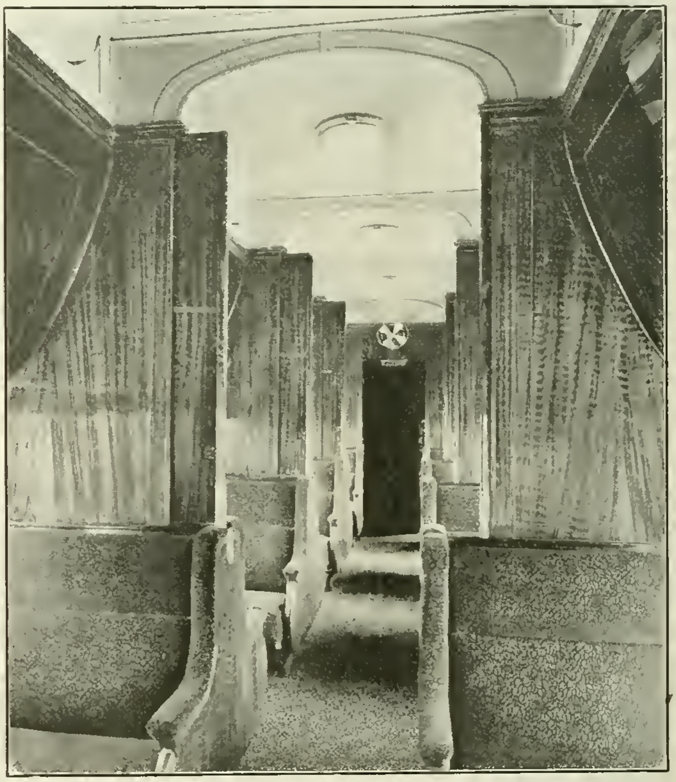
In conclusion, it may be said that under the unit system of repairing freight cars described, the entire operation of the freight car department at Readville has been put on a more orderly and systematic basis, with a reduction of confusion and lost effort, and a decidedly favorable effect on output, as shown.

Permanent Headboards Between Sections of Pullman Sleepers

FOR some time the Pullman Company has been working on the development of the interior arrangement of its standard sleeping cars with a view to increasing the privacy of the sections when the cars are made up for the day. The first step in this development, which was illustrated in the April issue of the *Railway Mechanical Engineer*, page 224, consisted in the installation of permanent headboards between the sections, extending out from the side of the car flush with the side of the upper deck.

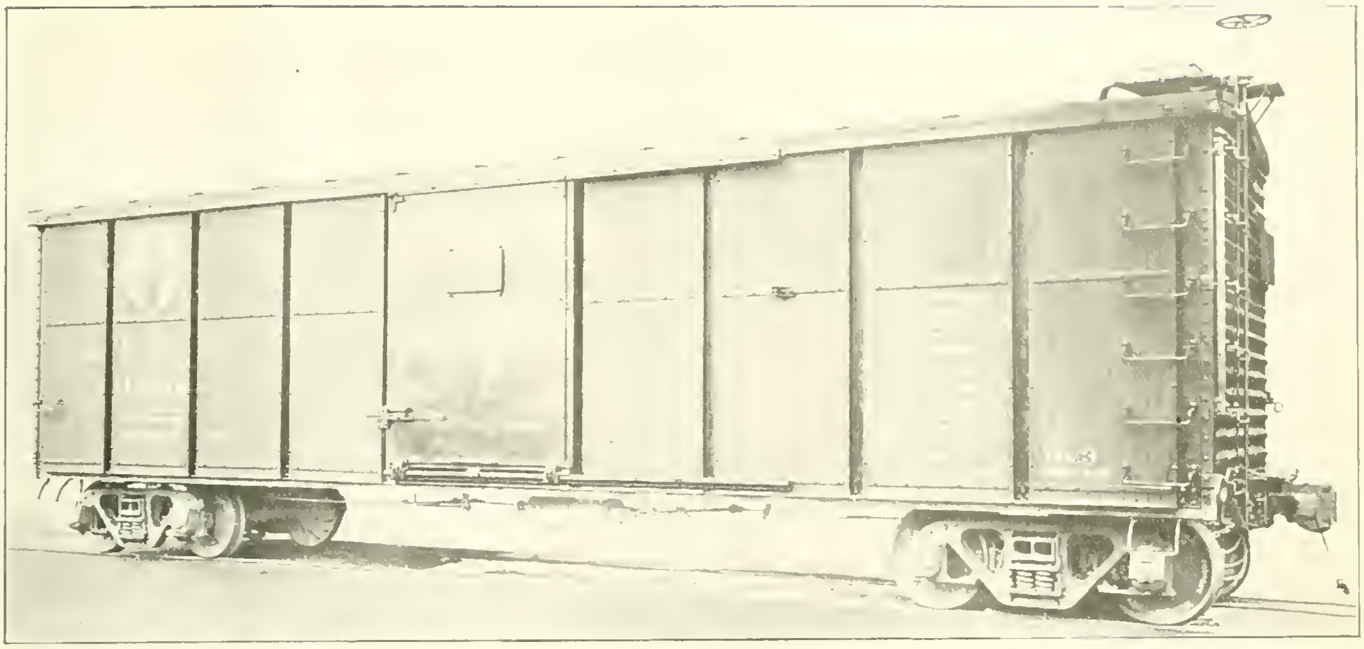
To complete the partition when the berths are made up, a removable section of the headboard is locked in place against the edge of the permanent partition.

The next step in this development is shown in the illustration. In this case the permanent section of the headboard has been extended out farther from the side of the car, and carried across the ceiling so that each pair of sections in effect is in a separate compartment with an arch opening between the compartments. In this construction the headboard is completed for night use by sliding out a section which telescopes inside the permanent partition. This is automatically locked in place by a latch in the end of the seat which can be released with the berth key.



New Pullmans Have Permanent Headboards; Telescopic Extensions in Place for Night Use at the Left

This type of construction has been applied in a combination 10-section observation car, of which 30 have already been built. Other than in the headboard arrangement, the interior design of the cars does not differ from the standard Pullman sleeping car except that the dome lights, which are located between the sections in the standard cars, are located, one in the center of each pair of sections. There is also a departure from the customary interior finish. The interior steel work below the upper decks is grained and stained to represent Italian walnut, with which is combined upholstery and carpet of blue.



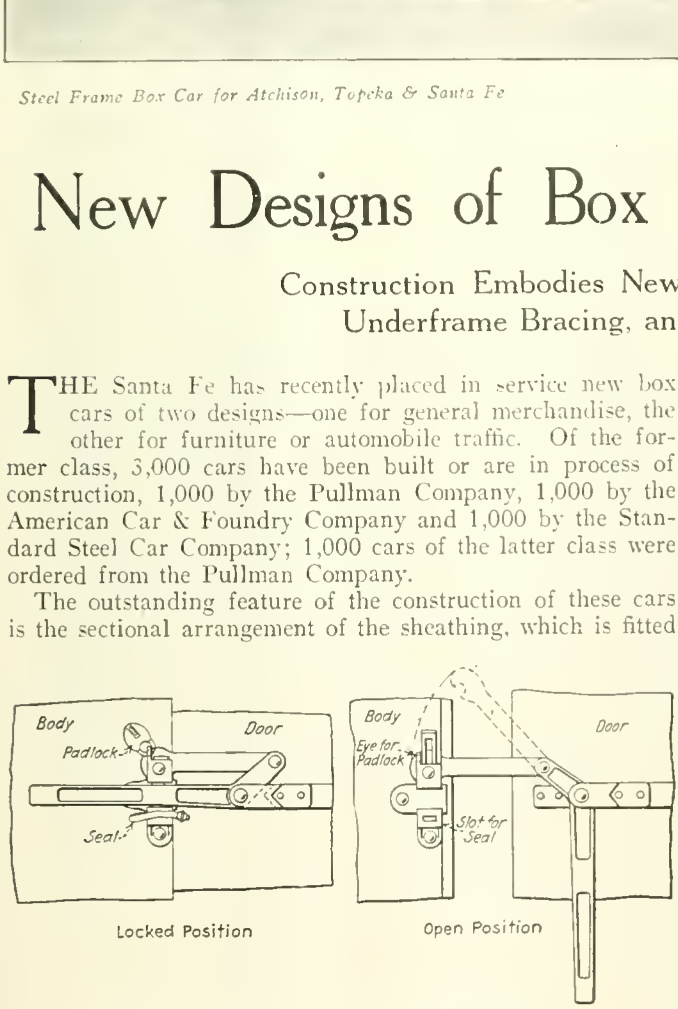
Steel Frame Box Car for Atchison, Topeka & Santa Fe

New Designs of Box Cars for the Santa Fe

Construction Embodies New Arrangement of Side Posts, Underframe Bracing, and Door Opener and Closer

THE Santa Fe has recently placed in service new box cars of two designs—one for general merchandise, the other for furniture or automobile traffic. Of the former class, 3,000 cars have been built or are in process of construction, 1,000 by the Pullman Company, 1,000 by the American Car & Foundry Company and 1,000 by the Standard Steel Car Company; 1,000 cars of the latter class were ordered from the Pullman Company.

The outstanding feature of the construction of these cars is the sectional arrangement of the sheathing, which is fitted flush between the side post flanges. Where the sheathing extends in an unbroken expanse from door post to corner post, the cumulative effect of shrinkage has been found to result in the opening up of cracks somewhere along the side of the car. The sectional arrangement between the steel frame members localizes this effect so that cracks are unlikely to develop.



Locked Position Open Position

Door Starter and Locking Mechanism

The general merchandise cars are designed with center sills of uniform cross section, the body frame being designed to carry a large part of the load. In the case of the automobile cars, however, the size of the door opening is too great to permit with safety this form of construction and therefore the fish-belly type of center sill is used.

The total weight of the merchandise car is 46,000 lb. The automobile car is slightly heavier, its weight being 50,500 lb.

The Underframes

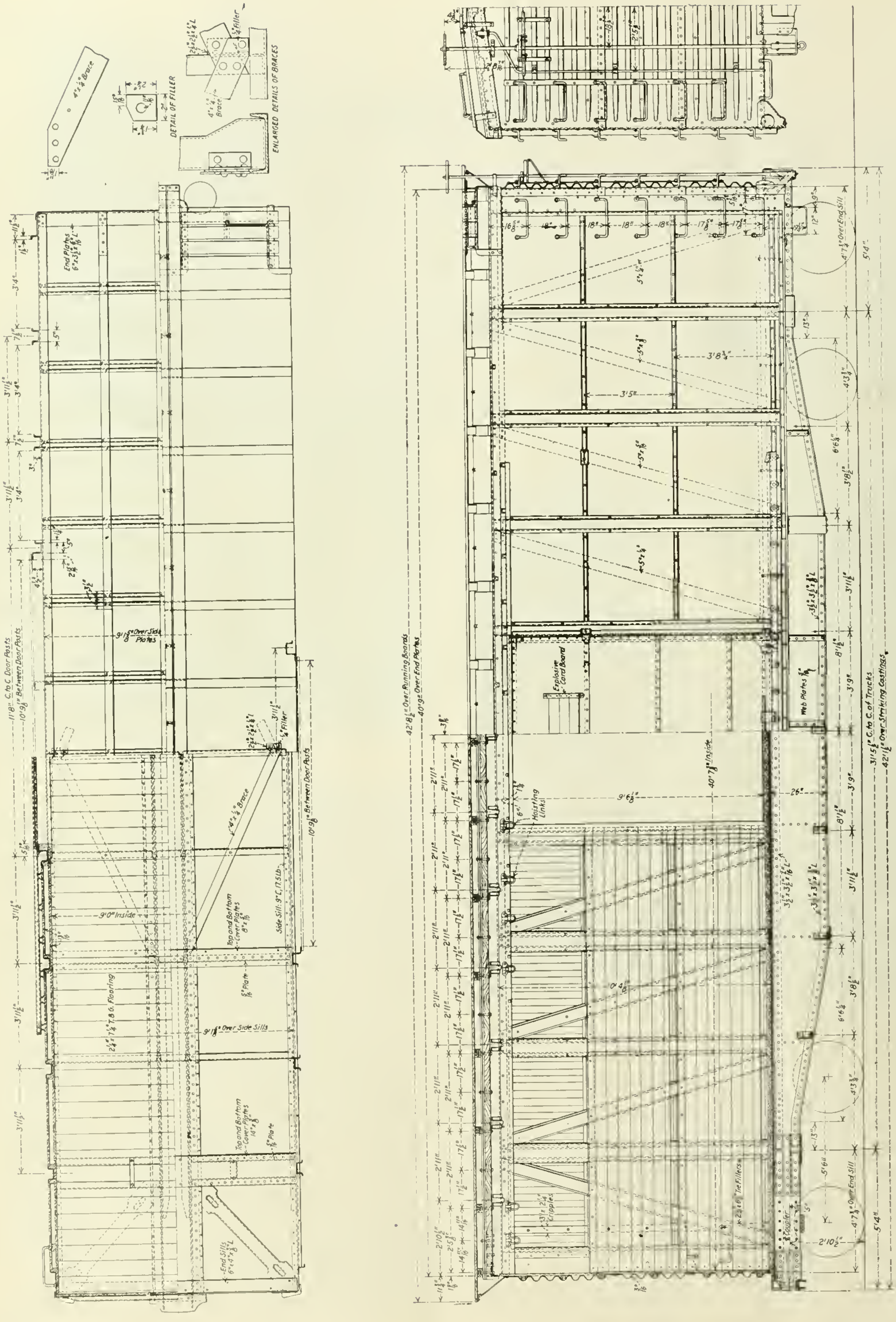
The underframes are of open-hearth steel throughout. The center sill of the general merchandise car consists of two ship channels, reinforced by a ¼-in. top cover plate; at the bottom two 3½ in. by 3 in. by ⅜ in. angles are riveted to the webs of the channel. These bottom angles extend underneath the center filler and rear draft lug combination casting.

The center sills of the automobile car are of a built-up fish-belly type, consisting of 5/16-in. web plates reinforced at top on the outside by 3½ in. by 3½ in. by 7/16 in. angles and at bottom on outside and inside by 3½ in. by 3½ in. by ⅜ in. angles. The sills are also reinforced on top and connected together by a ¼-in. cover plate.

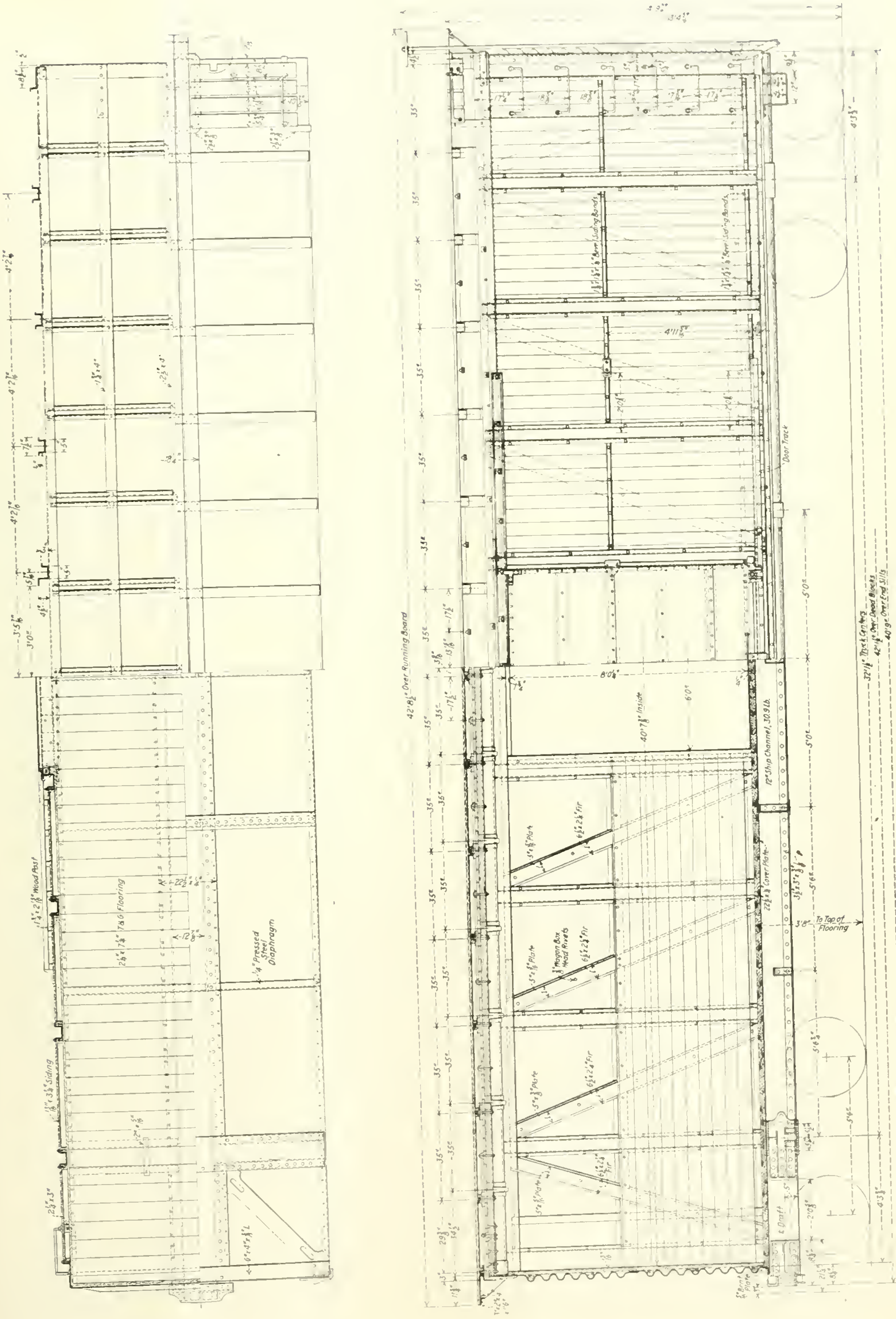
The side sills are of 9-in., 17.5-lb. channels and have angles riveted to the outside faces. The end sills are of 6 in. by 4 in. by ⅜ in. angles and are riveted to the side sills, diagonal braces and center sills. Malleable iron corner-castings and push-pole pockets are riveted to the end sills and side sills.

The body bolsters are of built-up design with cast steel center filler and rear draft lugs combined; the side diaphragms are of 5/16-in. steel plate spaced 7½ in. between webs and reinforced on top and bottom by 14 in. by ⅝ in. cover plates, and with ⅜-in. pressed steel stiffeners between the bolster webs at the side bearings. The body and truck center plates are either drop-forged or of cast steel riveted to the body bolster and truck bolster.

The main crossties are of built-up design, with single ¼-in. pressed diaphragms at the sides and between the center sills. Those of the general merchandise car are reinforced



General Arrangement of Steel Frame Furniture or Automobile Car for Atchison, Topeka & Santa Fe



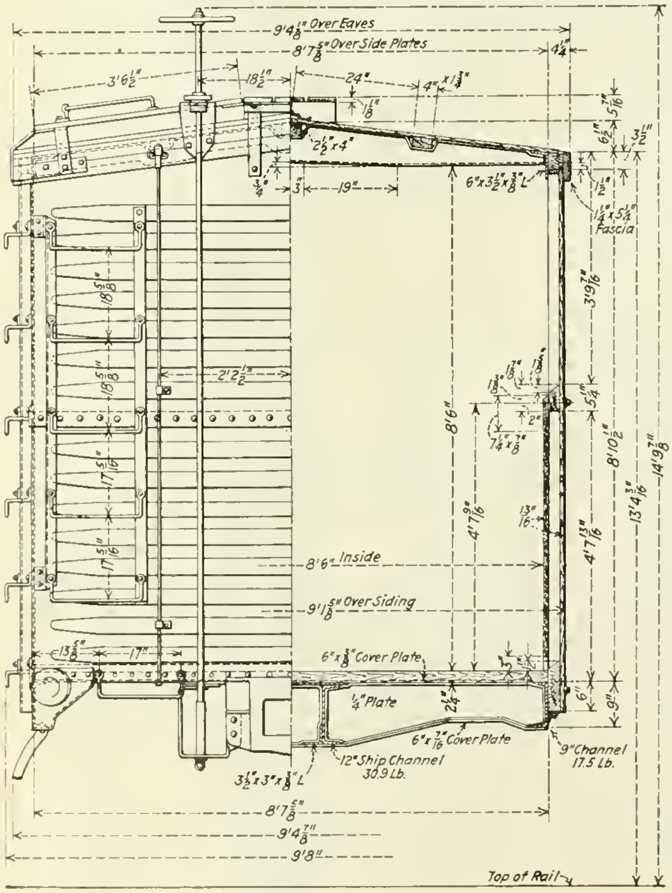
General Arrangement of Steel Frame Box Car for Atchison, Topeka & Santa Fe on top by 6-in. by 3/8-in. plate and on the bottom by 6-in. by 7/16-in. plate; those of the automobile cars are reinforced both top and bottom by 8-in. by 5/16-in. cover plates, and these cars are further strengthened at this point by diagonal bracing.

Body Framing

The body framing of both cars is of steel with wood stringers, post fillers, ridge pole, purlines, etc. All posts are cut perfectly square at the bottom ends so as to insure a good fit with the angle riveted to the outside of the side sill channel. To allow for fastening the siding, wood fillers are bolted under the flanges of the posts, and wood stringers, beveled on top, are fitted in between the post fillers and bolted to the side sill and to the supporting angles. Wood fillers are also placed at the tie plates.

There are 13 carlines of 5/32-in. steel plate, pressed to shape, with depressions for the ridgepole and purlines. The ridgepole is beveled on top to the pitch of the roof and riveted on each carline. The purlines are full length pieces, lap-spliced over and riveted to the carlines.

The construction of the body framing of the automobile cars differs only slightly from that of the general merchandise cars. The former have two belt rails instead of one and all posts are covered at the floor, lower belt rail, and between the upper belt rail and side plate with No. 26 galvanized steel. Similar covering is applied to the posts of the general merchandise car at the floor, the belt rail and between the belt rail and side plate. This is an important factor in making cars grain-tight around the posts.



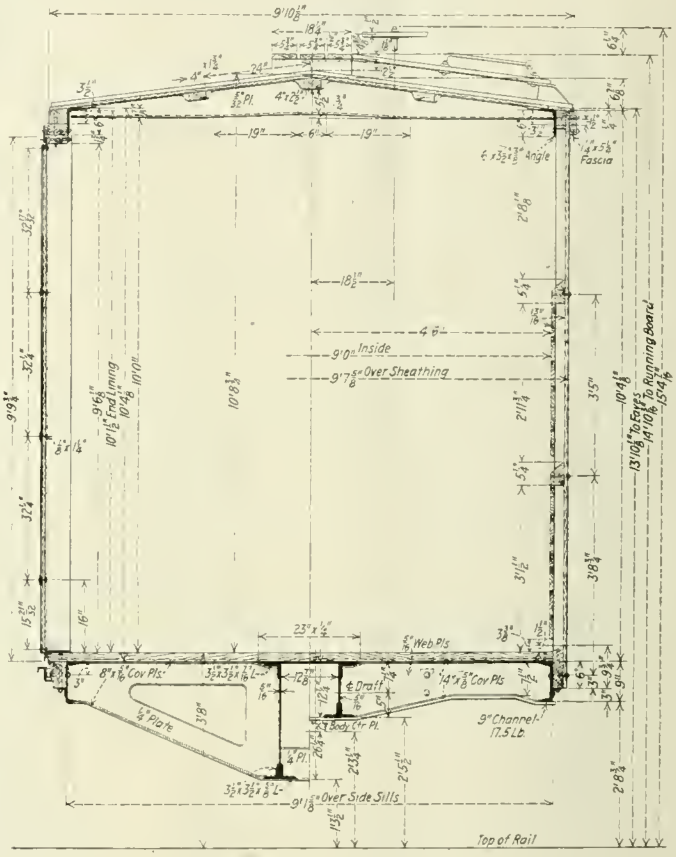
Cross Section of Santa Fe Steel Frame Box Car

End Construction

While both cars have similar types of end construction, they differ in some of the details; both cars are equipped with Murphy steel ends.

The end plates consist of 6 in. by 3 1/2 in. by 5/16 in. open hearth steel angles, pressed to shape. The steel end of the general merchandise car is made in two pieces, of corrugated steel plate, the bottom piece being 1/4-in. plate and the top piece 3/16-in. The plates are riveted together horizontally and the side edges are flanged to lap over the corner posts and the end is riveted to the side corner posts, to the end sill angle, and to the end plate.

The steel end of the automobile car is made in three pieces. Each piece is 3/16 in. thick and the riveted seams are horizontal. The end sill, the corner post, and the steel end are all welded together to close the opening at the top of the side sills.



Cross Section of Santa Fe Steel Frame Furniture or Automobile Car

The lining is tongued and grooved standard section, dressed on both sides, and runs in one piece from the door post to the end of the car.

The siding is V-face fir, dressed on both sides, and tongued and grooved. At each side post the siding boards fit tightly against the flange of the steel post and wood filler, and, after being properly tightened and nailed to the car, are further secured at the side sill and belt rail with open hearth steel straps 1/4 in. thick, beveled on two edges.

The Roof

The roof boards are of 13/16 in. by 5 1/4 in. fir, dressed on both sides, tongued and grooved and applied crosswise of the car. All roof boards are gained on the top side for roof flashing and are sawed at the eaves and ridgepole on a bevel, parallel to the fascia.

The roofs of both classes of cars are Standard Railway Equipment Company's outside flexible metal roof, Type No. 2; the roof sheets, transverse cap, ridge cap and flashing, before galvanizing, are U. S. S. No. 24 gauge. The metal roof is secured to the ridgepole at the corners of the roof sheets by fir saddles and malleable iron center caps, and at intermediate points by sheet anchors and malleable iron sheet anchor caps.

The eave flashing is nailed to the side fascia, and the end roof sheet and end of ridge cap are nailed to the end fascia The eave flashing is also bolted, a galvanized iron cap being placed over the heads and soldered to the flashing.

All mullions are 1 in. by 2 in. and are nailed under the purlines, at the ridge pole, at side plates and through the roof boards.

The longitudinal running boards are vertical grain fir 1⅛ in. by 5¾ in.; the total width is 18¼ in. The boards are surfaced on one side and two edges and secured to the saddles with flat-head wood screws. The latitudinal running boards, which are of the same grade and size of material as the longitudinal running boards, are held together and secured to the car by steel straps bolted to the car.

The side fascia is of 1¼ in. by 5¼ in. fir, at each side of door head and 1¼ in. by 3¼ in. under the door hood. The fascia is beveled on top to the pitch of roof, rabbeted at the lower outside edge and securely nailed to the car. The end fascia—1¼ in. by 5¼ in. fir—is shaped on top to pitch of roof and bolted to the end of car.

The Car Doors

The side doors are of unusually sturdy construction into which both wood and steel enter. Single doors are used on the general merchandise cars and double doors on the automobile cars, center door-steps being provided for the latter.

The door frames consist of Z-section, steel bars and the corners are mitered; the top corners have malleable iron gussets, which extend above the outside face of the Z-bar sections and are formed to extend over the horizontal projection of the door hood section. The part of the mitered Z-bar not covered directly by the gussets is welded. The bottom corners of the doors are connected by the door-roller housing casting.

The outside of the door is 1/16-in. open hearth steel; the inside consists of fir strips riveted to the 1/16-in. plate and Z-bars. The doors are of the bottom-hung type rollers, housings and track being furnished by the Camel Company.

The door opening of the merchandise car is 6 ft. 0 in. wide by 8 ft. 0½ in. high; that of the automobile car is 10 ft. 0⅜ in. by 9 ft. 6⅛ in. clear with both doors open. With the smaller door closed, the opening is 6 ft. 0⅜ in. by 9 ft. 6⅛ in.

The door locking arrangement, door starter and door open fastener deserve mention. This device was designed by the railroad and consists of a malleable iron handle and arm which are fastened to the door, the arm being so designed as to engage a bracket fastened to the door posts. The method of engagement provides for closing and opening the door, and for locking or sealing it. The starting handle serves as the door hasp and is provided with two sealing positions, one with the door closed tight and the other with the door opened eight inches for ventilation.

The Trucks

The same design of truck is used under both types of cars. The principal features are Andrews cast steel side frames and cast steel bolsters with lateral motion caps cast integral with the bolster. The journals are 5 in. by 9 in. and the weight of a single truck is 7,740 lb.

Other Appliances

The deadlocks are of cast steel with the coupler carrier-iron cast integral with the dealock and provided with a wearing plate for the coupler. The draft gear is Miner Friction Type A-18-S and the A. R. A. Standard Type "D" coupler with 6 in. by 8 in. shank and 1⅝ in. by 6⅛ in. key slot, is used. The coupler yoke is cast steel.

The uncoupling device is the "Imperial" type. The brake rigging is the Westinghouse Schedule K. C. 1012 with K-2 triple valve, centrifugal dirt collector, 10-20 retaining valve, duplex spring loaded; "Creco" brake beams are used and all lever carrier irons, fulcrums, etc., are secured with rivets. The retaining valve is located on the end fascia. All piping for air brakes is of wrought iron and the trainpipe has a 10-in. nipple of extra heavy pipe at each end of car.

Each automobile car is equipped with 24 hoisting links. These are made from ⅝-in. diameter steel chain, welded into cast steel brackets, which are riveted to the inside face of the vertical flanges of the side plate angles.

Painting

Special provision for preventing the corrosion of metal parts has been made in the method of painting both types of cars. All parts coming in contact on trucks, underframe, and framing, which could not be painted after assembly, have been given a good coat of Lucas car roof cement before being put together. After assembly and before applying any of the wood superstructure, the entire underframe, posts, ties, steel ends and carlines were coated with the Lucas cement. A heavy coat of this same material was also applied to the top side of the outside metal roof, and the crack at the ends of the floor boards was sealed by applying the cement to the inside face of the side sill stringer, inside face of the posts for a height of 2¼ in., and to the top of the side sill flange. Wooden parts were painted all over before application and again after being placed in position. The entire trucks received two coats of carbon paint.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Missing Brake Rigging Removed from Passenger Car to Permit Safe Operation

In March, 1921, the Atchison, Topeka & Santa Fe rendered a bill for car repairs against the American Railway Express Company which contained charges for the replacement of a missing brake beam, brake lever, bottom brake rod and slack lever guide, together with the necessary bolts and cotters, and a broken safety hanger, to which the express company took exception. In addition to the brake rigging parts, the bill contained a charge for various pipe repairs made to the car on account of a broken branch pipe, for which the Santa Fe furnished a refund. The express company claimed that the character of the damage indicated it was not due to ordinary service, that the missing brake evidently had been torn off due to derailment, running over some obstruction, or had been removed from the car on account of the failure of some item necessitating its removal to safely operate the car into the terminal. Furthermore, the price of $10.02 charged for the renewal of the Diamond special brake beam, it was claimed, does not represent the actual cost of the item less the average credit allowance. After considerable correspondence, the Santa Fe advised that a thorough investigation of the matter had determined that the car was not derailed, that the conductor who handled it on November 11, 1920, removed the material after a hanger pin failure and a broken safety hanger had dropped one end of the beam on the ground. The express company contended that it was not responsible to the railroad for applying new material where the old material in good condition had been removed and retained by the railroad. The railroad contended that the provisions of Rule 95, paragraph 2, referring to missing brake beams and connections, was revised, effective October 1, 1918, for the purpose of taking care of just such conditions as found in this case and that Rule 101 was revised at the same time by the addition of items 171 to 174, inclusive, which provide an "average credit" price for "defective or missing" beams for the same purpose. Applying the same average credit price obtaining for the No. 2 brake beam, based on 34 per cent of the value new, the credit for the Diamond special passenger car beam, including shoes, would leave a net charge of $10.16. The railroad submitted that whether the defective material was left on the line did not enter into the case since the damage was not caused by any agency defined in Rule 8, as delivering line defects.

The Arbitration Committee decided that: "The missing material in question is owner's responsibility. Bill of the Atchison, Topeka & Santa Fe Railway is sustained."—*Case No.* 1256, *American Railway Express Company vs. Atchison, Topeka & Santa Fe.*

Responsibility for Missing Parts—Passenger Rule 7

During February, 1921, the American Railway Express Company rendered several bills against the Boston & Maine for applying bull bars to two of its passenger express cars, to fit them for the transportation of horses. These cars are listed in the Railway Equipment Register as horse cars and were furnished to the express company by railroads other than the owner, for loading horses. The express company maintained that the transportation of horses in these cars is impossible without the missing appliances to separate the animals. It further maintained that the bills cover only the actual invoice price for the material used with nothing added for the labor. The Boston & Maine set forth that the cars, which were first loaded by the express company with general merchandise for the West, are equipped with brackets for the use of metal bull bars and that when loaded with horses at Chicago wood substitutes were applied in place of the regular metal bars. The owner refused to pay the bill on the ground that the cars moved off its line in general merchandise service, and that it did not participate in the revenue movement of the live stock loading.

The Arbitration Committee decided that: "In view of Rule 7, section (d) for passenger equipment cars, the car owner is responsible for the missing details referred to. Therefore, bill of the American Railway Express Company is sustained."—*Case No. 1247, American Railway Express Company vs. Boston & Maine.*

Scope of 60-Day Limit in Rule 91

Bills rendered by the Chicago, Rock Island & Pacific against the New York Central, contained charges to which exceptions were taken by the latter road within 60 days from the date the bills were passed for payment. The Rock Island replied to the letter of exception about one month after its receipt, but did not satisfy the New York Central. The latter road again took the matter up with the Rock Island, but not until after a lapse of considerably more than 60 days following the Rock Island's reply. The Rock Island refused to handle the matter further, claiming that this delay in again bringing the matter up was a violation of the 60-day limit in Rule 91, which should apply to the second letter of exception as well as to the first, if the billing road is not to be required to keep its files open indefinitely. The New York Central contended that inasmuch as the exceptions were originally taken within the 60-day limit, the Rock Island should not be relieved of making settlement for the incorrect charges because of any subsequent laxity in handling the correspondence.

The Arbitration Committee in its decision stated that: "Rule 91 does not provide a time limit for further correspondence based on original exceptions. Therefore, the Chicago, Rock Island & Pacific should handle these exceptions to proper conclusion. It is important that all such correspondence be handled without delay."—*Case No. 1249, New York Central vs. Chicago, Rock Island & Pacific.*

What Constitutes Acceptance of Cars under Interchange Rules?

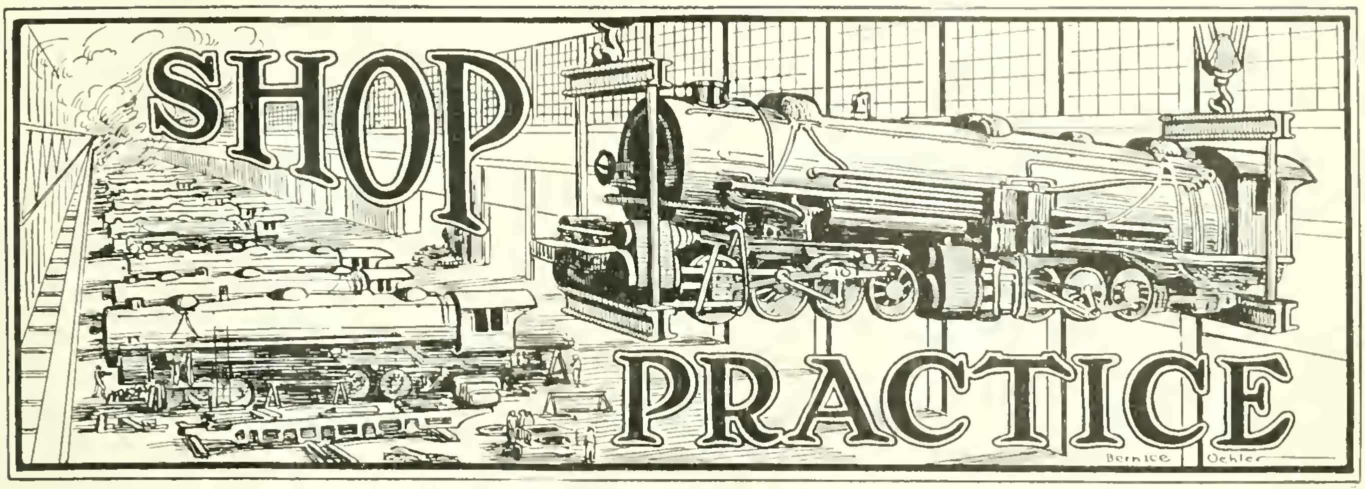
On the morning of August 12, 1921, the Atchison, Topeka & Santa Fe, acting for the St. Louis-San Francisco, placed Wabash car No. 20210, loaded with cotton, on the interchange tracks at Dallas, Tex., to be delivered to the Missouri, Kansas & Texas. At 7.15 a. m. the car was inspected by an inspector for the Dallas Car Interchange Bureau, and no exceptions taken to its condition. The interchange report covering the movement of this car from the St. Louis-San Francisco to the Missouri, Kansas & Texas was signed by B. A. Waldo, interchange inspector and showed the car to have been delivered at 7.15 a. m. At about 11.00 a. m. the car was damaged by fire. Later in the day the waybill was offered to the Missouri, Kansas & Texas, but its agent refused to accept it. The chief interchange inspector ruled that, inasmuch as the waybill had not accompanied or preceded the car, in accordance with car service rules it was still in the possession of the St. Louis-San Francisco railway. On August 31, an interchange report was made showing car delivered back to the St. Louis-San Francisco at 4.00 p. m., August 12. This report carried the notation, "Please add to interchange of August 12, 1921." The St. Louis-San Francisco claims that inasmuch as the car had been accepted and the interchange signed by duly authorized representatives, the delivery of the car had been made and the M. K. & T. was responsible.

The Arbitration Committee decided the case as follows: "The acceptance of cars under the interchange rules is not predicated upon the delivery of waybills to receiving line. Car was inspected on the designated interchange by the inspector of the receiving line and no exceptions taken to its condition. Under the interchange rules, the car was at time of fire in possession of the receiving line. The receiving line is responsible for the damage to the car."—*Case No.* 1254, *St. Louis-San Francisco vs. Missouri, Kansas & Texas.*

Intent of Rule 60 Where Broken Parts of Triple Valve Are Renewed

A K-1 triple valve was removed from Grand Trunk car No. 11411 by the Central Vermont and a new K-1 triple was applied and the owner charged for broken parts in the triple removed. The brakes were not cleaned at the time because they had been cleaned only a short time before. Exception was taken by the owner to the charge of $2.21 made for this material. The Central Vermont contended that the interpretation after Rule 60 does not prohibit this charge as it does not seem that the rule would make it compulsory needlessly to clean brakes and bill the owners for this work. The Grand Trunk claimed that the rules provide no charge for repairs to a triple valve other than mentioned in Item 29, Rule 111, which is based on cleaning of both triple valve and cylinder and failure to comply with the full requirements of this rule would prohibit the rendering of any bill.

The Arbitration Committee decided as follows: "It is the intent of Rule 60 that charges for repairing triple valve or brake cylinder is permissible only when regular annual repairs are made in accordance with the standard practice of the association. The charge should be withdrawn."—*Case No.* 1253, *Central Vermont vs. Grand Trunk, Western Lines.*



Locomotive Scheduling at the Silvis Shops

Part 2

New System of Locomotive Scheduling Now Being Installed at the Silvis Shops of the C. R. I. & P.

By L. C. Bowes[*] G. E. Sandstrom[†], and H. K. Robinson[‡]

HAVING in mind the three basic divisions, as explained in the July issue, it is desired in this article to bring out more in detail the complete cycle of centralized control of the activities in the back shop.

Organization for Centralized Production Control

Under the plan of organization existent in railroad back shops for many years, each department head was burdened with an entire set of activities which consisted of planning, ordering material, scheduling inspection and processing. Under such a plan of organization it is obvious that great difficulty is experienced in co-relating the separate activities of the various departments to provide for the most efficient sequence of both major and detail operations providing for a continuous and uniform flow of production. By careful and unbiased analysis it has been fully demonstrated that it is most unreasonable to expect one department to visualize the current or probable activities of all other inter-related departments.

It was also found that by reason of each department being burdened with the responsibility of all activities, there resulted a considerable overlapping of the two great divisions of any organization, *i.e.* functions (planning, ordering, and routing material, scheduling and dispatching of work, processing and inspection) and routine (that organizational machinery for carrying on these functions).

Therefore, the thought presents itself of the possibility of visualizing and providing for complete production control in the most efficient and effective manner. As a result, the plan adopted is one based on the proper grouping of unit activities under several centralized organizations. It may be well at this time to state that, in addition to the advantages gained through centralized control over production in the potential increase of output, there is the additional and very vital advantage of securing and controlling accurate cost data and operating statistics, which necessitated the need of a cost accounting division, the functions and routine of which will be fully described in a later article in this series.

In sequence of their relative importance and performance, we have the following major divisions: 1 Production, 2 Processing, 3 Inspection, 4 Plant, 5 Personnel, 6 Cost Accounting.

These are all separate and distinct divisions with complete authority within themselves, each reporting directly to the administrative office of the shop.

Function of Production, Processing and Inspection

The following is a brief description of the functions of the various divisions as outlined.

1—*Production Division*: The three main departments of this division, together with their respective functions, are:

A—Technical

Operation and material analysis
Time studies
Wage payments
Capacity
Operating statistics
Shop layout
Equipment analysis
Tool record
Equipment record

B—Schedule

Schedule
Routing
Dispatch
Material requisitions
Production cards
Time checkers and dispatchers
Material delivery
Trucking

C—Material

Analysis of
  Future schedule
  Locomotive Work Report
  Inspection reports

Record of:
  Order
  Reserve
  Disburse

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[†] Industrial Engineer, Roberts-Pettijohn-Wood Corporation.
[‡] Special Accountant, C. R. I. & P.

2—*Processing Division*: This division includes all shop departments, as follows:

Tool department
Forge shop
Machine shop
Boiler shop
Electrical department
Stripping and erecting department

and functions only as to the responsibilities of actually performing the work as reflected on the schedules created by Production Division. This responsibility is a very important one, each general foreman and his aides being held strictly accountable for discipline in their respective departments, watching closely methods and proper training of the workmen, co-operating continuously with the Production Division in order that schedule dates be maintained. Also they are held strictly accountable to the Inspection Division for accuracy of production.

3—*Inspection Division*: The three main departments of this division, together with their respective functions, are:

A—Receiving

Locomotives
Back shop
Material

B—Processing

Material and operations in process
Locomotives in back shop

C—Finish

Locomotives in back shop
Material and operations

4—*Plant Division*: The functions of this division are:

A—Power house
  Boiler room
  Engine room
  Maintenance
B—Maintenance
  Millwright
  Electrician
C—Watch service

5—*Personnel Division*: The functions of this division are:

Employment records
Emergency and first aid
Welfare and safety first

6—*Cost Accounting*: As stated before, the functions and routine of this division will appear in a later article.

Based on the foregoing functions and by reason of intense and centralized routine, as outlined in the following, it may be well to state that the ultimate goal of this endeavor is to demonstrate the possibility of doubling the output of locomotives in the back shop, with no appreciable increase in man-hours.

Routine of Production, Processing and Inspection

The proper basis for starting the consideration of the routine of production control is with the origination of the locomotive work report. This pre-supposes complete and definite analysis and the reporting thereof of all necessary work to be performed on the locomotive assigned to the shop, as lies within the capabilities of enginehouse and line organization, and such defects as may be revealed by effective enginehouse and line inspection.

The completeness of this locomotive work report is most vital in that it serves a double purpose, first, that of providing prior data upon which to schedule the purchase of material; second, that of providing prior data for scheduling the locomotive in its proper course of overhauling in the back shop in its relation to the other activities, thereby providing a very definite means of maintaining the maximum in balance loading of all production facilities.

In addition to the necessity for completeness and accuracy of the locomotive work report, it was found necessary and possible to have these reports in the office of the superintendent of motive power at the same time that shopping lists are received from the line, which is at least 45 days in advance of the month in which the locomotives in question are scheduled for shopping. At the time the superintendent of motive power assigns these engines to the respective shops, the locomotive work report is released with the assignment. Too much stress cannot be laid upon the effective routine of the handling of this locomotive work report.

When this locomotive work report is received at the shop, it passes immediately into the Material Department of the Production Division, where it is carefully analyzed as to itself and its relation to the material schedule in general. When the data on this locomotive work report, by reason of its analysis, has found its proper place in the material schedule, authority is given the Store Department to provide for necessary material, as regards quantity and time requirements.

In conjunction with the analysis by the Material Department, the Schedule Department also analyzes the locomotive work report, and by considering the material schedule and the work schedule as reflected on the Master Schedule Board, assigns the locomotive in question to its proper place on the Master Schedule. The important point to be brought out in this connection is that all of the above routine is carried on prior to the actual arrival of the locomotive at the shop.

Before even attempting to schedule, and the consequent processing and inspection, it is imperative that there be complete, detailed and accurate technical data—originated and established by the Technical Department of the Production Division. This technical data incorporates the basic and most vital operating analysis which is the back bone of all shop activities.

Contrary to the general supposition heretofore that the secret of economical increase in production was the perfection of mechanical details of operation, it was found that the real controlling factor was the analysis and possible perfection of these activities reflected in—

1—Shop layout
2—Shop capacities (vs. desired output)
3—Operation analysis

  a—Times
  b—Compensation
  c—Sequence of operations
  d—Routing of parts
  e—Man-hour analysis
  f—Unit operations
  g—Tool analysis

4—Equipment analysis and record
5—Tool record
6—Material delivery system
7—Processing analysis
8—Operating statistics

which is the responsibility of the Technical Department of the Production Division. Having this information available in record form, it is now possible to proceed with an effective and production schedule.

When the locomotive is actually received at the shop, the Receiving Department of the Inspection Division, makes their inspection of the locomotive, immediately rendering a report jointly to Material and Schedule Departments of the Production Division, who then make the necessary analysis with respect to material and work schedules.

Referring to the former article in the July issue, it will be noted that supporting the master schedule boards, there are the necessary sectional or departmental boards located at proper points in the shop. With particular reference to dispatch booths, the dispatch boards therein, and booth dispatchers, these men are now ready to originate production or work order cards based on the aforementioned sectional or departmental schedule boards. They will also be in a position to originate the material requisitions calling for delivery of necessary material from the store house to the proper point in the shop at the proper time. All cards, both production and material, are originated at least a day in advance of the schedule needs.

The point of actual production is now arrived at and the workmen will present themselves at their respective booths, call their production center number and receive from the booth dispatcher their production cards. The dispatcher, before releasing these cards to the workmen, will enter the "Start Time" and will supply the workmen with all necessary blue prints, specifications and standard practices to enable them to complete the work without delay. The workmen, before leaving the dispatch booth, will surrender the card for the work they have completed, together with the blue prints, specifications and standard practices for the work they have performed. The dispatcher will then stamp "Stop Time" on the cards surrendered.

The dispatcher will also check with the Process Department of the Inspection Division and enter on cards the quantities produced by the workmen.

The general foremen and their aides will refer continuously to the sectional or departmental boards in their departments and also the dispatch boards—as the very important responsibility of performance now lies with them—in order that schedule dates may be met in all cases. They also work in conjunction with, and are responsible to the Processing Department of the Inspection Division. When operations on locomotives have been completed the work will be inspected by the Finish Department of the Inspection Division, whose responsibility will be the transfer to the transportation department of 100 per cent locomotives.

[The forthcoming article will deal with details regarding the organization, functions and routine provided for the Cost Accounting Division. There will also be discussions on the performance resulting from this endeavor.—Editor.]

Standardization of Locomotive Repair Parts*

Part 2

Manufacturing and Fitting Standard Knuckle, Crank and Crosshead Pins Requiring Frequent Renewal

By M. H. Williams

KNUCKLE pins and bushings are readily standardized similar to the smaller valve motion parts as previously explained. Therefore, when describing side rod parts there will from necessity be a certain amount of repetition of what has previously been stated.

Knuckle Pins

Fig. 11 illustrates a side rod knuckle pin of a design common to the majority of railroads. Step sizes are readily set for these pins, the magnitude of which is largely governed by the taper per foot of the two taper ends and the length of the body *A*. It is advisable as a general proposition to make the steps as great as these limiting conditions will admit. Assuming that the body *A* is 2 in. long, the steps for body diameter can be as follows:

Taper per foot	Steps
¾ in.	0.125 in.
1 in.	0.150 in.
1¼ in.	0.200 in.
1½ in.	0.250 in.

Step sizes for any length of body or taper are arrived at by dividing the taper per foot by 12 which gives the taper per inch and multiplying this product by the length of the body.

Having determined the diameters, the sizes for the taper ends *B* and *C* are readily calculated from the taper per inch *i.e.*, assuming that the body of the pin shown in Fig. 11 is 4 in. in diameter and 2 in. long and that each taper end is 1 in. long, the length from the right hand end of the body to the large end is therefore 3 in., which multipled by 0.083 in. (the taper per inch for 1 in. per foot taper) equals 0.249 or practically ¼ in., which is the amount the large end of pin should be blanked out greater in diameter than the body or, in this case, the large end will be 4¼ in. The larger end of the small taper *C* is preferably the same diameter as the body or, in this case, 4 in.

It is advisable to set the largest step size for any particular pin same as the maximum allowable reaming or forging sizes of the side rods. As an example: For rods where ⅜ in. enlargement of holes is permissible, the step sizes for nominal 4 in. diameter and 2 in. long body pins are shown in Table 3. Similar tables are readily made up for any diameter or length of pins.

Table 3

Step Sizes for Bodies or Bearing Surface of Side Rod Knuckle Pins with Bodies 2 in. Long

Taper per foot	Standard or First step size	Second step size	Third step size	Fourth step size
¾ in.	3.988 in.	4.113 in.	4.238 in.	4.363 in.
1 in.	3.988 in	4.138 in.	4.288 in.	4.363 in
1¼ in.	3.988 in.	4.188 in.	4.363 in.	4.363 in.
1½ in.	3.988 in.	4.238 in.	4.363 in.	4.363 in.

Note—The sizes shown above are 0.012 in. smaller than the recommended bore of accompanying bushings.

In a shop where knuckle pins are kept in stock to step sizes as explained above, one of the sizes may be selected from stock and the taper ends ground to fit any size of taper hole in rods coming between the standard or new rod sizes and the maximum allowable.

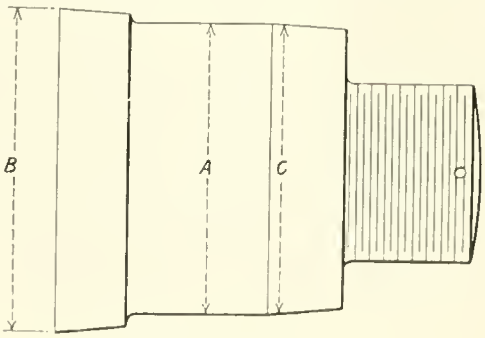

Fig. 11—Representative Side Rod Knuckle Pin

These pins, when made in the central production shop, should preferably be blanked out, holes for cotters or taper pins drilled, keyways milled, threaded, stamped showing catalog numbers, casehardened, body ground to size and placed in stock, following the same general plan as previously explained for valve motion pins.

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*This is the second of a series of articles, the first of which appeared in the June issue of the *Railway Mechanical Engineer*, describing the methods that have successfully been adopted on one of the large railroad systems and which have expedited locomotive maintenance work and reduced the cost.

Knuckle Pin Bushings

Having determined the step sizes for side rod knuckle pins, setting the sizes for the accompanying bushings becomes a simple matter. The size of the bore can to good advantage be the nominal size, such as 4 in., 4¼ in., etc., with 0.012 in. larger than the pin body, the difference of 0.012 in. to allow for compression of the bushing when pressing into the rod and also for a running fit between the pin and the bushing.

The outside diameter of the first step size which is used with pins having standard bodies should as a general proposition, be about ¼ in. larger than the standard for new rods, the diameter of the remaining sizes increasing with the bore, *i.e.*, the walls all of the same thickness. Actual experience has shown this to be a happy medium for meeting conditions of repair work.

These bushings are readily made from forgings or seamless steel tubing on automatic chucking machines or turret lathes, it being the custom in the case of forgings, to bore and ream about 0.010 in. small, face ends and rough turn the outside. When tubing is used the work is reduced to that of facing the ends and reaming.

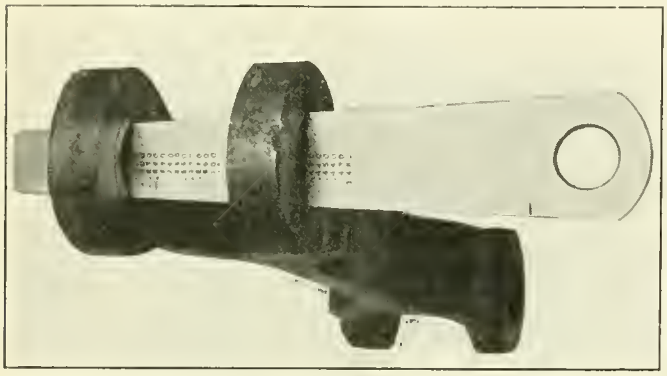


Fig. 8—Gage for Measuring Taper Holes and Checking Their Accuracy

After completion of the work on these machines, the oil holes are drilled, oil ways milled, stamped with catalog numbers, selective casehardened as explained later on, bore ground to sizes called for within a limit of plus or minus 0.001 in. and placed in stock.

Case Hardening, Selective

The requirements on a number of roads call for these bushings to be casehardened. In order to meet this condition and also admit of quick machining at the time of repairs, they are selective casehardened as follows. Five or six, or as many bushings as the casehardening boxes will accommodate are placed end to end forming a tube. They are held together during the casehardening operation by a central bolt and two end plates, the inside being filled with a casehardening compound while the vacant spaces in the box between the bushings is filled with burned foundry sand. As the gas from the casehardening compound comes only in contact with the bore of the bushings, this is the only surface hardened.

Grinding the Bore and Fitting to Rod

The bores of the bushings are ground on the same production internal grinding machines as the valve motion bushings, each piece being inspected with a plug limit gage. This method of internal grinding and inspecting insures a true cylindrical bore, which is desirable in order to form a satisfactory bearing on the knuckle pins.

In shops where side rod knuckle pin bushings are manufactured as explained, the work of fitting to the rods in repair shops is reduced to that of turning the outsides to the proper diameter and forcing into place. The usual practice is to measure the diameter of the rod bore with inside micrometers, place a bushing on arbor, turn or grind about 0.006 in. larger than the rod hole and force into place, the bushing being measured with outside micrometers. It is advisable to fit bushings to rods previous to fitting pins as explained in connection with fitting companion pins.

Fitting Knuckle Pins to Side Rods

The taper ends of side rod knuckle pins are preferably fitted to the side rods by grinding, similar to valve motion lever pins. One very good practice is as follows: The taper holes in the side rods are reamed sufficiently to remove all irregularities and true up, but without reference to sizes. When ready to fit the pin, the diameter of the taper holes in the rod is measured with a flat taper gage of the same general design as that shown in Fig. 8, made of suitable size and taper for rods of each particular class of locomotive. The size of the taper hole is read from the gage at the inside of the clevis as shown in Fig. 8. The pins are then ground following the same general practices as far as sizing and machine setting as described in connection with valve motion levers.

The pins are driven when grinding by a carrier pin projecting from the head stock face plate or by a treaded carrier similar to that shown in Fig. 9. The time taken when fitting taper ends of pins ranges from 6 to 10 min., largely governed by the time taken in going to and from the rods for the purpose of taking measurements.

Where the diameters of pin bodies are large, say 4 in. or greater or walls of bushings are comparatively thin, it at times happens that the compression of the bushing bore can not be controlled and as a result the bore of bushing which has been ground at the time of manufacturing to exact plug sizes will not be of a uniform diameter after forcing into the rod. In order to correct errors of this nature, the pins are tried in the bushing and if not of a proper fit the pin body is ground to the correct size.

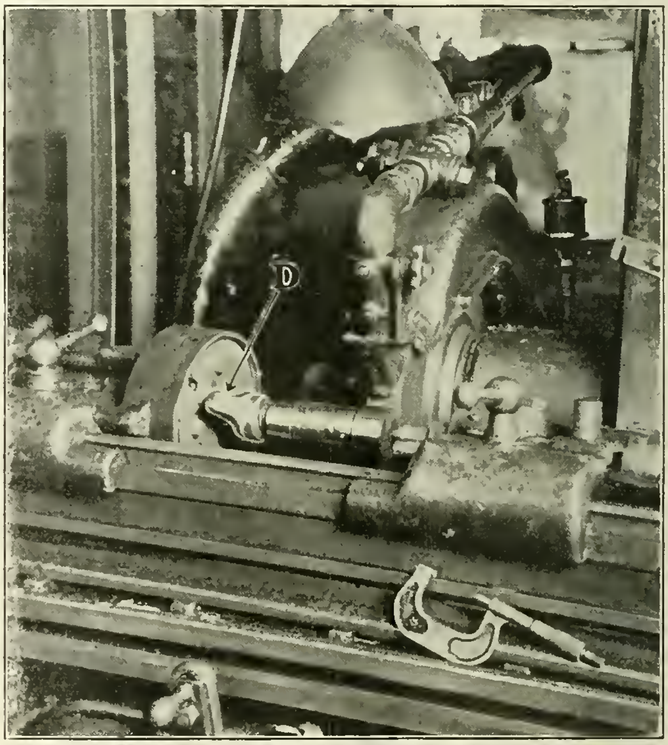


Fig. 9—Close-up View Showing How Taper End Bearings Are Ground

When reaming taper holes in side rods, there is always the possibility of the top clevis springing owing to downward pressure applied when reaming, this being particularly noticeable with dull reamers. Errors in reaming are shown up when the taper gage is tried in the holes, defective reaming being at once detected which has the effect of toning up the general grade of this work. Objections have been raised in certain shops to the frequent use in side rods of the conventional forms of cylindrical taper gages owing to the time required to thoroughly clean the hole, chalk mark gage, apply and examine the chalk marks in order to ascertain if holes were of the same taper as gage, a small amount of dirt or chips affecting the results. With the flat gage it is not necessary to clean the holes with great care, the usual practice being to rub the hole once around with waste, place gage in hole, give it about ⅛ turn which centers it. The gage is then tried for side shake at top and bottom. If there be an absence of shake at both ends, this is an indication that rod has been correctly reamed. Should the lower end admit of side shake, this indicates that lower member of clevis has been reamed too large in reference to the upper member.

Crosshead Pins

Crosshead pins are the same general design as side rod knuckle pins only differing in sizes, for which step sizes are readily set governing the body and taper ends.

In some shops, when making class repairs to the main rods, it is customary either to renew the front brasses or to close them by filling the abutting ends. In either event the brasses are, as a general proposition, bored to standard or drawing sizes. When this practice can be followed, the pin bodies are ground to standard sizes, likewise the brasses are bored to standard sizes. As a result the pins and brasses are interchangeable, each being a suitable size for a running fit with the other. This practice can be followed when new pins and brasses are used. However, conditions arise where the taper holes for pins in crossheads have been enlarged to a size where the smaller of the two taper holes is as large as the standard pin body. Where this condition is encountered it becomes necessary, in order not to scrap the crosshead, to make use of pins having bodies larger than standard, or resort to the questionable practice of bushing, or autogenous welding of the pin holes.

Another condition is met where crosshead pin bodies have been worn from service and they are trued up on the bearing surfaces and continued in use, the brasses being bored to a suitable diameter for a running fit on the pin. In some cases pins removed from crossheads are worn on the taper ends. These are laid aside and used in crossheads having smaller holes.

It would be difficult to lay down rules to govern crosshead pin sizes. As a general proposition,, when manufacturing for repair work, it is advisable to make the body diameter to standard sizes, the smaller taper the same as the body diameter and the large taper a continuation of the taper per foot carried from the body size, similar to valve motion and knuckle pins as shown in Fig. 1. Step sizes from a shop standpoint may be about ¼ in. larger and if permissible a larger step size, providing the design of the rod brass will admit of the necessary enlargement. These sizes must be determined for each design of crosshead.

The bodies should be ground to the diameters called for with a limit of 0.001 in. plus or minus, the taper ends rough turned, drilled, threaded, centered and key ways milled, in fact completed except machining the taper ends.

The taper holes for pins in crossheads, as a general proposition at times of repairing, are reamed in order to true them up and remove the effects of wear. The diameter of taper holes are readily measured with flat taper gages.

When turning or grinding taper ends, the same general plan of sizing can be followed as explained in connection with side rod knuckle pins.

Supplying repair shops with crosshead pins completed in all respects excepting the two taper ends reduces the time of applying to that of machining the taper surfaces, which is readily done on 12 in. by 36 in. plain cylindrical grinding machines.

Where the bodies are finished to close limits at the time of manufacture, the rod brasses are readily bored to plug gage sizes with the assurance that they will fit the pin. This insures satisfactory fitting, and in addition reduces the time required for boring the brasses.

Pins removed from crossheads which have worn or cut bodies are economically refinished on grinding machines used for taper ends, a good practice being to true the surfaces, measure with micrometers and make a memorandum of sizes. When boring brasses, the diameter is bored to micrometer sizes agreeing with the memorandum. The use of micrometers has the effect of improving the grade of fitting and the sizes shown on the memorandum become a record in event of mistakes.

Crank Pins

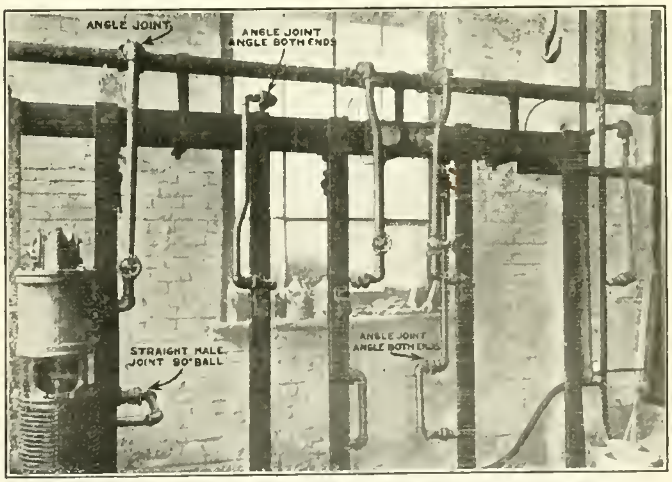
Crank pins are blanked out on center lathes or large turret lathes, a good practice being to rough machine the ends fitting the wheel center approximately ¼ in. larger than standard, the part fitting rod brasses being turned about 0.020 in. large, collars faced, etc. The bearing surfaces are then ground to standard sizes to a limit of 0.002 in. plus or minus.

In the repair shop, it is only necessary to measure the diameter of the hole in the wheel center, which is preferably done with inside micrometers, and turn the pin about 0.010 in. larger and force into place. This reduces the repair shop work to a minimum.

(To be continued)

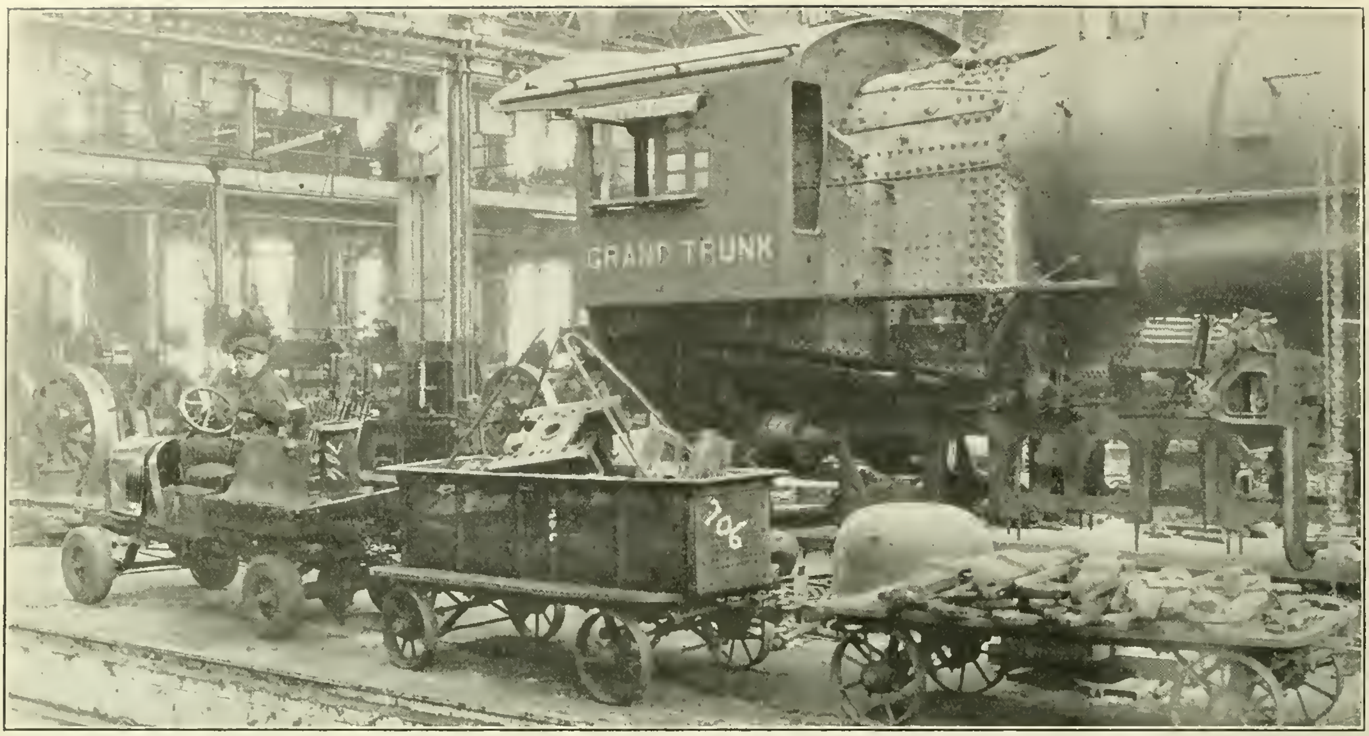
Convenient Air Pump Test Rack

To facilitate the connecting and disconnecting of the steam and air pipes when locomotive air compressors are set up for testing, the test rack shown in the illustration has been installed at the Jackson, Mich., shops of the Michigan Central. All pipes leading from the mains to the pump are fitted with Barco joints so that they possess complete flexibility. In setting up a pump for testing, no changes or adjustments in the piping are necessary other than attaching the nipples to the pump and connecting the unions on the ends of the flexible leads.


ANGLE JOINT
ANGLE JOINT ANGLE BOTH ENDS
STRAIGHT MALE JOINT 90° BALL
ANGLE JOINT ANGLE BOTH ENDS

Air Pump Test Rack With Flexible Pipe Connections

The construction of the rack is clearly shown in the illustration. The vertical members are spaced to fit the various sizes of pumps coming into the shops for repairs. Stirrups are bolted to the uprights, and in these the pump lugs are supported. Bolts are inserted through the top lugs to prevent movement of the pump while under test. An air hoist is provided for handling the pumps on the repair bench and to and from the test rack.



This 1-Ton Ford Truck Cut Down Proves a Flexible Power Unit for Hauling Loaded Trailers

Erecting Shop Practice at Battle Creek[*]

Many Efficient Devices and Methods Facilitate Erecting Work at Grand Trunk Locomotive Shops

By M. H. Westbrook
Shop Superintendent, Grand Trunk, Battle Creek, Mich.

THE suggestion that erecting shop foremen "wake up" and tell each other about labor-saving methods is rather timely for, as a class, these men say little for publication. This may be on account of excessive modesty or possibly because they are usually a very busy class of men. The following is a description of the manner in which erecting shop work is handled at the Battle Creek shops of the Grand Trunk.

For the purpose of making comparisons month by month with the corresponding periods of the previous year, there has been worked out a system whereby each week's output can accurately be gaged and indicated on what is known as the output meter, as shown in Fig. 1. The relative value of a Class 6, 5, 4, 3, 2, or 1 repair, using the U.S.R.A. system of classification, is designated by points. Thus for a Class 6 repair, one point is allowed; a Class 5, twelve points; Class 4, eighteen points; Class 3, thirty points; Class 2, forty points, and Class 1, fifty-two points. These relative values were carefully worked out by calculation of the output of two years and take into consideration labor costs only. Thus it has been found that the average labor costs of a Class 3 repair is thirty times that of an average number of Class 6 repairs. This, of course, would vary with local conditions should any other railroad shop organization wish to introduce this method.

The calculations, which are the actual figures used for the months of January, 1921 and 1922, in computing the units of effort for the two periods mentioned, were made as follows:

RESULTS FOR THE MONTH OF JANUARY

	1921	1922
Engines out	20	9
Points made	381	206
Number of men	513	543
Shop-hours	164	72
Man-hours	84,132	39,186
Man-hours per point	221	190
Monthly percentage:		
Gain	...	14 per cent
Loss	...	...
Yearly percentage	...	...

ENGINES TURNED OUT BY CLASSES

Class	1921	1922
1	...	...
2	...	1
3	10	5
4	5	1
5	2	...
6	3	2
Total	20	9

From the table it will be seen that although twenty engines were turned out in January, 1921, and but nine in the same month of 1922, still the man-hours to produce a point were 190 compared with 221 for the corresponding period, or a gain of 14 per cent. The columns to the right of the meter are used to total the gains or losses, month by month, until the end of the year. All figures for the corresponding periods are on red cards while those for the current period are on white ones, which are slipped into the frames after being stamped as shown on the drawing.

This method keeps all foremen and men thoroughly conversant with any fluctuations in the amount of work performed, making it a simple matter to locate causes of fluctuations. This system is a much more accurate measure of what is actually being accomplished in the erecting shop than the old-time method of comparison of total engines turned out, with its attendant grounds for arguments and excuses.

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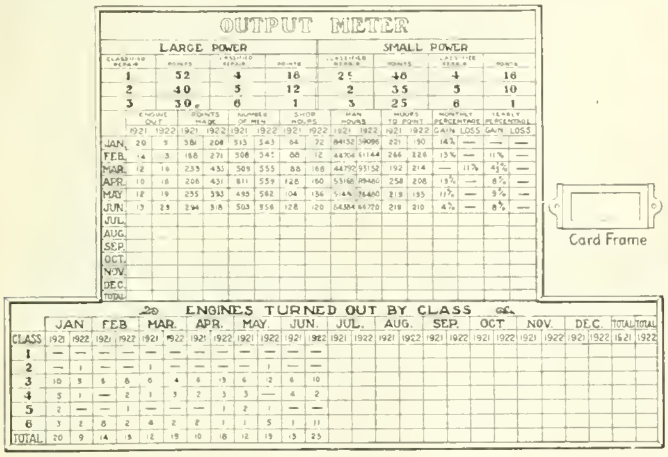
[*] Awarded the first prize in the Erecting Shop competition.

The shop referred to has 22 pits served by one incoming and one outgoing track. Engines are all inspected and stripped on the pit at the end of incoming track. The boiler, erecting and machine foremen are present at the inspection, each one having a copy of the report previously sent in by the road master mechanic, for the purpose of insuring that the necessary castings, etc., are on hand in due time.

Trailer System for Handling Material

All parts removed are marked—the smaller pieces being placed in heavy wire baskets—loaded on trailer trucks and sent to a cleaning vat just outside the shop where they are handled by a crane and pneumatic hoist. Driving wheels are put in a cleaning vat located in the wheel department by a 10-ton traveling crane. From the vats mentioned, material is distributed to the various departments, such as motion, rod, wheel, air brake, etc., which are in charge of foremen responsible for the work. A 1-ton Ford truck which has been cut down and shortened so that it can be run freely to any part of the shop is used for such distribution. Two floor lines are marked throughout the whole shop, no material of any kind being permitted to be placed between them, thus insuring a clear right of way to any shop or department. The introduction of this truck, which is shown in the leading illustration, does away with several laborers and provides prompt service.


OUTPUT METER

LARGE POWER				SMALL POWER			
CLASSIFIED REPAIR	POINTS	CLASSIFIED REPAIR	POINTS	CLASSIFIED REPAIR	POINTS	CLASSIFIED REPAIR	POINTS
1	52	4	16	2	46	4	16
2	40	5	12	2	35	5	10
3	30	6	1	3	25	6	1

	ENGINE OUT		POINTS MADE		NUMBER OF MEN		SHOP HOURS		MAN HOURS		HOURS TO POINT		MONTHLY PERCENTAGE		YEARLY PERCENTAGE	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	GAIN	LOSS	GAIN	LOSS
JAN.	20	9	381	208	313	543	64	72	84132	39096	221	190	14%	—	—	—
FEB.	14	3	168	271	308	542	88	12	44704	61144	266	226	13%	—	11%	—
MAR.	12	16	233	433	509	555	88	168	44792	93152	192	214	—	11%	4½%	—
APR.	10	16	206	431	811	559	128	160	53168	89480	258	208	19%	—	6%	—
MAY	12	19	235	393	495	562	104	136	5144	76400	219	195	11%	—	9%	—
JUN.	13	23	294	318	503	556	128	120	64384	64720	218	210	4%	—	8%	—
JUL.																
AUG.																
SEP.																
OCT.																
NOV.																
DEC.																
TOTAL																

ENGINES TURNED OUT BY CLASS

	JAN		FEB		MAR.		APR.		MAY.		JUN.		JUL.		AUG.		SEP.		OCT		NOV.		DEC.		TOTAL	TOTAL
CLASS	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
1	—	—	—	—	—	—	—	—	—	—	—	—														
2	—	1	—	—	1	—	—	—	—	1	—	—														
3	10	5	6	8	6	4	6	13	6	12	6	10														
4	5	1	—	2	1	3	2	3	3	—	4	2														
5	2	—	—	1	—	—	—	1	2	1	—	—														
6	3	2	8	2	4	2	2	1	1	5	1	11														
TOTAL	20	9	14	13	12	19	10	18	12	19	13	23														

Fig. 1—Output Meter Which Visualizes the Comparative Monthly Shop Productions

Small boxes are hung at convenient locations as a receptacle for trucking orders. The driver picks these orders up at regular intervals on making his rounds.

Boiler Work Limits Shop Schedule

After the internal inspection is completed, the engines are then listed for completion at a given date, usually governed by a boiler foreman's report. A schedule routing board (Fig. 2) adapted to suit local conditions but similar to those in general use, shows in white chalk figures the dates every essential part is to be completed and delivered to the pit to which the engine has been assigned. A blue chalk figure indicates the date completed, if on or before date requested. If late, red chalk is used. In addition to the complete master board kept in the erecting shop foreman's office, each department also has a board similar to the one shown in Fig. 3, showing the dates material must be delivered.

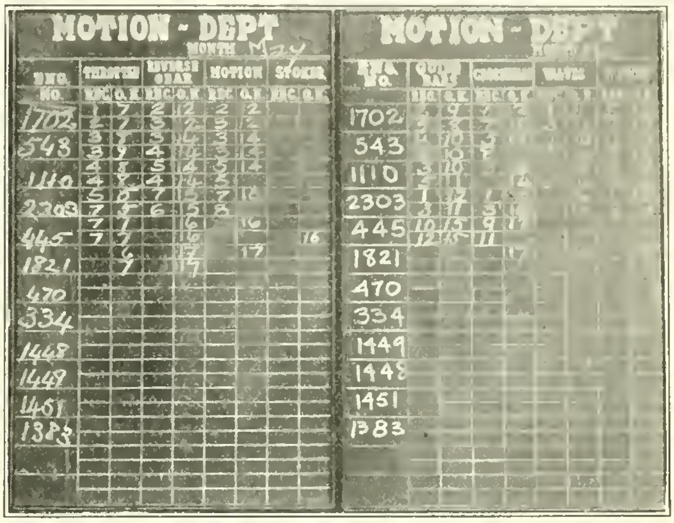


Fig. 3—Example of Typical Department Schedule Board

Foremen's Meetings a Consultation of Experts

Foremen's meetings are held three times a week, immediately after work ceases, and each delay is thoroughly discussed. Under the heading, "My Principal Trouble," each has an opportunity to explain delays in his department. These meetings are in no way, as is too often the case in some shops, arenas where hard feeling, enmity and discord are engendered between foremen or heads of departments, but the idea is successfully conveyed that each meeting is a consultation of experts called in to analyze a condition and offer suggestions for improving it, just as a body of medical men would be expected to discuss a difficult case when called upon.

This has resulted in developing an organization, any member of which in an emergency such as the enforced absence

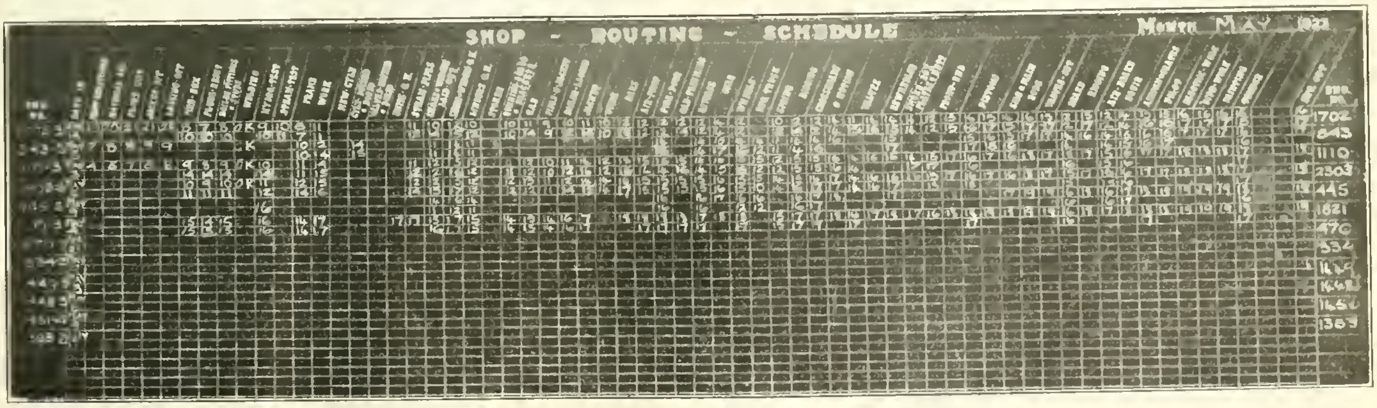


Fig. 2—Master Schedule Board—Dates Due Are Shown in White Chalk; Dates Completed in Blue Chalk, or Red If Late

of a department head, could take hold and temporarily, at least, carry that department along successfully. Thus the forge shop foreman becomes thoroughly familiar with all the troubles or joys of the boiler shop foreman. The boiler shop foreman appreciates that he is not the only one who has troubles, but is thoroughly familiar with, and can clearly see the erecting shop foreman's difficulties. The sheet metal foreman understands the paint shop foreman's troubles and thereby can and does aid in preventing them. All other foremen also are placed in a similar situation and willingly cooperate to prevent delays because each has heard the other's difficulties, handicaps, or successes thoroughly discussed at these meetings which are kept by the chairman from dragging out by limiting each speaker to three minutes in which to present his case and allowing no meeting to last over 45 minutes.

Labor-Saving Devices and Methods Used

In describing labor-saving devices and methods used to facilitate the work of the erecting shop, it is almost impossible to state these in any regular sequence or order; therefore, they will be presented just as they occur to the writer.

Taper Bolt System.—Taper bolts with a taper of 1/16 in. per ft. are used wherever possible, all being turned to fit holes made in standard master gage blocks (Fig. 4) and kept in the bolt department. The erecting shop is provided with several sets of complete taper gage plugs following each other in sizes from one to 48, Fig. 5 showing a set of plugs and the stand for holding them.

No more material is reamed than necessary to make a good hole. A taper plug is then put in and the distance it measures from one of several numbered grooves, struck around each plug about 3 in. apart, is noted and an order given for the required number of bolts. Thus an order on the machine shop might read as follows:

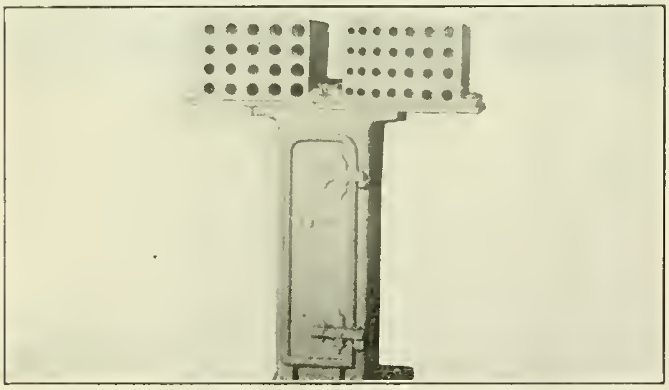


Fig. 4—Master Gage Blocks for Taper Bolts Kept in the Bolt Department

Supply: Six 8-in. bolts, No. 36, ¾ in. out
Four 8-in. bolts, No. 32, 1 in. out
Ten 9-in. bolts, No. 20

Bolts are then turned to fit the gage blocks at the lathe (the amount allowed for drive has been included in the order) in accordance with instructions. The No. 20 bolts go in to the head because the plug went to No. 20 line within driving distance.

By this method it is not necessary to have lathe hands go near the erecting shop to fit bolts. On new work, such as cylinder saddles, etc., all are reamed out to one size.

Reamers for Taper Bolts.—The best reamers found for this work have a left-hand spiral with but four flutes and are made from high-speed steel with flutes rolled, not milled, and twisted while hot. This makes a very free cutting, tough reamer having so much chip room that it never is necessary to remove one from the hole to clean out the chips which is sometimes done with other reamers. This shape of reamer alone is a great time-saver over any other style. The following is a report of some actual tests made, using an air motor to drive the reamers:

	Four-flute Spiral Reamer	Nine-flute Straight Reamer
	Not removed from hole until finished	Reamer removed frequently to remove chips
Number of holes	12	12
Diameter of holes	1¼ in.	1¼ in.
Length of holes	8 in.	8 in.
Time required for reaming	24 min.	54 min.

The cuttings from these reamers frequently curl up several inches, giving the appearance of having been made in a lathe which is an indication of the free-cutting quality of the tool.

The bolts are turned to the correct taper on specially designed lathes made in the shop, having the ways planed off the center line 1/32 in. per ft., which makes it a very positive and simple matter to turn them to the desired taper with no adjustment of taper attachments or setting over the tailstocks when bolts of varying lengths are to be turned.

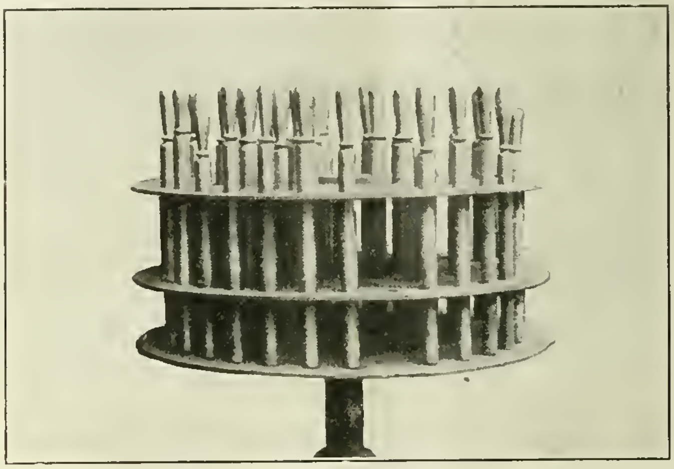


Fig. 5—One of Several Sets of Taper Gage Plugs Used in the Erecting Shop

Removal of Bolts.—Bolts are removed by driving a long tapered split steel wedge under the heads. A careful acetylene torch operator can, when necessary, burn a slight groove under the heads to allow the wedge points to enter. Broken bolts have to be removed by drilling when other methods fail.

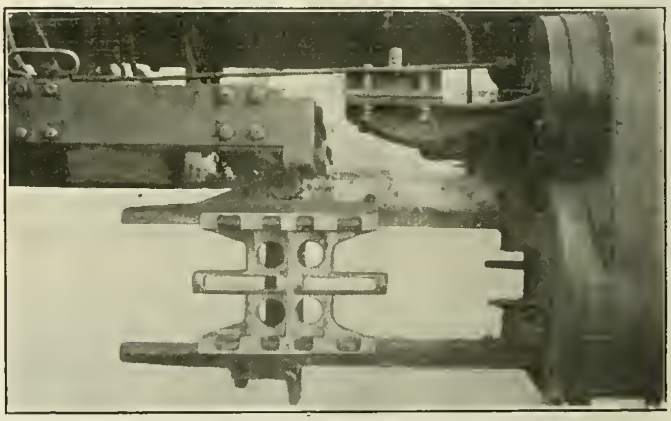


Fig. 6—Aluminum Dummy Crosshead for Lining Guide Bars

Lining Guide Bars.—Guide bars are lined in the usual manner by passing a line through the cylinder. After lining the bottom bar, a skeleton made of aluminum (Fig. 6), an exact counterpart of the regular crosshead, is used. This is placed on the bottom bar and, being very light, is easily handled. The top bar is then set upon this dummy and the lining up completed quickly and in a most accurate manner. When crossheads are received from the machine shop, it is absolutely certain they will, if properly planed, go into place.

The use of the aluminum dummy makes it extremely simple to set the bars to correct alinement.

Truck for Applying Crossheads.—The special elevating truck (Fig. 7) is used to place the crosshead in position. To do this with a crane requires considerable effort since the lifting cables must be pushed out of line under the obstructing parts above. With the truck a crosshead can be backed up to the guide bars, elevated by the screw to the correct height and slid into place by one man. The two end upright members shown are pipe guides for the purpose of keeping the lifting piece square with the guide bars.

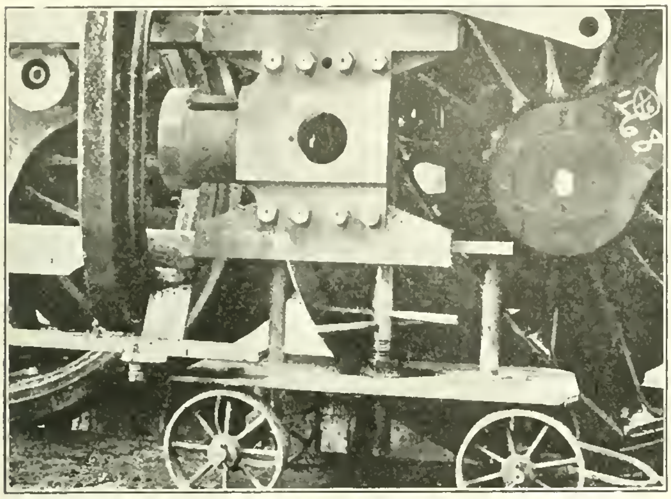


Fig. 7—Elevating Truck Assists in Applying Crosshead

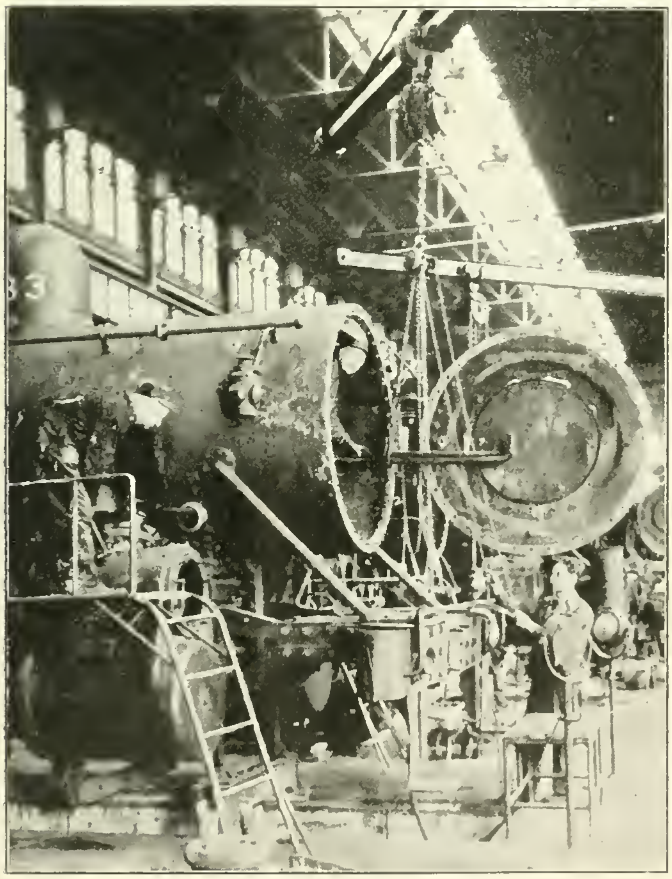


Fig. 8—Jib Crane with Double Hoist Being Used to Install Superheater Units

All guide bars are kept to a standard width by applying strips of cold rolled steel, 2¼ in. by ¼ in., to the sides, held in place by ⅜-in. copper plugs 1⅜ in. long and spaced 5 in. apart. A 5/16 in. steel ball is first dropped in each rivet hole, spreading the bottom of the plugs when the latter are driven in to fill the countersunk holes in the liners. This is cheaper than welding on liners and in several years none applied by this method have been known to loosen or give trouble.

Superheater Units.—Superheater units are removed and, unless broken, are repaired alongside the engine, our experience being that if they are not leaking when removed, the least work done upon them the better. They are cleaned with an air motor, using slotted disks of emery cloth, the slots preventing them from crumpling up when in use. They are used merely to clean up the joints both on the header and the unit, after which the units are tested by a small hydraulic pump and reapplied. Fig. 8 shows the method of lifting the units when replacing them.

Between every other pit is a jib crane equipped with a 2-ton chain hoist to relieve the overhead traveling cranes of much light lifting. When lifting light loads, the small ½-ton or ¼-ton high-speed chain hoists are hooked upon the larger ones. This appears to be a small item but it certainly counts up during the year when thousands of light lifts are made. The lifting tongs shown are also of interest.

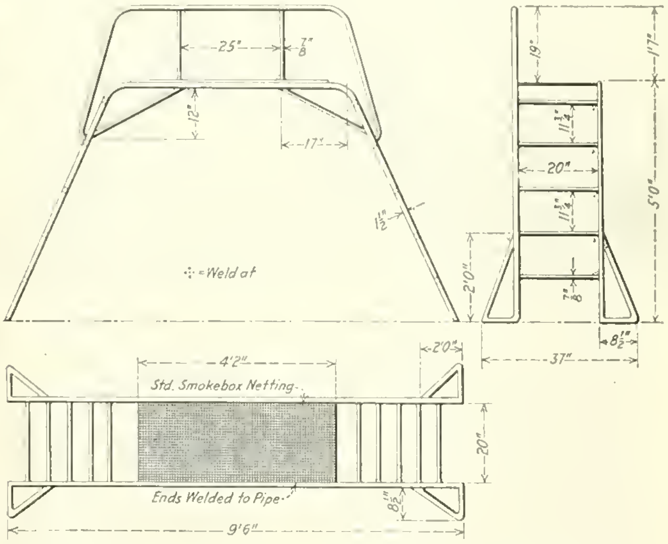


Fig. 9—Details of Convenient Platform Illustrated in Fig. 8

Platforms.—To avoid working on ladders or poorly-made platforms around the engines undergoing repairs, special platforms that can be easily handled by two men are made in the welding department from scrap pipe and old netting. These platforms are handy in many respects, especially for straddling the pits while working in cabs. The use of one of these platforms to facilitate working around a steam pipe joint on top of a cylinder is also illustrated in Fig. 8, details of the platform being shown in Fig. 9.

Portable Lighting Stands.—Portable electric light stands always are available and during dark days can be instantly lighted, it being impossible for men to work efficiently unless there is adequate lighting facilities around the pits. Two of these stands are shown in the foreground at the right of the pit in Fig. 8. Pits are also whitewashed every two weeks with a machine to improve the lighting, the whitewashing being made from used acetylene carbide.

Smokebox Doors.—Front end doors are equipped with patent hinges, as shown in Fig. 8, and the labor of removing the door and frame at each shopping is thereby saved. This is a great convenience as the disposition of these doors when removed is somewhat of a problem in an already crowded shop, to which any erecting shop foreman will agree.

Wheeling.—When valves are not to be set by the use of rollers, or when engines are equipped with Young valve gear, they are wheeled by the method shown in Fig. 10. Rods are placed on the wheels and binders are arranged in the position shown upon suitable jacks. The construction of the cross plates and screw jacks is clearly shown in the illustration. Turning the sleeves by means of a small bar raises the binders into place under the frame pedestals. A heavy engine can thus be wheeled completely with the least amount of laborious hand lifting in a very short time. Portable pneumatic hoists of the type illustrated in Fig. 11 are also used sometimes for applying binders. The cylinder in this case is made of brass and the jack can easily be handled by one man. All binders on an eight-wheel coupled engine can be tightened in place in less than one hour.

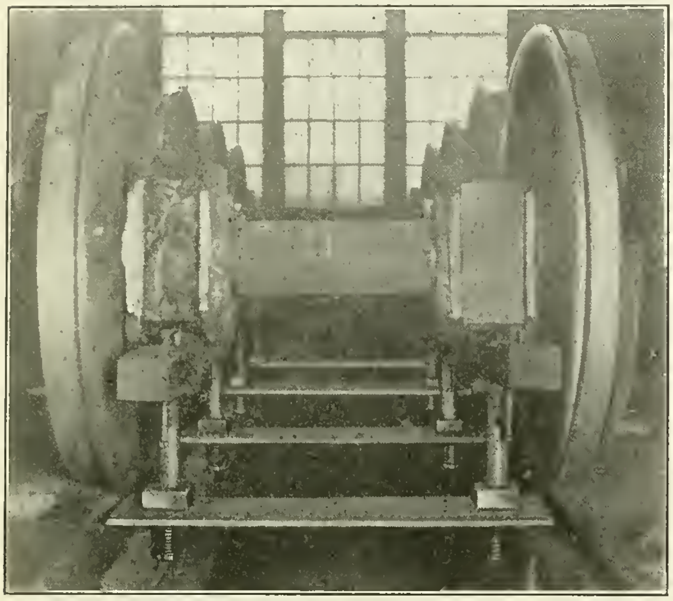


Fig. 10—Ready for Wheeling—Binders on Jacks and Rods on Wheels

When valves are set by the use of rollers, the main rods are always first applied and readings taken in every position.

Fig. 12 shows a special truck used when wheeling, it having two receptacles, the larger one containing sufficient 1½-in. nuts required for the engine being wheeled; the smaller one, holding the cotter keys to be used for the same purpose. This truck always remains in an upright position by gravity. Nuts and cotter keys are taken direct from the petty store by this truck to the wheeling pit as required.

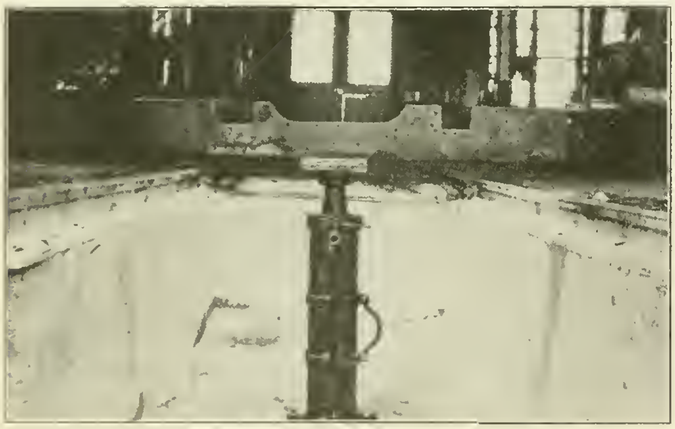


Fig. 11—Light Air Hoist for Lifting Binders

Removing Piston Valves.—Some piston valves prove difficult to remove, the device shown in Fig. 13 then being used. A Westinghouse 12-in. air brake cylinder has replaced the one shown, which was not large enough. A chain is passed around the arms of the spider, each end of which is caught on a special grab attached to the end of the piston rod, and as the valve moves outward, the chain is shortened to suit. The device is swung at its center of gravity from a jib crane and operated by air.

Spring Rigging Standardized.—All spring gear is standardized and jig-drilled and bushed. This was not done on some of the engines when built, the equalizers having to be plugged and redrilled at the first shopping. All bushings are made on a forging machine to the correct size inside. Machining the internal diameters is therefore eliminated. Bushings are then turned on a special eccentric arbor designed to turn them 1/16 in. thicker on the side that takes the weight. With the hard surface left by the plunger, this adds materially to the life of the bushing. After being turned, the bushings are case-hardened and stocked in large quantities. It is a question if this case-hardening is necessary.

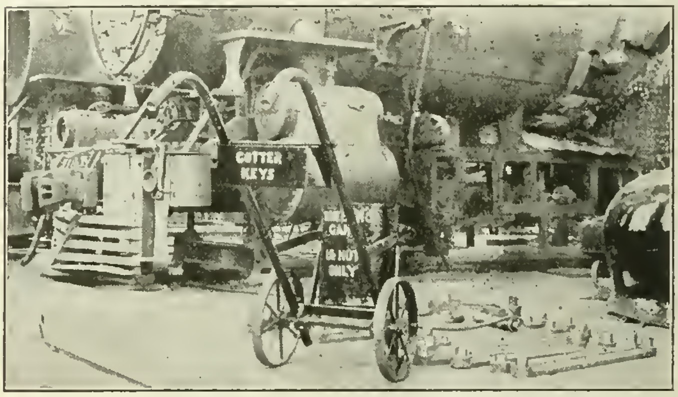


Fig. 12—Truck Containing Nuts and Cotter for the Wheeling Gang

Bushings over 3 in. in length are applied in two pieces, being more easily forged when short. An opening is left between them of 3/16 in. which does away with the necessity of drilling oil holes. The opening also acts as an oil cellar, insuring proper lubrication.

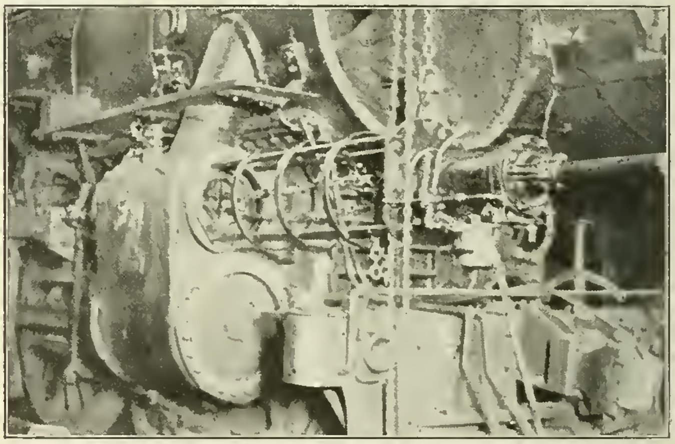


Fig. 13—Pneumatic Device for Pulling Piston Valves

When renewing spring rigging bushings it has been found that instead of transporting the equalizers to a press, a long-stroke air hammer fitted with special knockouts can quickly remove the old bushings. The new ones can then be applied immediately from stock. Frequently this work is carted a considerable distance to a machine shop where a regular press is used, but this use of an air hammer saves considerable time and labor by doing the work adjacent to where the parts are used. A set of spring hangers with bushings ready to apply and the long-stroke air hammer used for this purpose are shown on the floor at the right of the truck in Fig. 12.

Applying locomotive springs is usually an awkward operation without some such device as that shown in Fig. 14. This illustration shows plainly the use of the lifting rod in placing the spring in position, Fig. 15 giving details of construction.

Applying Cylinder Bushings.—All cylinder bushings also are applied in two lengths, being bored, turned and cut off at one setting on a vertical boring mill. Bushings can be completed in this manner in much less time than by the usual practice which is to bore them on a horizontal mill, then transferring them to a lathe, applying centers and finishing the outside diameter. This method usually distorts the inside bore through taking the rough scale from the outside after the bore is completed. Cylinder bushings are also much more difficult to apply when in one piece.

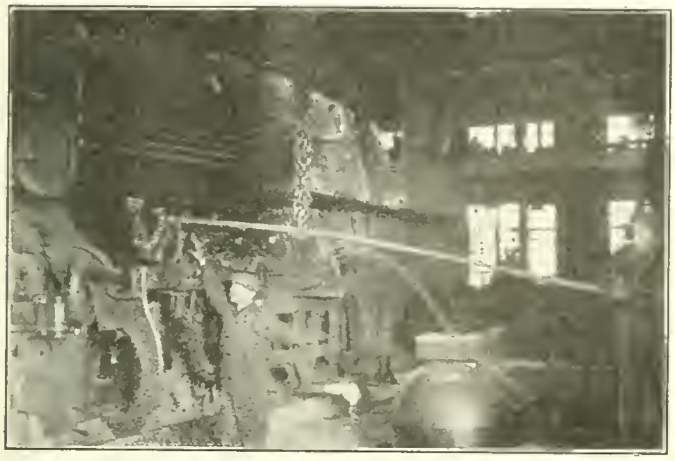


Fig. 14—Driving Springs Are Readily Placed in Position by This Method

In Grand Trunk practice the two short cylinder sections are left 1/8 in. below size in inside diameter and if no distortion takes place in applying, which is frequently the case, they are not rebored, the amount they have been left small adding to the life of the bushings and not materially affecting the capacity of the locomotive. Of course, great care must be exercised in seeing that both sections are bored exactly the same diameter.

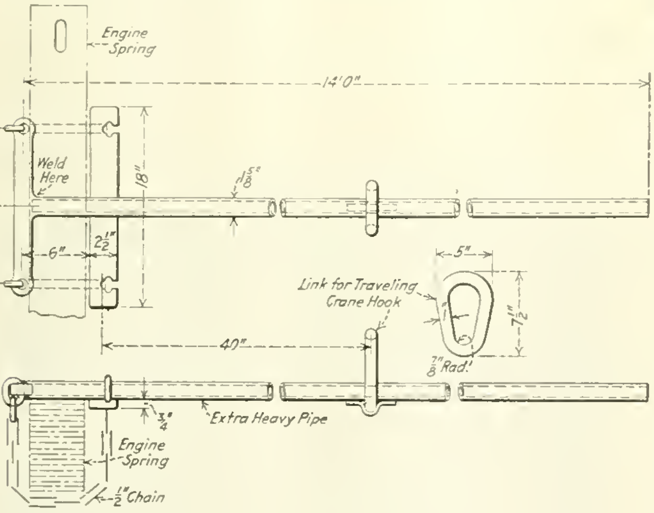


Fig. 15—Details of Device for Applying Driving Springs

In applying the bushings, the cylinder is first slightly heated by the burner made from a length of 3/4-in. pipe plugged at one end, having 1/16-in. holes drilled alternately along opposite sides and placed on the bottom of the cylinder. The open end is piped to a regular portable oil heater. The gases generated in the pipe, when lighted, envelope the walls of the cylinder, meeting at the top and quickly heating it sufficiently to permit the bushings to be slipped into place. They are held close together at the joint by a heavy clamp at each end with a 1 1/2-in. bolt tightening them and left until cool, the nut occasionally being tightened to take up the contraction.

Removing Cylinder Bushings.—The removal of worn bushings is quickly accomplished by a skillful use of the carbon electrode. They can be cut in 12 minutes without damaging the cylinder wall in the least. This operation is performed in some shops with air hammers and chisels, taking several hours to remove a bushing. All valve chamber bushings are rebored to standard diameters, increasing by 1/8 in. over the last boring.

Washout Plugs.—All washout plugs, which have good square ends on removal, are sent to the machine shop and recut to the next lower size, all sizes being represented by a number and no intermediate sizes are allowed to be used.

Crank Pins Maintained True.—All worn crank pins having threaded ends are trued with a special portable pin-turning machine which is attached to the threaded portion of the pins and makes an accurate and quick job of restoring these to their original form and in accurate quarter. A pair of main pins can be re-turned in less than three hours. Pins of the Walschaert gear type are turned by an attachment in the quartering machine.

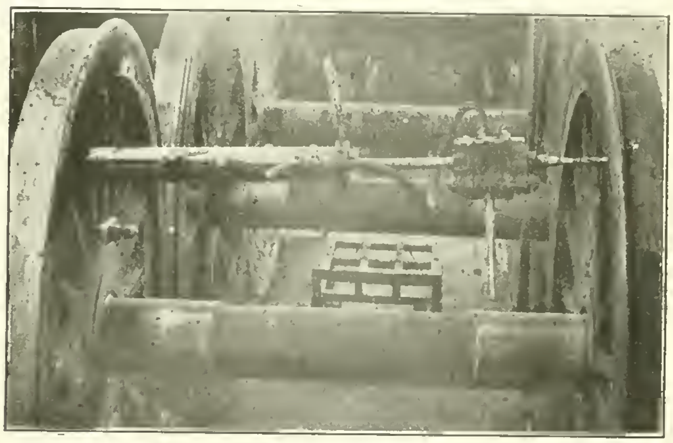


Fig. 16—An Efficient Device for Drilling Retaining Ring Rivet Holes in Wheel Centers

Drilling for Retaining Ring Rivets.—A pneumatic feed for the motor while drilling retaining ring rivet holes in driving wheels, or work of a similar nature as shown in Fig. 16, is quite effective. One valve acts to permit admission of air to operate the motor; the other admits sufficient air to support the motor in position and automatically feeds the drill into the work as fast as the operator wishes or the drill will permit.

Auxiliary Pits.—An auxiliary pit, 6 ft. long by 3 ft. wide by 3 ft. deep, on each side of a regular pit is a great convenience in preparing broken cylinders by patching or welding. One of the erecting pits in a shop so arranged will be found well worth while. The one shown in Fig. 17 is cemented and, when not in use, covered by a neat-fitting plate with ring for removal when necessary.

Pit Jacks.—All locomotives are placed upon pit jacks similar to the one shown in Fig. 18. These pit jacks are designed for maximum strength in proportion to weight and are safe and relatively easy to move about. They take far less room than the ordinary clumsy 12-in. or 14-in. timbers.

Lifting Air Reservoirs.—The device applied to the portable crane as shown in Fig. 19 is exceedingly handy for lifting or lowering air reservoirs. Considerable difficulty is met with when applying reservoirs with the overhead crane on account of being obliged to force the lifting cables out of line in order to get the reservoir under the running boards. With this device reservoirs are readily rolled onto the arms and lifted from the floor into position beneath the running board by two men. The arm is easily and quickly removed when the crane is to be used for other purposes, it merely being necessary to remove the pivot pin.

Referring to Fig. 19, the construction of the device will be evident. The elevating arm is made of two pieces of 5/8-in. by 2½-in. stock, shaped at one end in a segment of a circle to fit the reservoir and separated by spacing rods. The arm is pivoted on a pin bolted through the framework of the crane which has been re-inforced at this point by two 5-in. by 5-in. plates welded to the frame. In operation, the radial elevating arm swings to the floor to receive the air reservoir which is rolled onto the arm. Application of the crane hook to the cross brace on the elevating arm and operation of the crane will then elevate the reservoir quickly and easily into place.

Welding.—The fullest advantage is taken of autogenous welding, both electric and acetylene processes being used. A large amount of welding is done with a portable, one-man, semi-automatic welding machine, using the electrode from a reel containing 100 lb. of wire. An operator can work at least 15 per cent faster with this than with the ordinary type of machine, the metal deposited being automatically fed, his only concern being to watch his arc. No delays occur changing the short electrodes in general use and no short ends are wasted. An actual test under normal conditions showed a gain of 17 per cent in favor of the semi-automatic method of welding, especially on a big job.

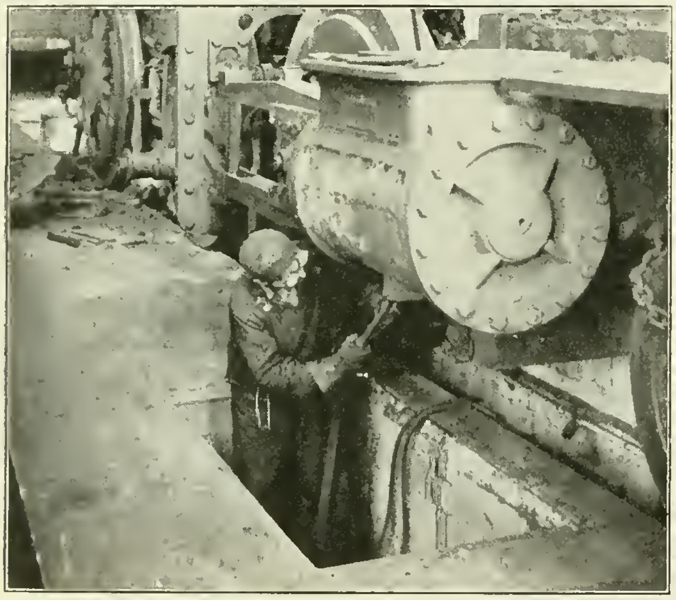


Fig. 17—Small Auxiliary Pit Proves Convenient in Welding Broken Cylinder

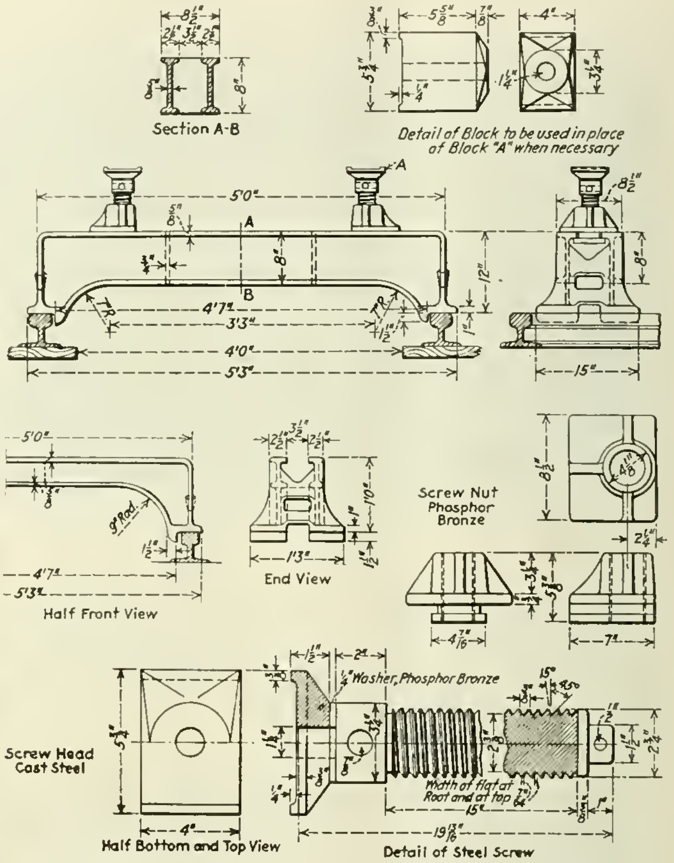
Wrenches.—All wrenches, spanners, etc., are kept in special iron cupboards, one for each four pits. The special multiple cast-steel wrench shown at the left in Fig. 20, is found useful and can be used on ¾-in., 7/8-in., 1-in. and 1⅛-in. hexagon nuts. A hole is tapped for a piece of 1-in. pipe used as a handle.

The high-speed wrench is also interesting and useful in removing and applying nuts on such parts as cylinder heads and places where a number have to be applied. After entering a nut on a stud, the wrench is applied and the wheel spun around at a high rate of speed, the hand grip not revolving with the wheel. The momentum carries the nut along until it is in a position to be finally tightened in the usual manner. Different size sockets can easily be applied to the revolving spindle. This will be found a time-saving device. It is illustrated at the right in Fig. 20 and shown in detail in Fig. 21.

Broken Asbestos Lagging.—This is removed to a shredding machine in a special building outside and ground into material which is then used for making a plaster for lagging.

Accident Prevention

No foreman can expect to obtain the best results with employees losing time through accidents from whatever cause. He has just so many men on his roll and to keep as many as possible of this number continuously at work should be one of his principal concerns.


Section A-B
Detail of Block to be used in place of Block "A" when necessary
A
B
5'0"
4'7"
3'3"
4'0"
5'3"
15"
Half Front View
End View
Screw Nut Phosphor Bronze
Screw Head Cast Steel
Half Bottom and Top View
¼" Washer, Phosphor Bronze
Width of flat at Root and at top
Detail of Steel Screw
19 13/16"
Fig. 18—Assembly and Details of a Convenient and Rugged Erecting Pit Jack

A committee on safe practices meets once a month to discuss these. Should a man become injured, as soon thereafter as consistent, he is asked to what he attributed the

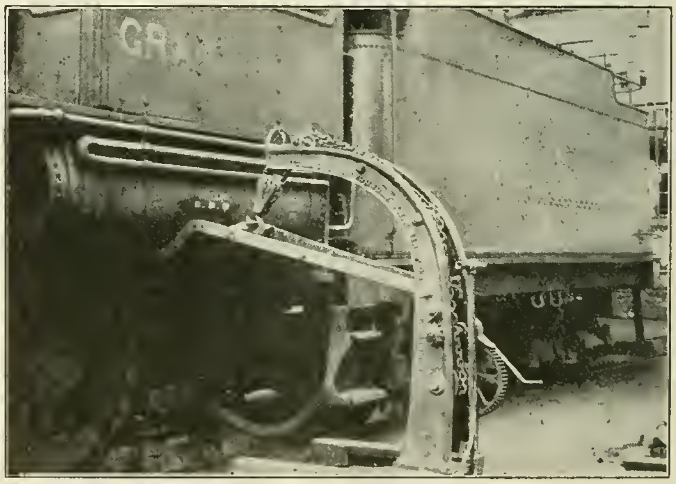


Fig. 19—Portable Crane with Attachment for Applying Air Reservoirs

accident and what he would suggest should have been done to have prevented it. A recording meter is set up in the shop, as shown in Fig. 22, and changed each month. After each accident, a sliding shutter is pulled down to equal the number of points that particular department is penalized. Each department is penalized an amount proportionate to the number of men in same, each starting off the month with a credit of 1,000 points. At the end of the month, a summary is made out and recorded at the bottom as shown. Thus for January, the machine shop ended with 987 points; the erecting shop with 981, while the carpenter shop had 1,000 which indicates no accidents occurred in that department. In addition to this, the total number of man-hours lost due to casualties is posted each month. It has been found this meter has created an amount of inter-department rivalry to see which can get through each month with the least amount of time lost due to accidents. Fig. 22 shows shutters purposely pulled down for the purpose of illustration.

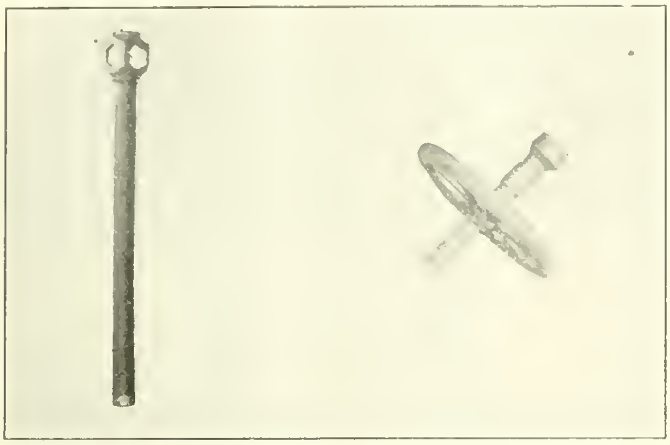


Fig. 20—Compact Multiple Wrench Design—High-Speed Socket Wrench

It seems that, as Americans, we are possessed with a certain amount of sporting instinct and anything which savors of a contest, is entered into quite readily. Thus the accident meter board is watched, especially at the close of the month, by men in all departments in a manner similar to the way a baseball score board is looked upon, and we feel that the results obtained are very satisfactory and well worth the trouble of keeping it up. The various colored glass strips, representing the different departments, give it a most attractive and interesting appearance. The sliding shutter has a graduation upon it showing when pulled down, say 5 points, the figure 1, which indicates that one accident has happened, and so on until it reaches the bottom, which position, I am pleased to state, none has ever yet reached. Anyone passing it can see instantly just how many accidents have occurred during the current month to date and also in what department they took place.

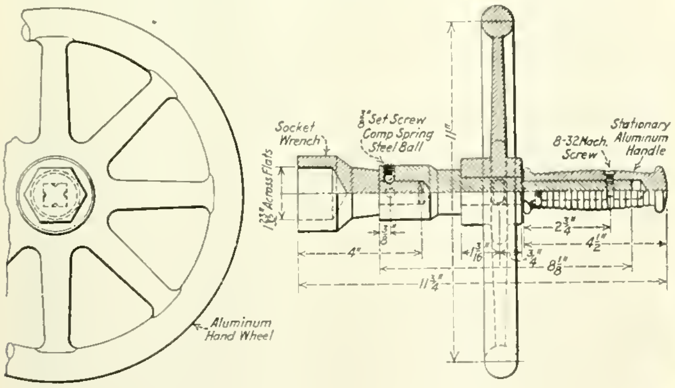


Fig. 21—Details of High-Speed Socket Wrench

While flower gardens may appear out of place in a description of erecting shop practices, we do not believe that a nice green spot with plenty of flowers for men to sit in during noon hours in the least detracts from their usefulness or interest in their work. Fig. 23 gives a faint idea of the charm and restfulness suggested in the lawn and flower beds kept up by the employee members of the shop horticultural society which has been in continuous existence since 1904. The garden is situated just outside the entrance to the erecting shop and is not considered one of the least of our united efforts toward the greatest efficiency.

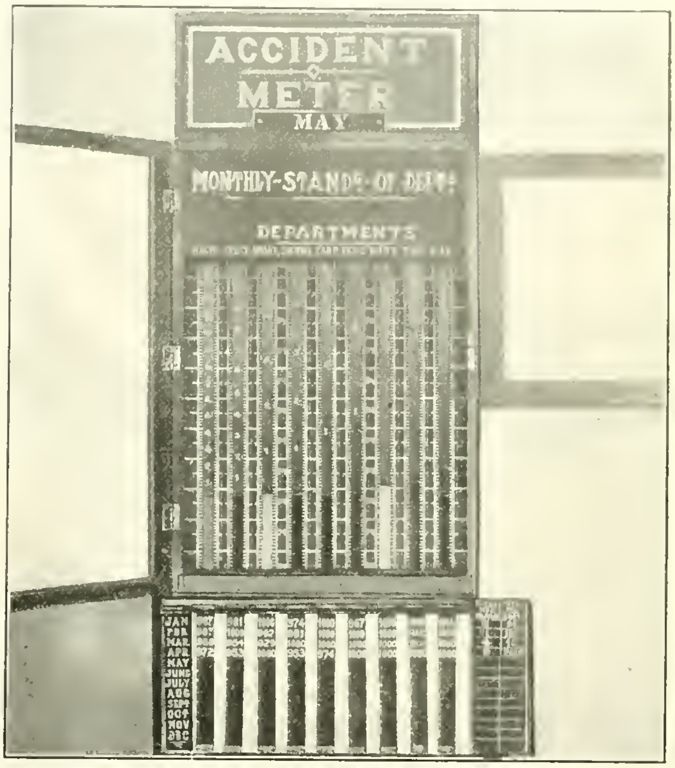
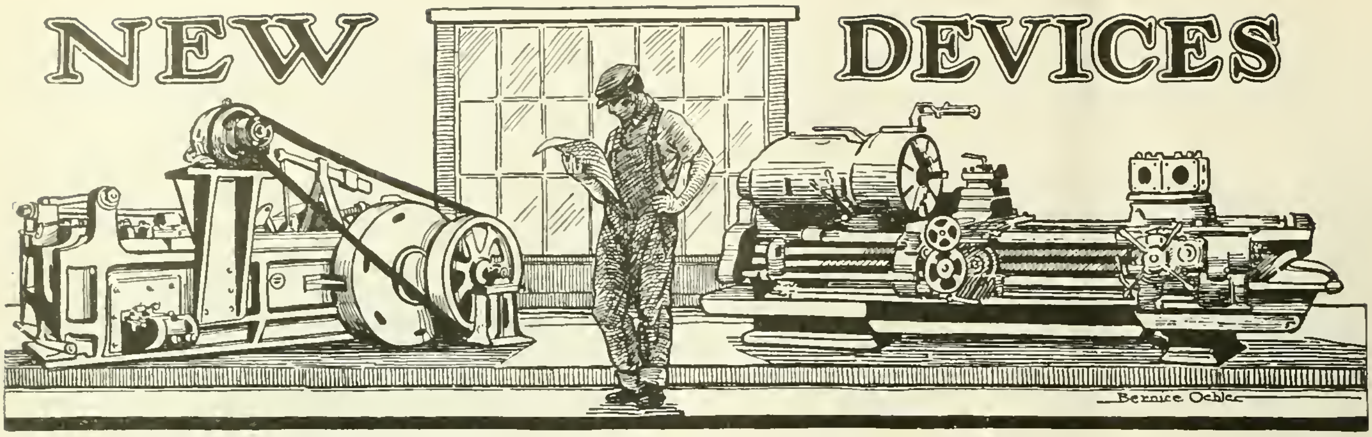


Fig. 22—Great Interest Is Evinced in the Accident Meter Which Compares the Records of the Various Departments

It must not be understood that every device or method mentioned is original with this shop, or never before described. Some have been adapted from the *Railway Mechanical Engineer*, others through exchange of ideas. Many have been suggested by various foremen and workmen. We also have in our erecting shop one man whose sole duty is to see that each device, tool, etc., is kept in an efficient and safe condition and to develop ideas or suggestions that may be presented for discussion at the foremen's meetings and relate particularly to erecting shop practices.

Fig. 23—Lawn and Flower Garden Maintained by the Shop Forces

NEW DEVICES



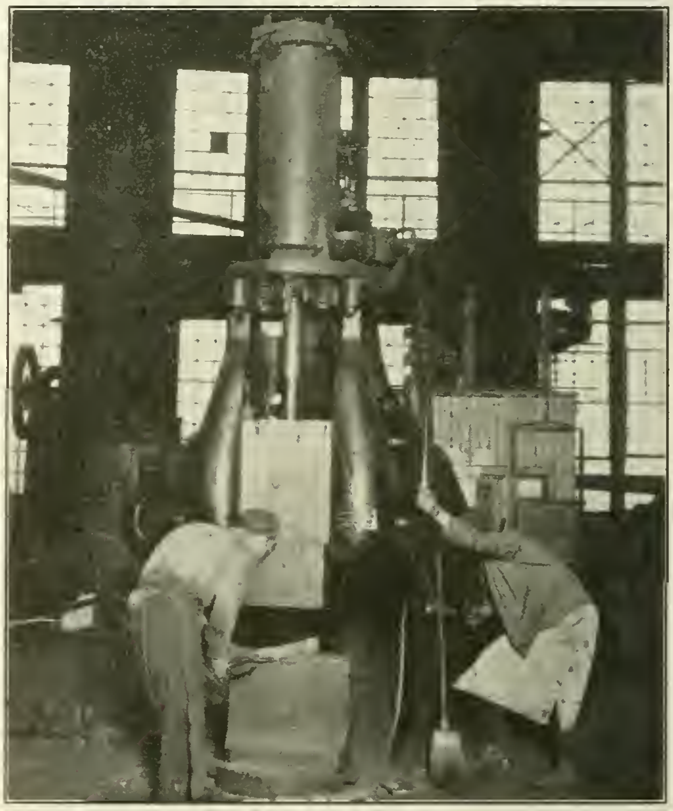
Single Frame Guided Ram Steam Hammer

THE latest model 3,300-lb. single frame steam hammer made by the Chambersburg Engineering Company, Chambersburg, Pa., is particularly adapted for railroad blacksmith shop work and has several improvements over earlier models. The cylinder of the new model has been provided with a self-draining feature which prevents cylinder troubles by draining all water that accumulates between runs. A special safety valve arrangement lowers the ram in case of an accident to the valve gear.

This hammer, which is built in sizes 3,300, 3,500 and 4,000-lb. weight, is of the guided ram type, designed with a special high frame. Great care is given in casting the cylinder to secure a clean, sound casting. The neck is bronze bushed for the piston rod fit and is provided with a packing gland made in halves for easy removal. Steel buffer springs protect the base from injury in case of careless handling. The steam pipe is led to the cylinder in the center of the back of the valve chamber, allowing cranes to swing close to the hammer from either side.

Simplicity and durable construction are features of the valve which is so designed as to afford the operator accurate control of the hammer at all times. Arrangement is made for lost motion due to wear to be taken up by gravity. This hammer is double acting, taking steam above and below the piston, and any variation of blow may be obtained. The general rigid construction of the frame and flanged, cross-webbed base plates which are cast in one piece is evident. The guides are hung in pockets planed in the frame, the weight of the guide being carried by a lug solid on the guide which fits in a corresponding recess in the guide pocket, thus taking the weight from the bolt. This arrangement locks the adjustment and relieves the strain on the frame. Adjustment for wear is made by a steel taper shoe which bears the full width and length of the guide and adjusts the guide equally top and bottom, preventing the ram from cocking in the guides. The piston rod is made solid with the piston, a safety pin being provided to give warning should the rod come loose. Piston rings may be examined without removing the rod from the ram.

A feature of particular importance in connection with the anvil is the fact that the anvil cap may be removed and the anvil die put in its place for upsetting high work. The anvil and anvil cap are of cast-iron unless otherwise specified. An efficient oil pump supplies oil to the valves and cylinder. Steam and exhaust nipples with stuffing box joints are furnished with each hammer. All hammers operate equally well with compressed air or steam.

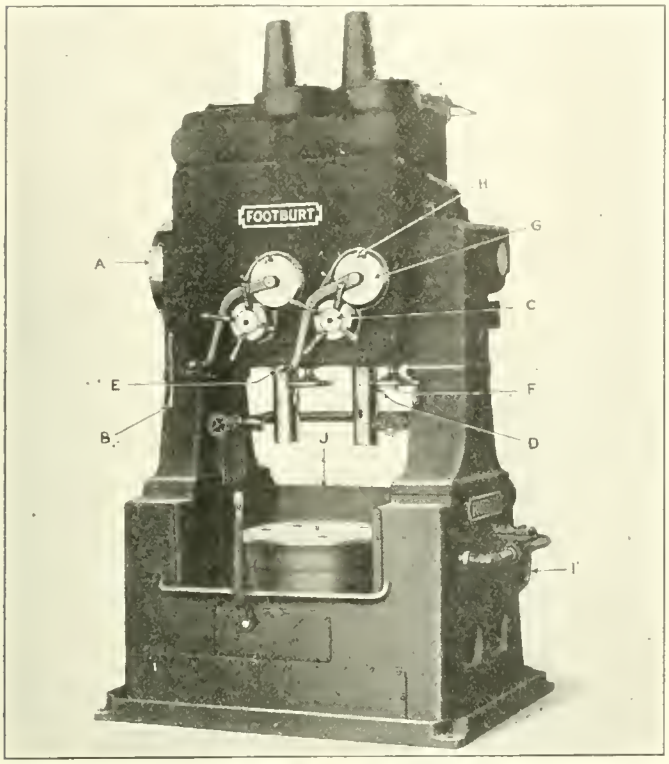


Chambersburg 3,300-Lb. Steam Hammer Adapted to the Varied Demands of Railroad Blacksmith Shop Work

Two-Spindle High-Duty Drilling Machine

AN interesting two-spindle high-duty drill design has been developed by the Foote-Burt Company, Cleveland, Ohio, as illustrated. The frame is constructed with a view to giving maximum strength and rigidity. Between the base unit and the head unit, pedestals of different heights can be inserted at either side, the use of suitable pedestals making it possible to bring the spindle nose as close as possible to the lower face of the head unit for the general character of the jobs on which the machine is to be used. Rigidity is obtained by the use of heavy and properly ribbed sections of cast-iron and by the use of four heavy 2-in. bolts, extending from the bottom to the top to tie the whole machine together. Drilling machines of this type are built in Nos. 101 and 103 sizes which cover practically the full range of capacities required for miscellaneous drilling work.

This two-spindle machine can be used for simply drilling holes, or it may be employed for the performance of such successive operations as drilling and counterboring, drilling and reaming, etc. When two similar operations are performed, a two-station fixture is mounted on the work table. This enables two pieces of work in one fixture to be under the two spindles of the machine, and while the holes are being drilled in these two parts, finished pieces will be removed from the other fixture and new pieces of work set up in their place. In such a case, the work table will be indexed 180 deg. at each movement. Where successive operations, like drilling and counterboring or drilling and reaming, are being performed, a three-station fixture is used. Such a fixture is indexed 120 deg. at each movement, the work being set up at one fixture station, while the first operation is progressing at the second station and the final operation at the third station. The large hand lever at the front of the base of the machine provides for engaging or disengaging the lock bolt which secures the table in the specified position.



High-Duty Drill Embodying Important New Features of Design

The speed and feed mechanism for the two spindles is arranged in such a way that they are entirely independent of each other. Power is provided by a single pulley *A*, which is furnished with a friction clutch operated by lever *B*. From the pulley shaft, motion is carried through two sets of forged steel bevel gears to two vertical auxiliary shafts, one of which serves each of the two spindles on the machine.

Standard gears are provided in sets to furnish spindle speeds from 45 to 504 r.p.m. and through the use of special ratios, it would be feasible to obtain spindle speeds up to 500 r.p.m. This drill is well adapted for long runs in production work, but on the other hand, it possesses ample flexibility to adapt it for a wide range of operations, and it is intended for such use rather than for the performance of a particular line of work.

The feed mechanism affords a range of feeds from .006 in. to .168 in. per revolution. In addition to the power feed, hand feed may be obtained by either of two ways. On the worm shaft that carries movement to the feed mechanism, there is a positive jaw clutch which may be engaged or disengaged by lever *E*. By disengaging this clutch, feed may be obtained by turning hand wheel *F*, or if it is desired to obtain a quick traverse movement of the spindle, this is accomplished by pulling forward the handles or any one handle of capstan wheel *C* which releases the clutch on the worm wheel and enables direct hand movement through the pinions to the rack teeth on the spindle.

In addition to the clutch control, disc *G* is geared to the feed movement, so that it revolves at the same rate as the pinions. On the disc there is a knockout plug which can be set in contact with lever *E* and trip the clutch at any predetermined point.

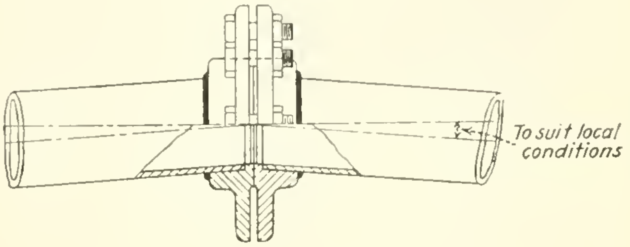
This Foote-Burt drilling machine is intended for use under severe conditions of operation. The designers have provided for the delivery of a copious flow of coolant to the work; the centrifugal pump used has a capacity of 45 gal. of fluid a minute, supplied to the work through a pipe 1¼ in. in diameter. One strainer is provided in the pipe line as shown at *I*, and guard *J* at the back of the work table in conjunction with a similar removable guard at the front prevents the coolant from spattering on the floor while the machine is in operation.

Life of Boiler Washing Plants Increased

THE rapid deterioration of enginehouse piping has been the cause of excessive maintenance costs for boiler washing plants. By the development of a so-called leadizing process of coating roundhouse piping, after the pipe is fabricated ready for installation, with a lead surface of sufficient thickness to withstand the abrasion due to ordinary handling and by substituting drop forged flanges shrunk and welded on the pipes, for threaded connections, the National Boiler Washing Company, Chicago, has overcome much of this excessive cost of maintenance.

The greatly increased permanency of the enginehouse piping thus provided makes practicable an initial installation of hot water boiler washing and filling equipment with mains of sufficient size to permit the future installation of additional capacity at comparatively small expense. The development of the tandem condenser permits the installation of additional condenser units as they may be needed to increase the number of locomotives that can be handled at one time, the additional storage capacity being provided by increasing the number of tanks up to the capacity of the mains.

Prior to the development of the leadizing process the greatest difficulty from corrosion was found to develop at the threaded connections. In order to eliminate this weak point and to overcome the additional weakness caused by bending the pipes to conform to the circle of the enginehouse the drop forged flange connections shown in the drawing were developed to replace the threaded connections. With these



Special Welded Drop-Forged Flange

tions the roundhouse mains are laid out in the form of chords of the circle of the house and the flanges bored out at an angle varying from the axis by an amount sufficient to bring the faces of the adjoining flanges together, with the adjoining sections of pipe located normal to the center lines of the stalls. The flanges, thus bored, are shrunk and welded to the pipe, which has been cut to length, and the faces of the flanges are then accurately ground to the correct angle in a machine especially developed for the purpose. Since the development of the leadizing process on a commercial basis the sections of pipe thus fabricated are further protected by the addition of a strong lead coating.

The leadizing process was first developed on the Atchison, Topeka & Santa Fe about seven years ago. It consisted in immersing the pipes or other steel to be coated in a hot bath of acetate of lead. The resulting chemical action causes the transfer of lead to the surface and iron to the bath, the action continuing only so long as any of the steel surface is exposed. The lead coating is therefore extremely thin and easily subjected to damage in handling.

To provide a commercially practicable coating the National Boiler Washing Company completes the lead deposit by a heavy electro plating process. After this the material is thoroughly washed and painted.

Unusual Applications of Franklin Automatic Wedges

In the design of automatic driving box wedges, as usually applied by the Franklin Railway Supply Company, New York, the spring operates directly on the wedge bolt and is placed underneath the pedestal binder. There are, however, many locomotives with small-sized driving wheels where the clearance between the binder and the rail is not sufficient to permit such an application. There also are a considerable number of locomotives having thimble binders which make it impossible to employ the standard spring arrangement. In such cases as well as in some others it is necessary to resort to special spring arrangements to take care of the peculiar conditions. A few of the unique designs of automatic driving box wedges that have been made recently to meet unusual locomotive conditions are shown in the illustrations.

The arrangement shown in Fig. 1 is one that has been used on a number of small 10-wheel locomotives having pedestal binders of the thimble type. As will be noted, a lever has been introduced between the wedge and the operating spring. One end of the lever is forked in order to straddle the frame and engage with slots on extended lips added to the wedge. The lever and fulcrum pin of the spring bolt are carried on a cast fulcrum bracket which is bolted to the frame, being held by three bolts. The bolts are located just beneath the lower rail of the frame and thus do not weaken it. On other locomotives a boss for the lever fulcrum pin has been welded to the frame. Where more convenient, the spring bolt may be forked and straddle the lower rail of the frame with the spring bolt fulcrum pin carried in a bracket held by the cross-tie bolts. Arrangements of this kind dispense with additions below the frame and thus are suitable for engines with small wheels or those having underhung spring rigging.

The arrangement shown in Fig. 2 was used on some Mallet locomotives of the 0-8-8-0 type on the Bingham & Garfield.

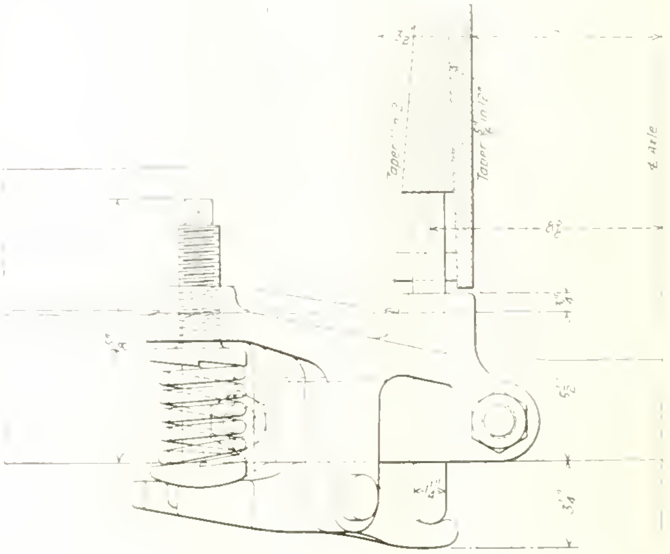


Fig. 2—Arrangement on Mallet Type Locomotives of the Bingham & Garfield

In this case the space occupied underneath the frame was reduced to a minimum by the introduction of a lever and a rail clearance of from 6 1/8 in. to 6 3/8 in. was thus secured. The

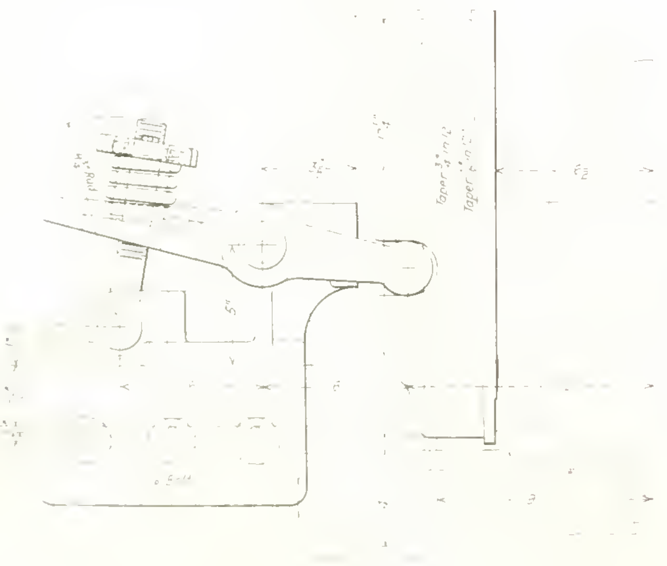


Fig. 1—Arrangement on Locomotives with Small Wheels or Underhung Spring Rigging with Thimble Binders

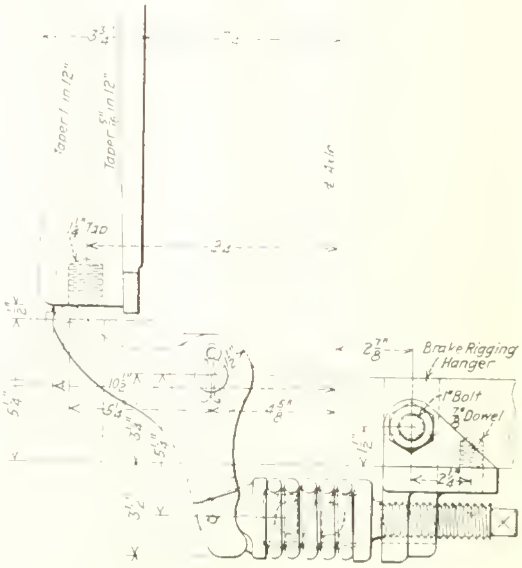


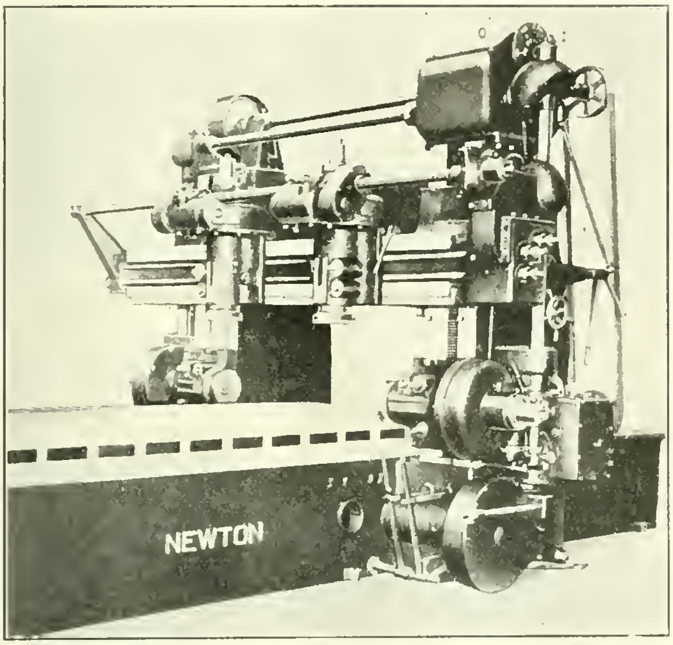
Fig. 3—Bellcrank Lever and Horizontal Adjusting Spring Give Ample Rail Clearance

bracket is fastened to the 5½ in. wide frame by two bolts and the lever is placed at an angle of 45 deg. with the frame, thereby obtaining sufficient clearance for the spring and locating the spring adjusting screw in an accessible position.

Fig. 3 shows a novel method employed to obtain the necessary rail clearance. In this case the adjusting spring is placed horizontally just beneath the frame and a bell crank lever used to transmit the spring pressure to the wedge.

Heavy Planer-Type Milling Machines

A NEW series of planer-type milling machines has recently been added to the heavy-duty milling machines made at the Newton Works of the Consolidated Machine Tool Corporation, New York. They are designed to meet present day demands for high-production machinery in locomotive building and repair shops as well as other large manufacturing plants. The machines, known as Multi-Millers, are rigidly constructed and provided with a wide range of feeds and table speeds adapting them to both light- and heavy-duty milling. Control levers are located on both sides of the machine in front of the housings so that the operator has complete control from the side which is most convenient.



Planer-Type Miller with Four Heavy-Duty Milling Heads

The bed is of one-piece box construction with closed top to meet safety requirements. It has an internal gib which clamps the table firmly to the bed when feeding the saddles holding the vertical heads along the cross-rail. The uprights are bolted to the sides of the bed and have a 42-in. bearing on each side. The table is of the double plate construction with a total thickness of 8 in. over the ways and each way provides a bearing 7 in. wide. When the machine is equipped with cutter lubrication system, the table is fitted with shields and is arranged to handle lubricant in large volume.

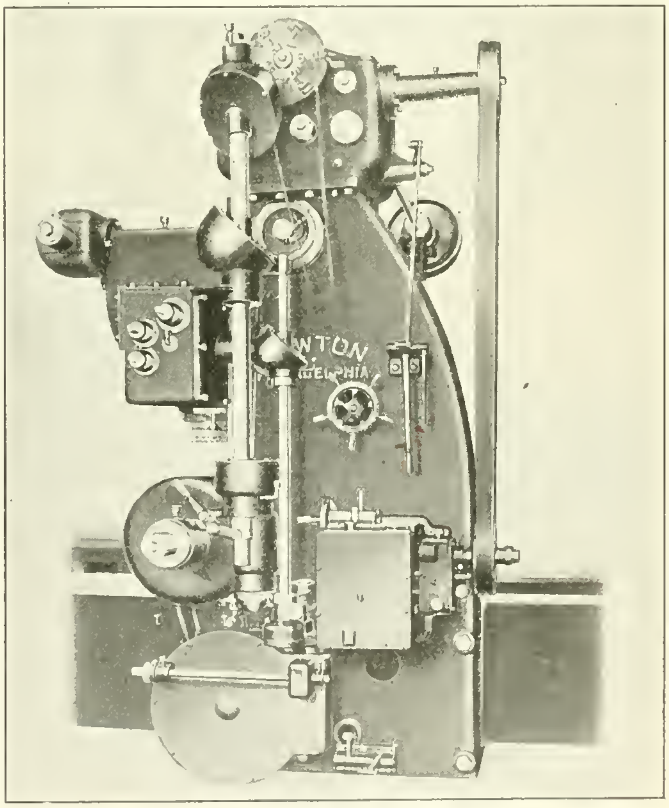
The table rack is of fine pitch and has a face 6 in. wide. Power rapid traverse is provided and moves the table at the rate of 12 ft. per min. in both directions. Hand adjustment is also provided. The table length is sufficient to allow a 12-in. cutter to clear the work at both ends when the table has traveled through a distance equal to the rated length of the machine. The table feeds are entirely independent of the spindle speeds. They are 18 in number and range from 1 in. to 33 in. per min.

The housings are of box section bolted and doweled to the sides of the bed, being reinforced at the top by a heavily-ribbed tie-beam 18 in. deep. The housings are of liberal proportions insuring rigidity and accuracy of alinement under the heaviest cuts.

The cross-rail is a one-piece casting with a 16-in. face. It is strengthened vertically and horizontally according to the width of the machine.

The cross-rail counterweights are contained within the housings and the cross-rail can be raised and lowered by power rapid traverse in both directions at the rate of 3 ft. per min. Hand adjustment, controlled from the end, enables the rail to be moved ⅛ in. per turn of the crank. The cross-rail is clamped to the inner and outer faces of both housings through cam-actuated clamps controlled from the front of the machine.

The saddles for vertical spindle on cross-rail are independent of each other, though feed and rapid traverse are taken from the same shaft. Each saddle has hand adjustment, feed and rapid traverse in both directions on the cross-rail, with provision for clamping by wedge action, when table feed is being used. Feed for each head is engaged or disengaged from the end of the cross-rail. It ranges from ½ in. to 16½ in. per min. The saddles for horizontal spindles are separately counter-weighted and independently controlled, and are arranged so that they can be bolted to the under side of the cross rail when desired.



View Showing Controls and Powerful Spindle Driving Mechanism

The spindles are made from solid steel forgings and are of taper end construction with Morse taper hole, face keyway and draw-in bolt. They are hardened and finished ground on dead centers; run in bronze bushings and are fitted either with Ames dials or scales as desired.

The main drive is by a phosphor bronze worm wheel which is bolted to a hub carried in a bearing separate from the spindle; thereby relieving the spindle of torsional thrusts. On each head there is provision for disengaging the spindle so that it does not operate except when its service is required. All gears in the driving and feed train are either of hardened steel or phosphor bronze, except the table rack and large diameter table gear, which are cast-iron. All driving and feed gearing are enclosed to run in oil, the gears being enclosed for safety by built-in methods rather than by arrangement of loose covers such as are frequently employed.

The machines can be arranged for belt or motor drive through a friction clutch pulley mounted on top of the left upright, the power being transmitted through a horizontal shaft to a 12-speed gear box mounted on the right-hand upright. The motor is belted to the main pulley and can be mounted on the floor, wall or ceiling as preferred. The type of drive tends to eliminate vibration in the machine due to the high speed of the motor.

Clark Pressure Retaining Valves

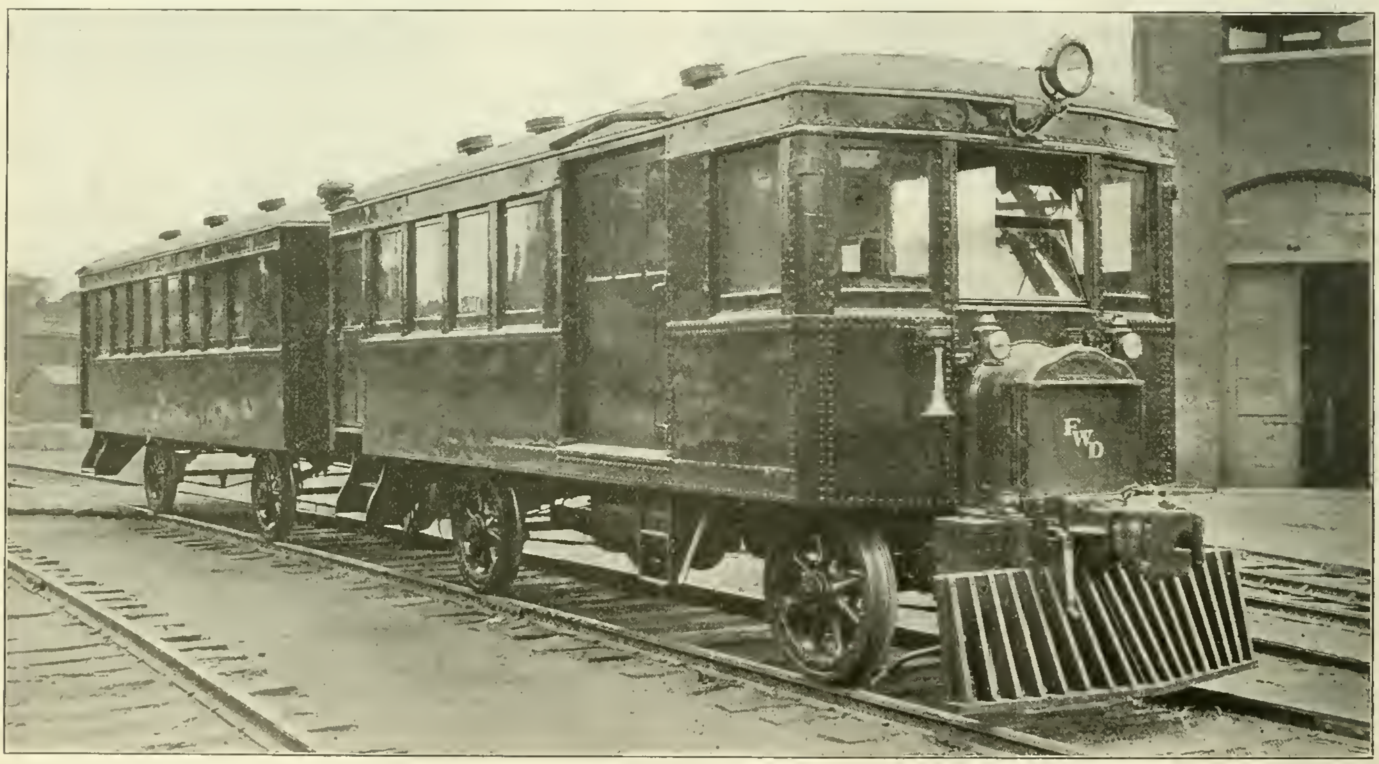
THE Clark Company, West Pittston, Pa., has now designed complete pressure retaining valves of both the single and the double pressure types. These contain the Clark valve of rubber composition which was designed originally as a substitute for the weighted valve in the older type of retainers.

The plug cock used in other pressure retaining valves has been dispensed with and in its place a camshaft has been mounted in the top of the case. This cam, dependent upon its position as determined by an attached lever handle, either permits the valve to lift and allow the exhaust from the triple valve to escape to the atmosphere without obstruction or exerts a certain pressure on top of the stem attached to the rubber valve and thus determines the amount of air pressure retained in the brake cylinder. In the single pressure retainer there are two positions for the cam shaft handle and three positions for the double pressure retainer. The possibility of leakage past a plug cock is obviated by this construction.

A still further modification consists in the use of a single attaching lug at the top of the valve. With this form, a pipe clamp is used below the valve.

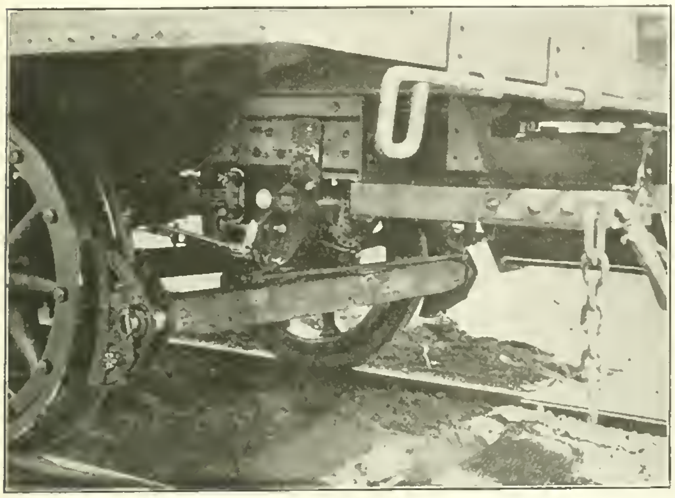
Four-Wheel Drive Motor Car and Trailer

THE past year has seen a slow but steady increase in the number of gasoline driven motor cars used on small roads and for branch line traffic on larger roads. At the present time there is a noticeable tendency toward the development of larger and more powerful units and in many cases increased flexibility is attained by the use of a trailer, a sufficiently powerful engine to drive the two cars being used for the motor car.



Two-Unit Train on Hoosac Tunnel & Wilmington Accommodates 44 Passengers and Baggage

The Four-Wheel Drive Auto Company, Clintonville, Wis., has furnished recently to the Hoosac Tunnel & Wilmington a two-unit train in which a number of improvements have been embodied. The cars are of steel construction throughout and neat in appearance. The motor car is 25 ft. 5½ in. long from center to center of couplings and has a wheel base of 15 ft. 5 in. The trailer car is 27 ft. 5 in. long from center to center of couplings and has the same wheel base as the motor car. The body of the motor car is 21 ft. 7 in. long and that of the trailer 25 ft. 6½ in. The motor car has seats for 15 passengers and an 80 sq. ft. space for carrying 2,000 lb. of baggage or express matter. The motor car complete with body weighs 18,000 lb. or 11,000 lb. for the chassis without body. The trailer car weighs 16,000 lb. complete with body or 6,300 lb. for the chassis alone and seats 40 passengers. The great importance of a minimum light weight of car per passenger carried evidently has been kept in mind for the car weight is only 617 lb. per passenger seated.



Air Brakes with Well Designed Brake Rigging Are Used on These Cars

Power is furnished by a 6-cylinder Wisconsin engine having cylinders 5.1 in. in diameter and 5.5 in. stroke. The horsepower is 62 hp. S. A. E. rating and 94 hp. developed on brake test. The equipment includes a Stromberg plain-tube carburetor, an Eismann high tension magneto and a 30 gal. gasoline tank. Gasoline is fed by pressure, the air pressure being supplied by a reducing valve connected to the air brake system.

The car is driven by all four wheels. Transmission is by means of a jaw clutch, the gears being always in mesh. Four speeds forward and four speeds in reverse are provided. The axles are rigid and of the full floating type. The wheels are 35 in. in diameter, of cast steel and fitted with rolled steel tires.

Considerable attention has been given to the spring suspension to provide easy riding and at the same time take care of lateral sway. The springs are 54 in. long, 2½ in. wide and made of chrome-silicon-manganese steel, heat treated. The four springs are connected to the chassis frame with double spring shackles which permit the chassis to swing sidewise slightly, thus cushioning the side impacts against the rail. The spring arrangement may be seen in the illustration of the chassis and also in the view of the brake rigging underneath the car.

In equipment and furnishings the two cars are complete and modern. Drinking water and toilet facilities are provided. A. R. A. couplers are fitted. Heating is secured by passing the exhaust gases through a system of piping, although a hot water system may be substituted if preferred. Seats are of full size, the same as used in steam passenger coaches. Electric lights are used for illumination and headlight.

Air brakes of the Westinghouse semi-automatic type are provided. The air compressor of 10 cu. ft. per minute capacity is mechanically driven from the rear of the transmission and is controlled by an automatic governor. The semi-automatic brake is a two-pipe system similar to that used on electric surface cars where motor and trailer cars are operated. Operator's valve, application valves, emergency valves, etc., are included. Cast iron brake shoes, one per wheel, are of the same type used in steam service. The manner in which the brake rigging is suspended is clearly shown in one of the illustrations.

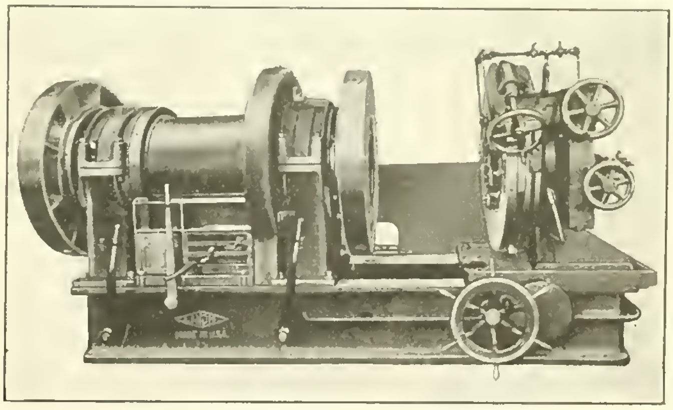
Pipe Threading and Cutting Machine

The Landis Machine Company, Waynesboro, Pa., has added to its line of pipe threading and cutting machines an 18 in. size. The range of this machine is from 8 in. to 18 in. and this entire range is covered by one die head and one set of chasers. The machine, which is about 12 ft. long by 6 ft. wide, weighs 22,000 lb. It has a single pulley drive and the variations in speeds, eight in number, are obtained by means of a speed box located beneath the main spindle. A friction clutch is mounted on the main drive shaft with the pulley. The operating cone of the clutch is moved by two levers which are located at the ends of the head stock within easy reach of the operator. The forward lever is used when threading pipe, while the lever at the rear end of the machine is used for starting and stopping when making up flanges. The lever in the middle is for reversing.

All gears are fully enclosed and, with the exception of the main driving gear and its pinion, run in an oil bath. The main bearings of the hollow spindle are lubricated with flat link chains which run in oil contained in large reservoirs in the base. The driving pinion shaft as well as the reverse shafts are lubricated by sight feed oilers.

At each end of the hollow spindle there is a three-jaw independent chuck for holding the pipe. The rear chuck is equipped with flange grips for fitting flanges.

The carriage which supports the die head, the cutting off tool, and the reaming tool are moved either by power or by hand. The power traverse or movement is both forward and backward and is controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the chuck, the lever is pulled and held until the threading position for the die is reached. In reversing the movement of the carriage, the lever is pushed forward and held. Releasing the lever stops the carriage at any point within its travel.



Landis 8-in. to 18-in. Pipe Threading Machine

Automatic stops prevent the die head from coming in contact with the chuck in the forward movement and the carriage from running off the guides of the machine in the backward movement. The reaming tool is quickly set to position and locked with a lever.

The machine is converted to motor drive by replacing the pulley with a sprocket and mounting the motor on a base over the gear box. A silent chain is employed to drive from the motor to the sprocket. The Landis long life tangential chaser is used with this machine.

Bradford Rocker Type Draft Gear

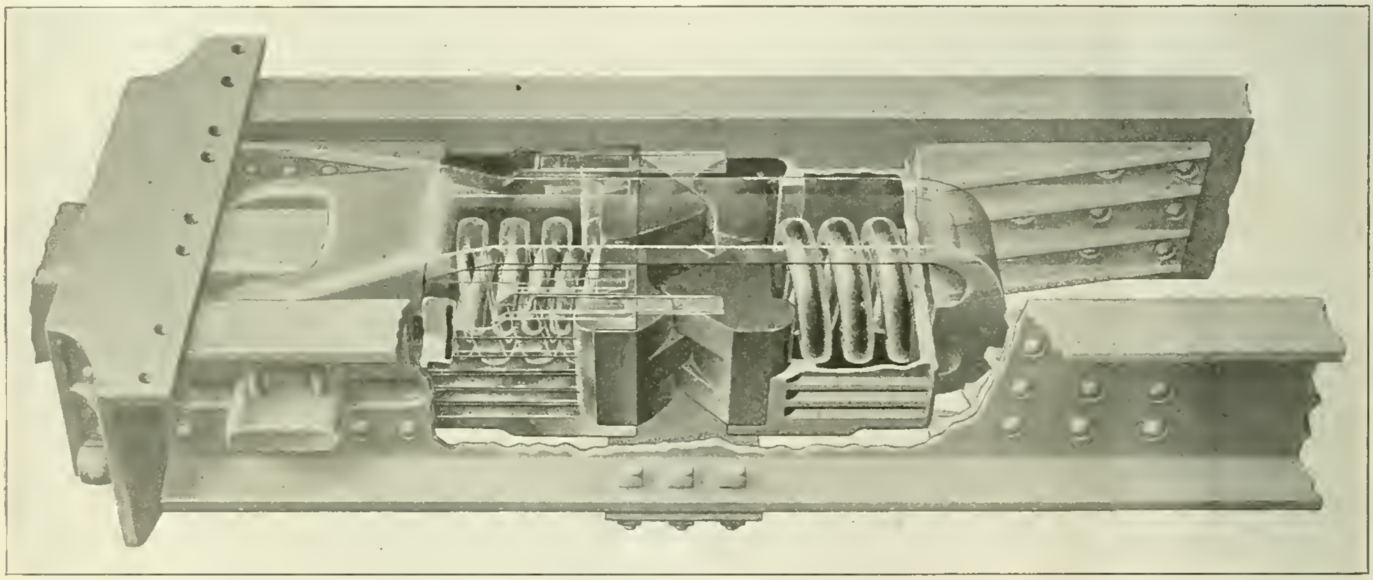
The Bradford Draft Gear Company, New York, without departing from the principle or general design of the rocker type draft gear, has materially increased its strength and shock-absorbing capacity. In its present form this gear has a capacity of 500,000 lb. and can be designed for a travel up to 2¾ in.

The Bradford rocker type draft gear, as will be noted from the illustration, consists of two cast-steel spring housings, two pairs of interacting steel rockers, two sets of special springs and two spring plates between the springs and the rockers. All parts are held together for shipment and application by 1 in. by ⅛ in. band iron hooks.

One end of each rocker rotates on a cylindrical seat in the spring housing while the other end bears on the spring plate. The inner contacting faces of the rockers are of two different contours, the face of one rocker being straight and that of the engaging rocker being made up of a series of curves.

The peculiar shape of the rockers is such that for the first 1⅜ in. of gear travel the action of the rockers is almost entirely a rolling one. The performance is practically the same as that of a plain spring gear. As the shocks received in ordinary service would not compress the gear beyond this point, there is but little wear under normal operating conditions. The fact that the gear is assembled under initial compression insures that whatever wear may occur will have little effect on the capacity. Should the parts wear an amount equal to ¼ in. coupler travel, this would merely reduce the initial resistance of the gear from 12,000 lb. to 8,000 lb.

During the last half of the travel, the contour of the rockers increases the effective spring pressure and the friction builds up rapidly so that an ultimate capacity of 500,000 lb. is obtained. The injurious effect of unusually severe shocks occasionally encountered in service is thus guarded against.



High Capacity Bradford Rocker Type Draft Gear

The initial leverage ratio of the gear is about 1-⅜ to 1 and this is but slightly increased at 1-⅜ in. travel. At full travel it becomes over 3 to 1.

An important feature of the improved gear lies in the 50,000 lb. capacity springs now employed. These springs, in addition to being made of special steel and carefully heat treated, are of a peculiar section as will be noted from the illustration. The flat faces are of great value in preventing injury to the springs should the gear be compressed solid under unusually severe shock.

Wabco Gaskets for Brake Cylinder Pressure Heads

The Westinghouse Air Brake Company, Wilmerding, Pa., has developed and recently placed on the market a new brake cylinder pressure head gasket, called the "Wabco." These gaskets are made of the same materials as enter into the construction of Wabco packing cups which have been in general service for some time.

A tough, oil-proof and heat-proof composition is used in combination with an open-mesh, heavy cord fabric. The fabric, around and through which the composition is moulded, serves as a skeleton framework to give stamina to the gasket. It is not as limp as the ordinary rubber gasket and the work of applying it to the brake cylinder consequently is considerably facilitated.

The special composition employed is of such character that it will not disintegrate even after long service under conditions which would cause the ordinary rubber gasket to break down. Because of the fact that they remain intact when removed from the cylinders at the cleaning period, Wabco gaskets can be reapplied, which is rarely possible when a rubber gasket is used. These gaskets do not lose their life when subjected to high cylinder temperatures, therefore they are especially valuable for use in driver brake cylinders which often are so located that they receive considerable heat from the boiler of the locomotive.

American Car Door Operating Device

THE car door fixtures made by the American Car Door Company, Michigan City, Ind., are used in connection with sliding doors for box cars and consist of the complete door hardware, including roller track, hangers, rollers, front lips, rear stops, bottom guides, burglar-proof guides, steel binding, American flexible protection strip and the American door operating device.

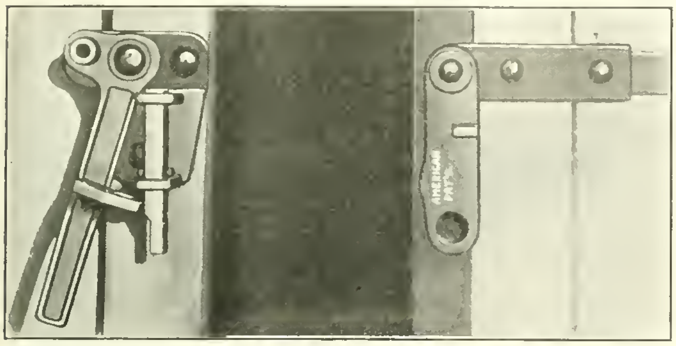


Fig. 1—American Car Door Operating Device in Disengaged Position

The principal feature of these fixtures is the door operating device which is a door starter, closer and sealing arrangement combined into one unit. The purpose of this device is to afford a mechanical means to force the door open or to pull it closed which will prevent the necessity of prying or sledging at the door to start it open or completely to close it.

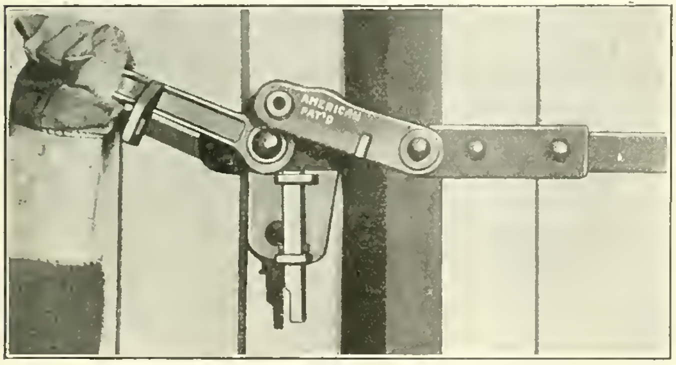


Fig. 2—A Powerful Force Is Available for Opening or Closing the Door

Power to open or close the door is obtained by the use of a bell-crank lever located on the door post and the connecting link attached to the sliding door. The door travel of 2½ in. is secured with a lever ratio of 5 to 1.

In the closed and locked position the connecting link is engaged with a protruding lug on the bell-crank lever and is in a horizontal position. A seal-pin is provided which is in front of the connecting link and is free to be raised and lowered within the limits of the two lugs in the bracket. The seal-pin is retained within these two lugs by the heads of a rivet which passes through the central portion of the seal-pin. The handle of the lever is in a vertical position and is provided with a slotted lug which the lower portion of the seal-pin passes through, locking it in place. The upper projecting portion of the seal-pin, which is forward of the connecting link, locks it in position and it cannot be disengaged from the lug on the lever without first raising the seal-pin to disengage the lever and then dropping the seal-pin to its low position.

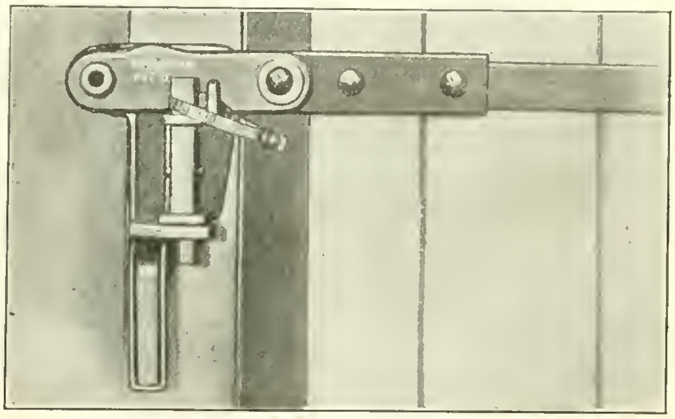


Fig. 3—Door Locked and Car Sealed

The seal passes through the upper portion of the seal-pin and the slotted lug on the connecting link, making it impossible to operate the device or to gain entrance to the car without destroying the seal.

When the car door is open all parts of this device are clear of the door opening and do not project or obstruct the door opening.

Air Compressor Exhaust Disposition and Utilization

FOR a number of years it has been the usual standard practice on most railroads to pipe the exhaust of the locomotive air compressor into the left back exhaust passage of the locomotive cylinder. This has been a convenient point for a connection and the air compressor exhaust was disposed of with little added draft on the fire. The arrangement is not ideal since the back pressure on the air compressor may be considerable should an air compressor exhaust occur at the same instant as that from the back end of the left-hand locomotive cylinder. To overcome this objection and at the same time so dispose of the air compressor exhaust that some real benefit will be derived from it, the Locomotive Lubricator Company, Chicago, has devised an arrangement by which the air compressor exhaust is piped to all four exhaust passages from the main locomotive cylinders. The air compressor exhaust can then, so to speak, take the course of least resistance with a corresponding benefit to the compressor in reduction of back pressure and an increase of capacity and efficiency.

The advantages of this arrangement are not limited to the air compressor as it provides an excellent drifting device. The air compressor exhaust acts to break the cylinder vacuum formed when the throttle is shut off and the locomotive is drifting, as when approaching a station stop and thus avoids the drawing in of front end gases and cinders through the exhaust nozzle.

When a locomotive is drifting is the time when the air compressor is frequently running at more than its average speed. Should the amount of exhaust steam from the air compressor be insufficient, as might occur on roads where there is considerable drifting, the Locomotive Lubricator Company has arranged to provide an auxiliary valve which will automatically admit a certain quantity of live steam to the exhaust passages when the locomotive throttle is closed. This valve is opened by a tappet attached to the throttle lever, but the amount of opening can be easily regulated by the engineer.

As the air compressor exhaust carries with it a certain amount of lubricating oil, the benefit to the valves and cylinders will be even greater than from direct steam. The arrangement is simple and there is practically nothing to get out of order. It is stated that the mileage of valve and cylinder packings has been materially increased and that carbon incrustation has been reduced to a minimum on locomotives equipped with the air compressor exhaust arrangement described.

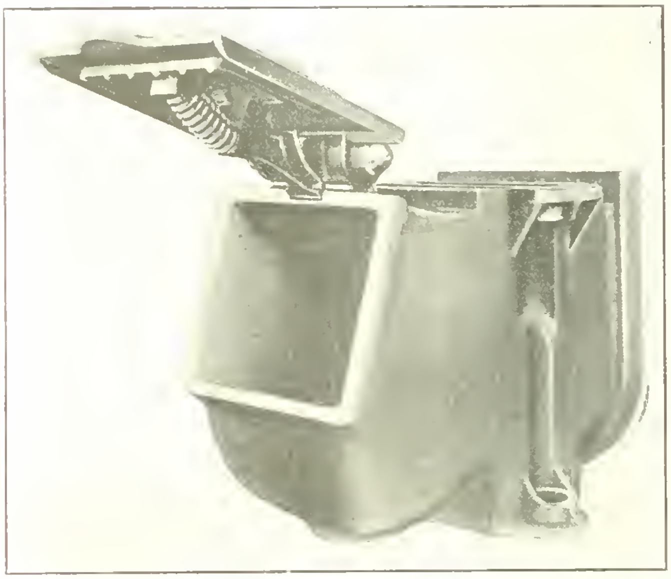
Coiled Spring Lid Journal Box

IMPORTANT improvements in the details of construction have been made recently in the National coiled spring lid journal box manufactured by the National Malleable Castings Company, Cleveland, Ohio.

The face of the box opening in this journal box, as now furnished, is milled to insure a perfect contact with the lid. In accordance with established practice, an accurate surface also is secured on the journal box lids by placing them between two dies in a special drop hammer machine. As a result, a continuous contact between the lid and the face of the box opening is obtained around all sides of the opening and the box is consequently dust proof and oil tight when the lid is closed.

The leverage of the spring fulcrum lever has been increased. This gives a more powerful inward pull on the lid when it is in the closed position and compels the lid to close from an angle of approximately 60 deg. from the box opening.

In the hinge lug, as well as in all other respects, this box conforms to the A. R. A. standard designs and requirements. Should it be necessary, in case of repairs to do so, an A. R. A. standard pressed steel or cast lid with a flat spring can be substituted for the lid with a coiled spring.



National Journal Box with Coiled Spring Lid

High-Test Vanadium Steel Locomotive Frames

THE four new Norfolk & Western electric locomotives which are being built by the American Locomotive Company and the Westinghouse Electric & Manufacturing Company, will have frames of a special high-test vanadium steel supplied by the Union Steel Casting Company, Pittsburgh, Pa. As each of these locomotives consists of two units, a total of sixteen frames will be required, four for each of the four locomotives. These frames are 41 ft. 2 in. long with the main section 6 in. wide and weigh 23,700 lb. each.

The composition used is the result of research work during the past year, this work being carried on by co-operation between the Union Steel Casting Company and the Vanadium Corporation of America.

Table I—Specified Physical Properties

	Standard Vanadium	High-Test Vanadium
Tensile strength, lb. per sq. in.	70,000	80,000
Yield point, lb. per sq. in.	40,000	50,000
Elongation in 2 in.	20 per cent	20 per cent
Reduction in area	35 per cent	40 per cent

The minimum tensile strength and also the yield point of this new high-test steel is 10,000 lb. greater than for the standard vanadium steel. This increase in strength has been obtained, moreover, without sacrificing anything in the way of ductility or toughness, the specification for reduction in area having been raised from 35 per cent to 40 per cent while the elongation in 2 in. has been kept at 20 per cent. A comparison between the physical properties of the two steels is shown in Table I.

The manner in which the physical specifications are being met is shown by the results of eleven tests made on the five heats for the first five frames cast. Instead of giving these tests in detail, the results have been summarized in Table II. The maximum and minimum figures show the ranges for each characteristic.

Table II—Summary of Test Results

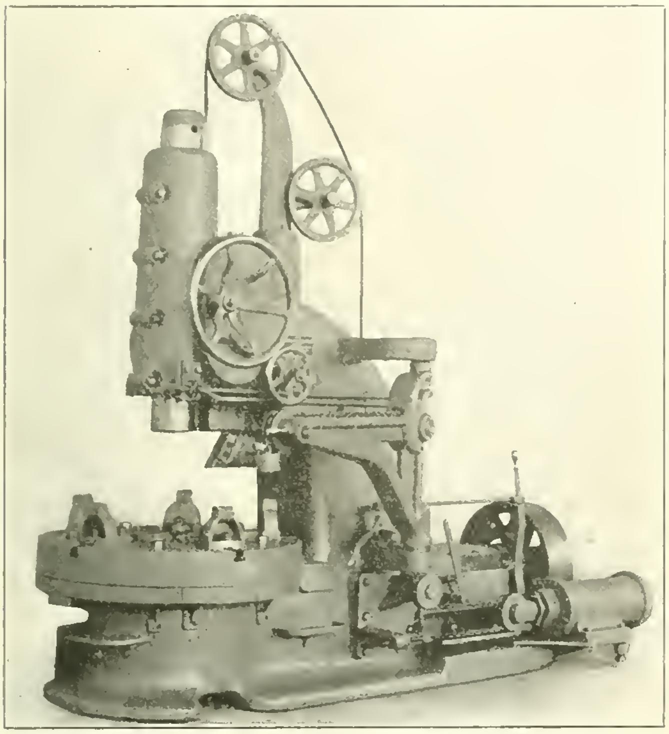
	Yield Point lb. per sq. in.	Tensile Strength lb. per sq. in.	Elongation in 2 In. per cent.	Reduction in Area per cent.
Maximum	57,580	97,120	28.0	54.1
Minimum	48,680	80,880	22.5	39.2
Average	54,550	88,480	24.7	46.6

The Union Steel Casting Company, in conjunction with the Vanadium Corporation of America, has prepared a set of specifications for high-test vanadium cast steel for locomotive frames. In general form the specification agrees with those of the American Society for Testing Materials and the

American Railway Association. In addition to the physical properties already mentioned, the chemical requirements are: Phosphorus or sulphur not over 0.05 per cent, and vanadium not less than 0.16 per cent. The steel is to be made by the open-hearth, or by the electric furnace process. The castings after being allowed to cool are to be heated to the proper temperature to refine the grain. The size of the annealing lugs, the location of the test coupons, the taking of drillings for analysis and the method of conducting the physical tests are all covered. Provisions are made for re-annealing in the event of the first tests failing to meet the specifications. Minor defects which do not impair the strength of the castings may be welded with the approval of the inspector. If this is done, the castings are to be annealed after the welding.

Car Wheel Borer With Air-Operated Chuck

Realizing the vital relation of the wheel-clamping and releasing mechanism in a car wheel borer to efficient operation, the Putnam Machine Works of Manning, Maxwell & Moore, Inc., New York, has brought out a new pneumatic chuck which clamps or releases instantaneously and can be operated as well when the table is running as when it is stationary. A large hole all the way through the spindle allows free passageway for the chips.



Putnam Car Wheel Borer with 5-Jaw Pneumatic Chuck

This machine is also equipped with a pneumatic hoist for lifting the wheels in and out of the chuck. By the manipulation of one valve, convenient to the operator, the movements of the hoist are easily and positively controlled for raising, lowering, or holding the load suspended at any point. With this combination, all the time formerly used in clamping and releasing and a large part of the time hoisting in wheels has been saved.

The hub-facing ram is of large size and is guided at the top by a square tongue insuring a rigid support for the tool, which is set in a sliding head for vertical adjustment of the cut. Hubs may be faced at the same time that the wheel is being bored, or independently as desired. A wide range of feeds is provided for both the facing ram and the boring ram.

The drive is through a gear box, giving four speeds in geometrical progression through sliding gears. These gears are of alloy steel, heat treated and hardened and operate in a bath of oil. A powerful multi-disc friction clutch and brake furnishes a convenient means for starting and stopping the machine.

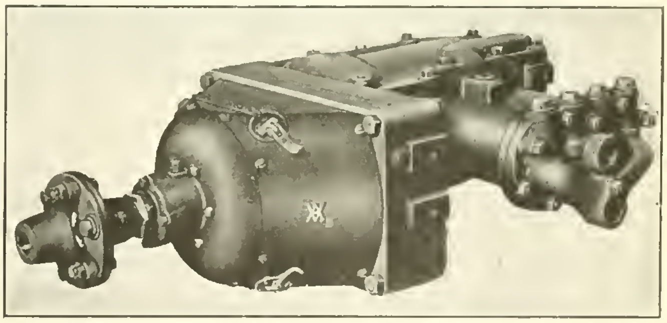
Wheels of from 16 in. to 42 in. diameter can be bored at speeds ranging from 10 to 30 r. p. m. and feeds from 3/64 in. to ½ in. Either single pulley belt drive or motor drive with a 15-hp., 1,200 r.p.m. motor can be provided. The machine is wholly self-contained. Arrangements are made throughout for convenient, and wherever practicable, reservoir or flood lubrication. No gears or other dangerous parts are exposed, full protection for the operator and conformity to safety laws being provided.

Air Brake Equipment for Gasoline-Driven Rail Cars

A new form of air brake equipment has been developed for gasoline-driven rail cars by the Westinghouse Air Brake Company, Wilmerding, Pa. Since this service involves the operation of a single motor car, or at the most a motor car and a trailer, the equipment is of the semi-automatic type.

The source of pressure for the brake system is an air compressor, mechanically driven from the power take-off on the transmission through a pneumatically operated disc clutch. The compressor is single-acting with two cylinders, and because of its low, compact design, is called the "Bungalow" type. Its operation is automatically controlled by a governor of the double safety valve type.

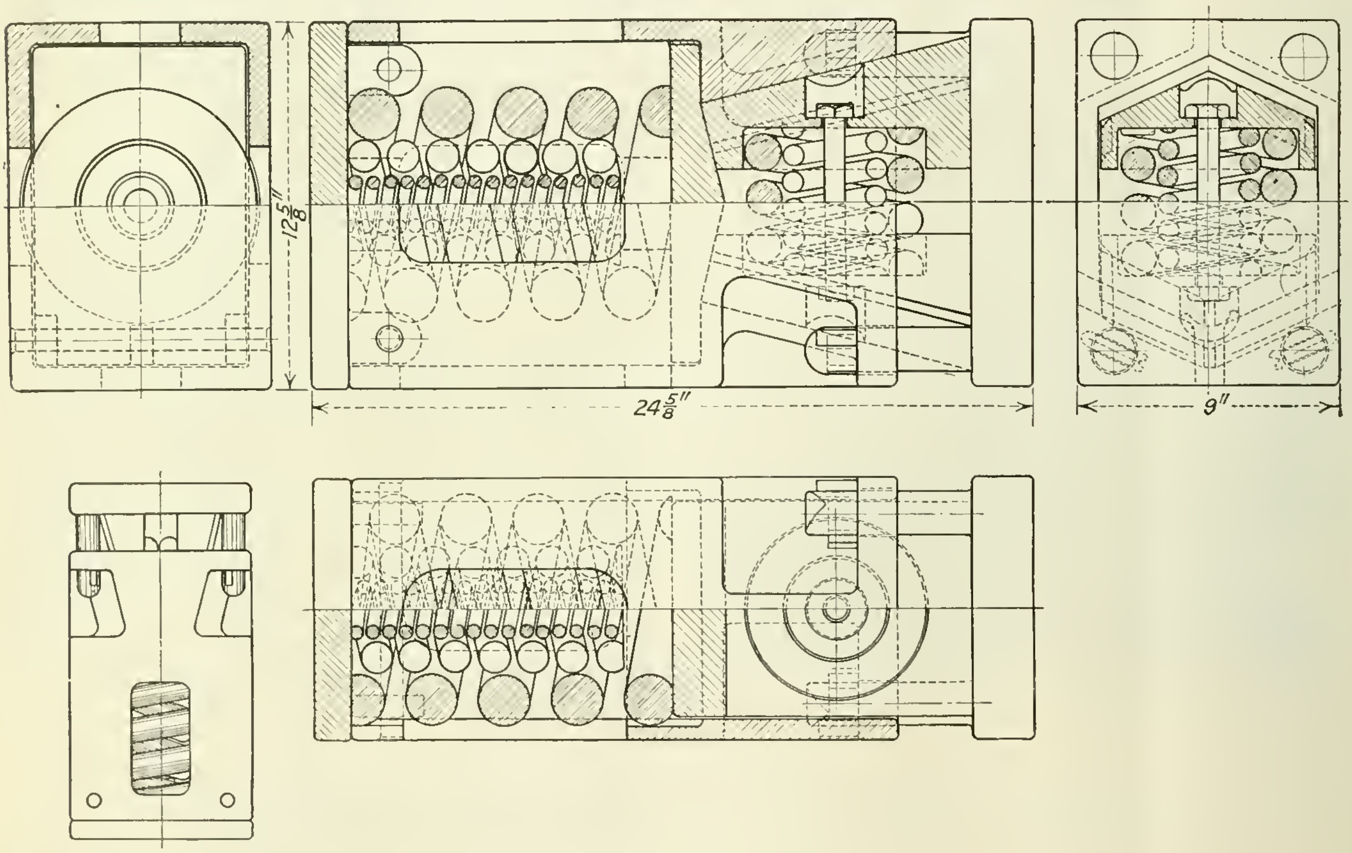
This semi-automatic equipment has all the advantages of a straight air brake equipment in which air is admitted straight from the reservoirs in which it is stored to the brake cylinder through the brake valve and piping during ordinary service brake applications. It is simple, of few parts and flexible; i. e., the pressure in the brake cylinder may be increased or decreased at the will of the operator in accordance with the requirements of condition of rail, grade, loading and kind of stop desired. It also has the safety features of an automatic equipment. During service operations of the brake, pressure is maintained in an emergency pipe. Should it be imperative to stop the car in the shortest possible distance to



Mechanically Driven Bungalow Type Air Compressor avoid accident, placing the brake valve handle in emergency position actuates the emergency valve which automatically opens a direct communication between the main reservoirs and the brake cylinder, resulting in a very prompt application. In case of ruptured piping also, the automatic feature operates. The automatic characteristic of this equipment makes it suitable for use on a motor and trailer car train in view of the safety and assurance of an application which are secured in the event of such an emergency as that of a burst hose or a break-in-two.

Symons Double-Vee Friction Draft Gear

A NEW type of friction draft gear, known as the Double-Vee, is being introduced by the designer, W. E. Symons, New York. As will be noted from the illustrations, this gear is of simple construction and contains but few parts. It consists of a casing, two V-shaped friction wedges, a set of three draft springs, a pair of friction springs, a bolt for holding the friction blocks and springs together, an end casting for the casing, an inside spring seat and a follower.



Details of the Symons Friction Draft Gear

The name of the gear is descriptive of the shape of the friction faces of the wedges and the casing grooves in which they function. The spring capacity is from 40,000 to 50,000 lb. and the gear travel 2½ in. In a test which was conducted on one of these gears, the following results were obtained:

Travel	Capacity
½ in.	32,000 lb.
1 in.	56,000 lb.
1½ in.	84,000 lb.
2 in.	201,000 lb.
2½ in.	233,000 lb.
Closing	285,000 lb.

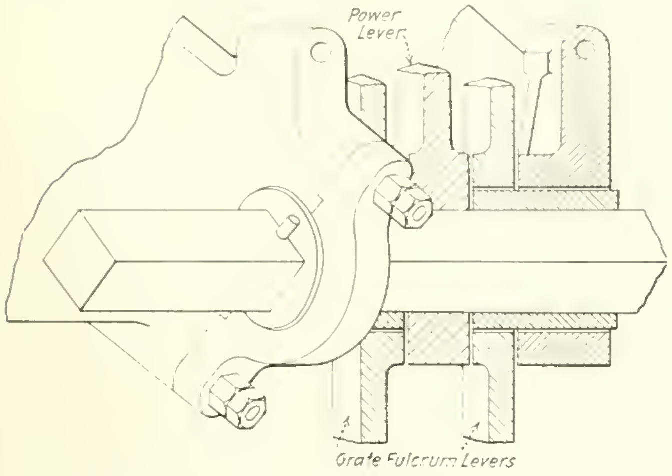
An important feature of this gear is the fact that it is a complete and self-contained unit. All parts, including the follower, are fastened together ready for application. No separate or additional parts are required.

As will be noted from the drawing, the dimensions are such that it can be applied in the standard A. R. A. gear pocket, 9 in. by 12⅝ in. by 24⅝ in.

Franklin Power Grate Shaker Improvements

THE Franklin Railway Supply Company, New York, has incorporated several changes in the design of the power grate shaker and in the method of connecting it to the grate rigging which has increased the reliability of action, added to the durability and reduced the expense of maintenance.

A full throw of the grates is essential and in order that this may be insured, the number of connections between the grate shaker and the grate rigging should be as few as possible and the pins properly fitted. The best arrangement is secured by fastening the grate shaker cylinders to the back head of the boiler, connecting the two cylinders together with a square shaft and rigidly attaching the power arms to the shaft instead of fitting them loosely as has been the practice hitherto. In some instances the power arms now are shrunk on the shaft and in other cases they are attached by welding. When the power arms are rigidly fastened to the shaft, it is necessary that the grate lever fulcrum brackets be equipped with split bushings so that the caps are removable to permit the shaft to be taken out. With this new arrangement, which is shown in the illustration, the only points where lost motion may develop are in the connections to the connecting locks and the pins in the ends of the fulcrum levers and the grate bars. The two inside grate fulcrum levers and bushings are of course applied to the shaft before the power levers are attached.



Split Bearings Are Used When the Power Arms Are Rigidly Attached to the Shaft

The control valve has been changed from the poppet type to the slide valve type. This change was made because it has been found that after continued service the poppet valve would wear and permit live steam to blow past the valve into the exhaust port and maintain a back pressure on one end of the cylinder which considerably reduced the power of the shaker. With the slide valve now used, this cannot occur as a free exhaust is maintained at all times. A slide valve is, moreover, much more easily maintained than a poppet valve as it can be reseated easily should a leak occur. With the poppet type valves, when wear developed, it was necessary to bush the valve body and apply a new standard valve in order to secure a proper fit.

Rex Coach Seats of Improved Design

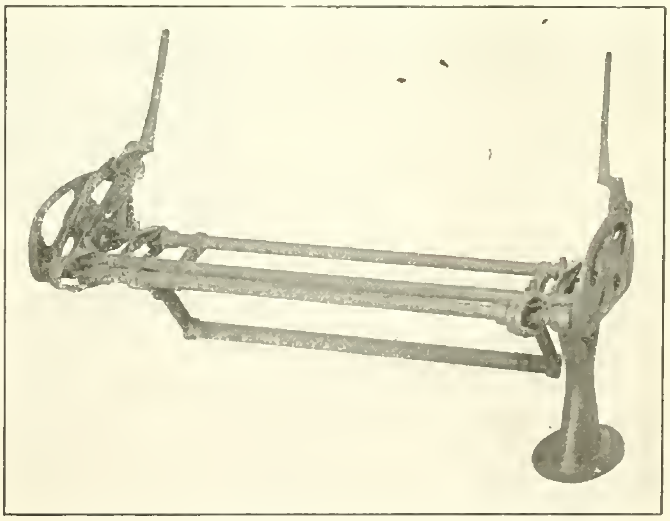
A NEW coach seat of improved design has been brought out by the American Car & Foundry Company, New York. This seat, known as the Rex coach seat, is of simple and rugged construction. The number of individual parts, either fixed or operating, is small and they have been well proportioned to reduce the liability of breakage; the limited number of rivets, bolts and screws has reduced the possibilities of trouble occurring with the seat mechanism. The close tolerances in machining the operating parts eliminates rattle, while the large bearing surfaces reduce the wear and insure long life. All parts are manufactured to standards, making them interchangeable should repairs be necessary.

One Model of the Rex Coach Seat

The reversing mechanism, which is independent of the pedestal or seat end, is of the link type, provided with large pivot bearings and rigidly tied together so that in the reversing operation there is no possibility of one end lagging behind the other and consequently binding and racking the frame of the seat back.

All members subjected to stresses are of rolled or forged steel. The use of pipe for the carrying rails presents a neat and sanitary support for the cushion carrier, as well as a simple and efficient connection for these rails to the mechanism of the end castings.

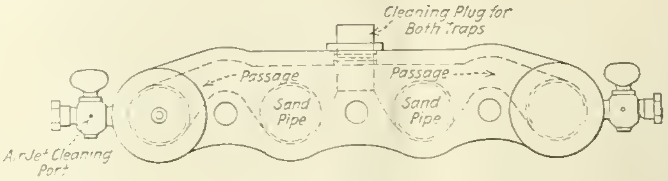
The pedestals, of which several designs in pressed steel or malleable iron are furnished, are independent of the seat rails and other mechanism. The seat ends are of double-wall pressed steel fitted with wood arm rests. Frames for cushion and back are made of either wood or steel. An automatic foot rest is also provided.



The Frame of the Rex Coach Seat Is Simple and Rugged

Watters Double Sander Trap

THE No. 11 double sander trap designed by J. H. Watters, Anniston, Ala., is simple, can be cleaned easily should any obstruction occur and is interchangeable with other types of double sander traps. A single central cleaning plug when removed, permits of the cleaning of either or both portions of the trap. The air jets are located outside of the sander body. The shut-off cocks are counterbored larger at the end entering the sander, thus permitting the air to expand and eliminating the cutting action of the sand blast against the body of the trap. A hole is drilled crosswise through the body of the cock to register with the opening in the plug when it is turned to the closed position. When turned to this position, a small wire can be passed through the cock which will clean out any obstruction that there may be at this point.



The Watters Double Sander Trap Is Arranged for Quick Cleaning of Air Jets and Traps

Powerful 72-Inch Open-Side Planer

MANY improvements have been incorporated in a new open-side planer, made by the Cincinnati Planer Company, Cincinnati, Ohio. Besides having forced lubrication to the vees, which has been the standard on Cincinnati planers for some years, the bearings in the bed are supplied with gravity lubrication. This oil is strained, settled and filtered several times before returning into the bearings. A quantity of this clean oil also cascades over each gear and pinion.

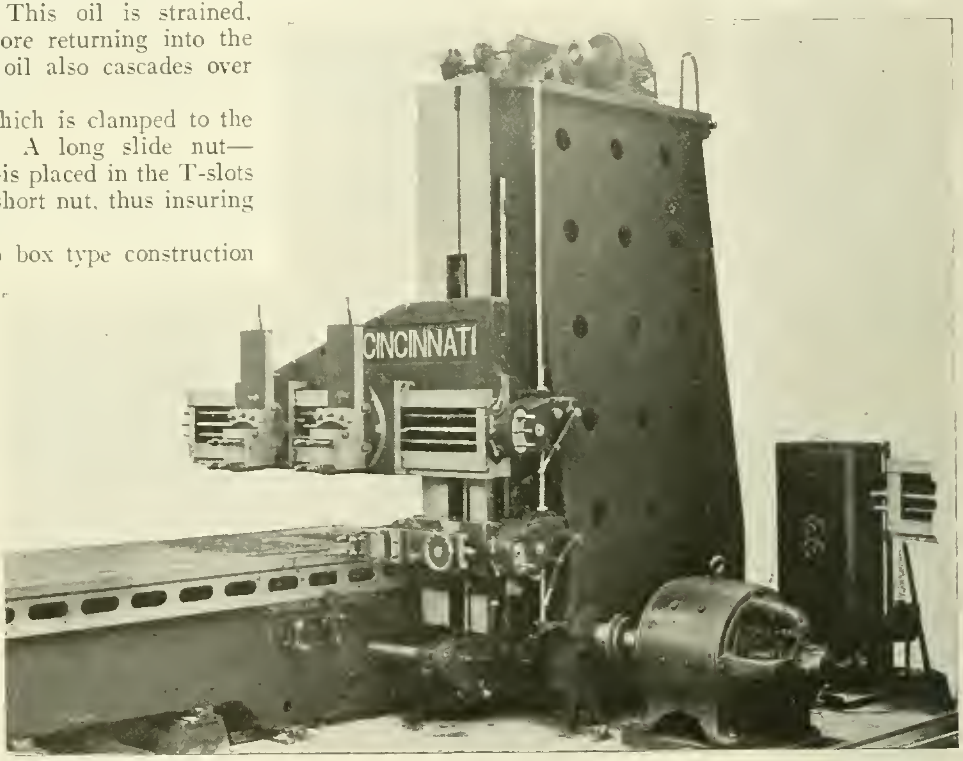
The rail is fastened to the knee which is clamped to the column through two large T-slots. A long slide nut—the length of the bearing of the knee—is placed in the T-slots in place of an ordinary bolt head or short nut, thus insuring a secure clamping surface.

The bed is extremely rigid due to box type construction and of extra depth. This has been done to strengthen the bed through a place where the greatest amount of rigidity is required and also to provide an extra long bearing for the column. The cheeks on the bed are extra heavy, extending considerably above the top of the table and a great distance below the bottom of the bed which provides a greater area for bolting the column onto the bed. Oil pockets are cast integral with the bed of such length to prevent any oil dripping on the floor.

The table, of the standard box type construction, is provided with inner guides which have a bearing the full length of the table. The right-hand side of this table is also provided with a clamp which insures the table against lifting out of the vees when planing work which extends beyond the left-hand side of the machine. The column is thoroughly braced and ribbed on the inside in such a manner that distortion is practically impossible. Besides having the column bolted and dowelled to the bed there is an exceptionally large tongue cast integral with the bed insuring the column against any possible chance of moving.

The rail is equipped with a power-elevating device, the screws which raise and lower the rail being mounted on special heavy ball bearings. The heads are also provided with rapid power traverse in all directions and are equipped with safety crank handles which will prevent accidents when throwing in the rapid traverse. This is so arranged that when engaging the rapid traverse handle, the ordinary crank handle will stand still. There is a limit stop which prevents the rail from raising beyond its maximum height.

All the control levers are within reach of the operator, making it needless for him to move out of his position at any time excepting when setting up work. This machine will plane 72-in. under knee, accommodating work 12 ft. long. The width of the table is 62 in. and the total width of the machine 182 in. The driving motor is rated at 35 hp.



Modern Features of Planer Design Are Included in This 72-In. Open-side Planer

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Cutting Up Steel Cars with the Electric Arc.—In an article on cutting metals with the electric arc, A. M. Candy states that by this process an entire coal car was cut up in four hours' time into pieces sufficiently small to be handled by four men who were shearing the material into smaller pieces. The cost of the arc cutting including labor and power for the motor generator was $6.80. For cutting rivets currents of 400 or 600 amperes are usually used. When using 400 amperes the average operators will cut from 1,800 to 2,000 rivets ⅝ in. in diameter per 10-hr. day and some operators will run as high as 2,600 to 3,100 such rivets when the work is on a piece-rate basis.

GENERAL NEWS

The Utah Supreme Court holds that an employee killed while repairing a locomotive which had been used in interstate commerce before being put in the shop for repairs, which took nearly a month, was not engaged in interstate commerce. Larkin v. Industrial Commission (Utah) 208 Pac. 500.

The threatened strike of shopmen on the Denver & Rio Grande Western has been averted by Governor Sweet, of Colorado, who proposed that the charges of unfair practices be taken before the District Court at Denver, for settlement. The shopmen agreed to await the decision of the court, which has authority over the road through the receiver.

Atlantic Coast Line Locomotive No. 432, Pacific type, hauled a train of nine cars, carrying members of Egypt Temple Shrine from Tampa, Fla., to Richmond, Va., early in June, a distance of 883 miles, without being detached from the train. The party was en route to the Shriners' conclave at Washington, D. C. Fires were cleaned at intervals of approximately 100 miles.

A special passenger train of a locomotive and seven cars, which left Winnipeg, Man., on July 6 at 8:15 a. m., ran through, over the Canadian Pacific, to Quebec, 1,579 miles, in 36 hours, 12 minutes, equal to 43.6 miles an hour. From Smith's Falls, Ont., to Ballantyne, 121 miles, the time was 118 minutes. The regular time of the fastest train between Winnipeg and Quebec is 53 hours. This special train was run to make connection with a steamship for Europe for passengers who had been delayed west of Winnipeg by a landslide.

From January 1 this year to July 2, a total of 10,217,830 tons of bituminous coal had been unloaded at Lake Erie ports for shipment up the lakes. The Car Service Division of the American Railway Association reports that this is the largest quantity ever dumped during the corresponding period except in 1921 when the total exceeded the total this year by 38,059 tons. During the week which ended on July 2 this year, 21,245 cars were dumped at Lake Erie ports, the largest number of cars reported during any corresponding week except in 1921 when that total was exceeded by 141 cars.

The Mechanical Division of the American Railway Association has four scholarships at Stevens Institute of Technology, Hoboken, N. J., two of which are now vacant. These scholarships are available for the sons of members of the division and cover the regular tuition charges for a four-year course, leading to the degree of Mechanical Engineer (M. E.). The course offered also includes instruction in electrical, civil and other branches of engineering.

Applications for these scholarships should be in the hands of V. R. Hawthorne, secretary, as promptly as possible. In case there are more than two applicants, they will be given to the two passing the entrance examination with the highest standing.

Missouri Car Shed Act Held Unconstitutional

The Federal District Court for the Eastern District of Missouri holds that the "Car Shed Act" is in violation of the state Constitution as being too indefinite and uncertain, and as fixing no ascertainable standard of guilt.—Wabash v. O'Bryan, 285 Fed. 583.

St. Louis-San Francisco Offers Insurance to Employees

The St. Louis-San Francisco has arranged with the Metropolitan Life Insurance Company to issue group insurance to its officers and employees. Those earning $200 a month or less will be permitted to take out $3,000 insurance, of which the railroad will pay 40 per cent of the premium on the first $1,000 and the employee all of the premium on the remainder. Those earning between $200 and $300 a month may take out $4,000, of which the company will pay 40 per cent on the first $2,000. Individuals receiving over $300 a month will be permitted to take $5,000 of insurance, of which the railroad will pay 40 per cent of the premium on the first $3,000. The $2,000 of extra insurance at the low rates offered can be obtained without medical examination, regardless of age or physical condition, provided 75 per cent of the individuals in that class take advantage of the offer. Besides life insurance, payable at death, the policies will carry total disability clauses.

Loss and Damage Reduced Thirty Per Cent

For the two months ended February 28, 1923, the amount charged to loss and damage on the Class I railroads of the United States, was $6,978,716, as compared with $10,042,534 for the same period last year, a decrease of 30.5 per cent. This year's record charges to rough handling 18.4 per cent; to unlocated damage, 14.7 per cent; defective equipment 12.4 per cent; loss of entire package 10.2 per cent and delay 9.1 per cent.

Revision of Car Service Rule No. 14

Car service rule No. 14, regulating emergency transfer of lading from freight cars, has been revised and was adopted August 1 by letter ballot by the transportation division of the American Railway Association so as to require that when the transfer or readjustment of a load is necessary because of the omission of proper inside door protection, the cost of transfer shall be borne by the originating road.

Fuel Conservation on the Missouri Pacific

A general fuel conservation committee, including the general manager, the assistant general manager, the mechanical superintendent, the superintendent of transportation, the superintendent of fuel conservation, the fuel purchasing officer, the assistant chief engineer, the auditor of disbursements and the secretary, has been formed on the Missouri Pacific. The committee will prescribe plans and practices to further economies in fuel purchases, distribution, handling, storage and consumption.

A Sixteen-Thousand Ton Train

The great Northern established a record in hauling ore on June 21 when a train of 16,360 tons was moved by one locomotive to Allouez Dock at Superior. Mallet engine No. 2022 hauled 125 loaded ore cars, from an assembly yard at Kelly Lake to Baden, Minn., a distance of 39 miles, where 25 more loads were added to the train and hauled to Allouez, a further distance of 64 miles. Between Kelly Lake and Baden the train was hauled up a 0.3 grade about three miles long.

Fuel Association Conducts Prize Paper Contest

A prize contest for the best paper on railway fuel conservation, open to enginemen, firemen, conductors, brakemen or switchmen, has been announced by the International Railway Fuel Association. A prize of $100, offered through the association by Eugene McAuliffe, special representative, Union Pacific System, will be awarded to the writer of the best paper submitted, the judges to be M. A. Daly, president of the association; L. G. Plant, mechanical department editor, Railway Review, and C. B. Peck, managing editor, *Railway Mechanical Engineer*. The contest closes on August 31, at which time all papers must be in the hands of J. B. Hutchison, secretary of the Fuel Association, 6000 South Michigan avenue, Chicago. The Central of Georgia has offered a supplementary prize of $25 to be paid to the winner if an employee of that road. The Southern Pacific offers a free trip to Chicago, with all expenses paid, for the best paper submitted by an employee he to go as the company's representative to the convention next May. A few other railroads have also signified their intention of supplementing the prize offered by the association, with a prize for the best paper submitted by any of their men.

Railway Club of Greenville, Pa., Establishes Magazine

The Railway Club of Greenville, Pa., has established a monthly magazine, Volume 1, No. 1, of which is the April issue. The club is entirely the affair of employees, although officers of the Bessemer & Lake Erie and the Greenville Steel Car Company are included in the membership. The proceedings of the club as well as railway matters of general interest will be published in the magazine. Marion B. Richardson, mechanical draughtsman for the B. & L. E., is editor.

Another Remarkable Performance by M-K-T Locomotive No. 411

Locomotive No. 411 of the Missouri-Kansas-Texas, noticed in the July *Railway Mechanical Engineer,* page 542, as running from St. Louis, Mo. to Austin, Tex., 975 miles, without being detached from its train, made another run somewhat similar four days later, June 15, when it took a train of 14 passenger cars from St. Louis to Oklahoma City, 549 miles, on 5,420 gallons of oil. Part of the way there were 15 cars and the total number of car miles was 8,523, making the fuel consumption per car mile 0.63 gallons. The train was taken over the ascending grades between Franklin, Mo. and Sedalia without a helper. This trip, like the former one, was made without detaching the engine from the train.

Wage Increases

The Delaware, Lackawanna & Western has increased the wages of shopmen, beginning on July 1, two cents an hour. First class mechanics heretofore receiving 80 cents an hour will now receive 82. The Louisville & Nashville has made a similar increase.

The Chicago & North Western and the Chicago & Eastern Illinois have increased the pay of shopmen, all classes, two cents an hour.

The New York Central Railroad, following protracted negotiations, announced on July 16 that for shopmen, about 20,000 in number, a general advance in wages of 3 cents an hour had been made, bringing the mechanics' rate up to 73 cents. Tentative agreements were reached between the committee and the management on working conditions, but certain of the revisions in the agreements must first be approved by a referendum vote of the union. Negotiations are now under way on the request for similar increases on other roads in the New York Central System.

The Lehigh Valley has granted the following wage advances to its maintenance of way employees: Track foremen and assistant foremen, $5 a month; foremen and assistant foremen in the bridge and building department, $2.50 to $3.50 a month. Clerical and station employees on this road have received increases of from one to four cents an hour. The following increases have been granted to the shop crafts employees: Machinists two cents an hour, carmen one to two cents an hour, helpers one to two cents an hour, apprentices one cent an hour, helper apprentices one to two cents an hour, car cleaners two cents an hour, stationary engineers, firemen and water tenders two cents an hour.

The Labor Board, in three decisions made public on July 18, ruled that contracts entered into by the Western Maryland with several contracting firms for the operation of its railway shops and for the performance of work formerly done by its signal department and maintenance of way employees, are in violation of the transportation act. The provisions of the contracts affecting the wages and working rules of the workmen were declared to be in violation of the decisions of the Labor Board.

MEETINGS AND CONVENTIONS

Railway General Foremen's Association

The following tentative program has been announced for the 1923 convention at Chicago: September 4—Convention called to order by J. B. Wright, president; invocation, Rev. Robert O. Cooper; address of welcome, Mayor Dever, Chicago; response, J. B. Wright, Hocking Valley; address, Ben W. Hooper, chairman, U. S. Labor Board; response, L. A. North, Illinois Central; president's address, J. B. Wright. September 5—Report of secretary-treasurer, William Hall; appointment of committees; address, James C. Davis, director general of railroads; response, H. T. Cromwell, Baltimore & Ohio; topic No. 1, Shop Efficiency in Locomotive and Car Departments, A. F. A'Hearn and Charles F. Baumann, chairmen; election of officers. September 6—Address, a prominent railroad official; response; topic No. 2, General Repair Methods and Maintenance of Valves, Valve Gears and Power Reverse Gears, F. J. Spanganberger, chairman; topic No. 3, General Repair Methods and Maintenance of Stokers, Coal Pushers and Air Fire Doors, W. S. Buntain, chairman; September 7—Topic No. 4, Shop Kinks, Locomotive and Car Departments, G. H. Logan, chairman; topic No. 5, Welding of Tires, Flanges, etc., H. T. Cromwell, chairman; reports of committees and miscellaneous business; adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical. V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meetings, second Thursday, January to November, Hotel Iroquois, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting Hotel Sherman, Chicago, October 3, 4 and 5.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 6,000 Michigan avenue, Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in each month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York, Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York.

Niagara Frontier Car Men's Association.—George A. J. Hocbgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in each month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting, beginning September 11, 1923, Chicago. Exhibit by Railway Equipment Manufacturers' Association.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The American Steel Foundries are negotiating for the purchase of the Damascus Brake Beam Company.

R. P. Dryer has been appointed district manager of the Whiting Corporation, with headquarters at 624 Penton building, Cleveland, Ohio.

The Latrobe Tool Company, manufacturers of high speed drills and reamers, Latrobe, Pa., has moved its Chicago, Ill., warehouse to 1440 West Lake street.

Manning, Maxwell & Moore, Inc., has removed its offices from 119 West Fortieth street to the Pershing Square building 100 East Forty-second street, New York City.

Percy R. Drenning, formerly with T. H. Symington Company, is now associated with the Boyden Steel Corporation as vice-president, with headquarters at Baltimore, Md.

C. C. Rosser, who for many years has been connected with the Detroit Seamless Steel Tubes Company, Detroit, Mich., has been appointed district sales manager with offices at 1206 Guardian building, Cleveland, Ohio.

The National Safety Appliance Company, Chicago, has removed its offices from the Peoples Gas building to 1527 Railway Exchange building. The office of W. T. Tyler will remain in the Peoples Gas building.

The American Steel Foundries has leased the fifteenth and sixteenth floors of the Wrigley building annex, Chicago, for 10 years commencing May 1, 1924, at which time it will move its general offices from the McCormick building.

A. E. Bancroft has been appointed southwestern sales representative of the Union Metal Products Company and the Standard Railway Equipment Company, with headquarters at 2014 Railway Exchange building, St. Louis, Mo., succeeding the O'Fallon Railroad Supply Company.

J. A. MacLean, vice-president and general manager of the Boss Nut division of the American Bolt Corporation, has had his jurisdiction extended over three other divisions of the American Bolt Corporation, which are located at Detroit, Mich., Columbus, Ohio, and Bayonne, N. J.

J. C. Bloomfield, inspection engineer of R. W. Hunt & Co., Chicago, has been appointed district representative of the Industrial Works, with headquarters at 1051 McCormick building, Chicago, succeeding J. Shearer, who will be in charge of all branch offices, with headquarters at Bay City, Mich.

John N. Reynolds, formerly western manager of the Simmons-Boardman Publishing Company, publishers of the Railway Age and the *Railway Mechanical Engineer*, died in San Diego, California, on July 10. He retired from active service in 1913. Mr. Reynolds entered the service of the Railroad Gazette, a predecessor of the Railway Age in 1875.

Lawrence Wilcox, mechanical expert for the Westinghouse Air Brake Company, Chicago, has been transferred to Columbus, Ohio, as a representative of this company, and the Westinghouse Traction Brake Company. S. T. Reid, formerly a locomotive engineer on the Michigan Central, has been appointed mechanical expert in Chicago, succeeding Mr. Wilcox.

Leo Ehlbert, formerly with Engineering & Contracting, has been appointed Western representative with headquarters at 605 Fisher building, Chicago, of the Railway Equipment & Publication Company, New York publishers of the Pocket List and the Equipment Register, succeeding Charles L. Dinsmore, who has retired after 20 years of service as Western representative of this company. In tendering his resignation Mr. Dinsmore acted upon the advice of his physician who has been urging him to retire for the past year.

H. C. Berckes, of New Orleans, La., who has been assistant secretary since 1919 of the Southern Pine Association, was elected secretary-manager of the association to succeed J. E. Rhodes deceased, at a recent meeting of the board of directors. Mr. Berckes was born in New Orleans thirty years ago and has been connected with the Southern Pine Association staff almost since its organization in 1915. The directors, at the meeting, also decided to continue in the future the policy and activities which have been conducted by the association for the industry in the past.

William A. Frye, formerly air foreman at Kansas City, Mo., of the Missouri Pacific; S. H. Winslow, formerly with the Baltimore & Ohio in charge of road tests with the dynamometer car; R. P. Barnett, road foreman of engines of the Southern Railway, and Ernest Keathley, general foreman of the Southern shops at Knoxville, Tenn., have been appointed service engineers, and C. D. Lentz, formerly chief inspector of the New York Central locomotive repairs at the Baldwin Locomotive Works, has been appointed an inspector of the Franklin Railway Supply Company, Inc., New York City.

E. H. Batchelder, Jr., has opened offices in the Lytton building, Chicago, where he will engage in the handling of railway supplies. Mr. Batchelder was for some years employed by the Chicago & North Western in the operating and executive departments at Chicago, and was later promoted to secretary to the president. During federal control he was secretary to R. H. Aishton, regional director of the Northwestern region. Following the return of the railroads to the owners, he was appointed secretary to the president of the Union Pacific, with headquarters at Omaha, Neb., which position he resigned to enter the supply business.

A. F. Stuebing, mechanical department editor of the Railway Age and managing editor of the *Railway Mechanical Engineer*, has resigned to take a position as chief engineer of the Bradford Draft Gear Company, New York City. Mr. Stuebing attended Cornell University and the university of Illinois, and entered railroad service in 1910 as a machinist's helper on the Boston & Albany at West Springfield, Mass. In 1911, he became a special apprentice on the Pennsylvania at Columbus, Ohio, and in 1913 went with the Rock Island Lines, where he was inspector in the test department, roundhouse foreman, and general foreman. He joined the staff of the Railway Age in 1917 as associate editor in Chicago, and in 1919 was appointed mechanical department editor and managing editor of the *Railway Mechanical Engineer*.

A. F. Stuebing

The W. N. Matthews Company, manufacturers of mechanical painting equipment and railway electrical specialties, St. Louis, Mo., has been reorganized as the W. N. Matthews Corporation, with the same headquarters. W. N. Matthews continues as president of the new company and C. L. Matthews as vice-president and secretary. C. C. Fredericks, general manager of the W. N. Matthews Company has been elected vice-president and general manager of the new corporation and A. G. Williams has been appointed manager of railroad sales. Mr. Williams started as mechanical apprentice in the Altoona, Pa., shops of the Pennsylvania railroad and was promoted through various positions to that of engineer of motive power of the Southwestern region, with headquarters at St. Louis, Mo., which position he resigned on May 1 to take charge of the railroad sales of the mechanical painting equipment of the W. N. Matthews Corporation.

Harry D. Rohman, formerly vice-president and chief engineer of the Stone-Franklin Company, New York, has become associated with Robert C. Shaal in the R. C. S. Equipment Corporation, a company dealing in general railroad supplies with offices at 8 East Forty-first street, New York City. Mr. Rohman is a graduate mechanical and electrical engineer with extensive railroad experience, having been prominently identified with the car lighting field, and for several years was in close touch with railroad matters abroad. After graduating from the technical schools of Zurich, Switzerland, he entered the works of the Oerlikon Electrical Construction Company, and in 1903 qualified as an electrical engineer, with experience in high and low tension and a.c. and d.c. work, especially electric traction. Later he entered the service of J. Stone & Co., London, and in 1910 was appointed chief of the testing and experimental departments. In 1914 he was appointed chief assistant electrical engineer, and held that position until October 1, 1915, when he entered the service of the Franklin Railway Supply Company as chief electrical engineer. In 1919 he was appointed chief engineer of the Stone Franklin Company and later vice-president of the same company.

J. C. C. Holding, who has been appointed assistant to G. W. Struble, in the management of the newly-organized steel car sales department of the Bethlehem Steel Company, was for several years with the Midvale Steel & Ordnance Company. After many years' experience in the Structural Department of the Carnegie Steel Company, he resigned in 1917 to become connected with the Midvale Company in the order department. Later he was appointed manager of the railroad division and in 1921 he was appointed manager of the structural division, at the same time having supervision of sales of standard rails, steel freight cars and boiler tubes. Mr. Holding is a graduate of the Rose Polytechnic Institute, Terre Haute, Ind., and immediately after graduation became connected with the civil engineering department of the Johnson Company, now the Lorain works of the National Tube Company. He later spent several years in the structural drafting room of the Shiffler Bridge Works and the Keystone Bridge Works, Pittsburgh, both of which companies were later merged with the American Bridge Company. In 1901 he accepted a position in the office of the structural engineer of the Carnegie Steel Company and shortly after when the general sales department of the Carnegie Steel Company was re-organized and divided into bureaus, he was transferred to the structural bureau. He was with the Carnegie Steel Company for 16 years.

Captain Robert Woolston Hunt, president of Robert W. Hunt & Co., Chicago, died at his home in Chicago on July 11 at the age of 85. Captain Hunt was born on December 9, 1838, in Fallsington, Pa. He spent several years learning the practical side of iron making in the rolling mills of John Burnish & Co., Pottsville, Pa., and later took a course in analytical chemistry in the laboratory of Booth, Garrett & Blair, upon the completion of which he entered the employ of the Cambria Iron Works, Johnstown, Pa., where on August 1, 1860, he established the first laboratory in America as a direct part of an iron or steel organization. After serving in the Civil War he was employed in the experimental Bessemer works of the Cambria Iron Company at Wyandotte, Mich. He then returned to the Cambria Company at Johnstown to take charge of its steel business. While there engaged he had charge of the rolling of the first steel rails made in America on a commercial order.

R. W. Hunt

Later he assisted George Fritz, Cambria's chief engineer, in designing and building its Bessemer works, and assumed charge of it on its completion July 10, 1871. In 1888, he established the bureau of inspection, tests and consultation of Robert W. Hunt & Co., in Chicago.

Mr. Hunt was president of the American Institute of Mining Engineers in 1883, and again in 1906. He was president of the American Society of Mechanical Engineers in 1891, of the Western Society of Engineers in 1893, of the American Society for Testing Material in 1912, and in 1914 American vice-president of the International Association for Testing Materials. He was awarded the John Fritz medal in 1912 for his contributions to the early development of the Bessemer process.

TRADE PUBLICATIONS

Chucks.—The Skinner Chuck Company, New Britain, Conn., has recently issued a 20-page condensed catalogue of its line of lathe, drill and planer chucks, vises and face plate jaws.

Riveters.—The size and capacity of each type of riveter illustrated and the use for which each is best adapted are the features of the circular recently issued by the Hanna Engineering Works, Chicago.

Combination Buffer and Grinder.—The Hisey-Wolf Machine Company, Cincinnati, Ohio, has issued a two-page bulletin, No. 3014-S, describing a new direct motor driven combination grinding and buffing machine.

Sectionfold Partitions.—Details of the construction and operation of the Wilson sectionfold partitions and standard type doors are outlined in an illustrated folder recently issued by the J. G. Wilson Corporation, New York.

Electric Hoist.—The Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has recently issued a 68-page illustrated booklet depicting the Shepard electric Liftabout hoist as it is used for moving and lifting loads of various kinds.

Locomotive Chart.—The Johns-Pratt Company, Hartford, Conn., is distributing a chart of a passenger type Mountain, or 4-8-2, locomotive on which the principal parts are numbered. Below the chart is a key giving the names of 385 parts with reference to I. C. C. rules in the "Laws, rules and instructions for inspection and testing locomotives."

Thread Grinding.—Instructions for setting up and operating multi-graduated Precision grinders and tables showing setting of grinding spindle to conform to Helix angle of thread are given in the 26-page booklet recently issued by the Precision & Thread Grinder Manufacturing Company, Philadelphia, Pa. The Precision and thread lead screw variator is also described in detail.

Kerosene Torches.—Wind and rain-proof portable torches for railway track, shop and locomotive service, etc., are described and illustrated in a four-page circular recently issued by the Chausse Oil Burner Company, Detroit, Mich. These torches burn in any position and are particularly adapted for thawing, drying, preheating, soldering, tempering, expanding and general shop use.

Gasoline Motor Coaches.—A folder has recently been issued by the Service Motors, Inc., Wabash, Ind., in which are illustrated a number of its model 55 motor coaches as they have been built for a number of steam railways. In addition to the specifications of the model 55 coach, it gives considerable data as to the cost of operating this equipment, which has been obtained from a number of users.

Air and Gas Compressors.—The Ingersoll-Rand Company, New York, has just issued a new 36-page, illustrated bulletin describing its Imperial type XPV steam driven air and gas compressors. In this bulletin particular attention is called to the steam valve gear used on these compressors, which consists of completely balanced piston valves with riding cutoff valves which telescope within the main valves.

Ferro Carbon Titanium.—The Titanium Alloy Mfg. Company, Niagara Falls, N. Y., has issued a small 44-page booklet describing ferro carbon titanium and its function in the manufacture of steel. In addition to a detailed description of the properties of this alloy, this booklet contains valuable data comparing the properties of untreated steel with those of steel to which titanium has been added. Numerous photographs are also presented showing the properties of this metal.

Tool and Cutter Grinding.—A tool grinding handbook, including a catalogue of universal tool and cutter grinding machines, has recently been issued by the Norton Company, Worcester, Mass. The book contains 117 illustrated pages and begins with a description of tool and cutter grinding. The following chapters deal with wheels for tool and cutter grinding, the general grinding procedure, and problems in tool and cutter grinding, the latter being adapted to makes of machines other than the Norton types for which they are especially applicable.

EQUIPMENT AND SHOPS

Locomotive Orders

The New York Central has ordered 5 Shay geared locomotives from the Lima Locomotive Works.

The Virginian has ordered 36 electric motive power units from the American Locomotive Company and the Westinghouse Electric & Manufacturing Company.

Passenger Car Orders

The Southern Pacific has ordered 16 steel baggage and buffet cars from the American Car & Foundry Company.

The Pacific Electric has ordered 50 electric motor coaches, 42 ft. long from the Standard Steel Car Company.

Freight Car Orders

The Chicago Great Western has ordered 300 box cars from the Pullman Company.

The Southern Railway has placed an order for 1,000 steel center constructions for box cars.

The Union Railroad will have 100 Clark dump cars built in the shops of the Greenville Steel Car Company.

The South African Railways has ordered 100 grain cars in England from the Metropolitan Carriage & Wagon Works, Ltd.

The Kansas City Southern has ordered 500 steel frame, single sheathed box cars of 40 tons' capacity from the Pennsylvania Car Company, Kansas City, Mo.

The Canadian National has ordered 750 box cars of 50 tons' capacity from the Canadian Car & Foundry Company, and 250 from the National Steel Car Corporation.

The Canadian Pacific is having 1,000 steel underframe, double sheathed box cars 36 ft. long, also 300 steel frame, automobile cars 40 ft. 6 in. long, built in its Angus shops.

Freight Car Repairs

The Central of New Jersey will have repairs made to 300 hopper cars in the shops of the Middletown Car Company.

The Erie is having repairs made to 200 produce cars at the shops of the Illinois Car Company, and is also having repairs made to 200 gondola cars at the shops of the Greenville Steel Car Company.

The Lehigh & New England has placed an order with the Magor Car Corporation to repair 150 steel hopper cars and an order has been placed with the Middletown Car Company for repairing 150 steel hopper cars.

The New York Central has let contracts for converting 500 old box cars to double deck stock cars to the Standard Tank Car Company; 500 old box cars to single deck stock cars to the American Car & Foundry Company; 500 old gondola cars to flat cars let to the Pennsylvania Tank Car Company; and 500 old gondola cars to flat cars let to the Steel Car Company. This company has also given a contract to the Merchants' Dispatch Transportation Company for the repair of 500 freight cars.

Machinery and Tools

Florida East Coast has placed an order for a 42-in. boring mill.

The Tennessee Central has placed an order for an 18-in. slotter.

The Central of New Jersey has placed an order for a 42-in. planer.

The Union Pacific has placed an order for a 1,500-lb. steam hammer.

The Virginian has placed an order for a 500 ton double end wheel press.

Chicago, Rock Island & Pacific has placed an order for a 53-in. boring mill.

The St. Louis-San Francisco has placed an order for a 600-ton, 90-in. wheel press.

The Missouri Pacific has ordered one 200-ton transfer table and one 15-ton electric crane from the Whiting Corporation.

The Norfolk & Western has placed orders for a number of tools including a 73-in. boring mill, axle lathe, 42-in. boring mill and 600-lb. hammer.

The Denver & Rio Grande Western has ordered 16, 7½ ton one-motor 17 ft. span overhead traveling cranes and two, 7½ ton 14 ft. span two-motor overhead traveling cranes from Alfred Box & Co. The company has also placed an order for one 90-in. driving wheel lathe.

The American Locomotive Company has placed orders for a 6-ft. radial drill, a double traveling head shaper, a locomotive axle and journal turning lathe, a 100-in. wheel boring and turning mill, a 60-in. planer and a 32-in. shaper; also for a 50-in. boring mill and a 5-ft. radial drill.

Shops and Terminals

In a Fire at Depew, N. Y., on July 8, the office and stock room of the New York Central car shops were badly damaged. Estimated loss $50,000.

Pennsylvania.—This company has commenced the construction of a new two-story machine shop at Mt. Vernon, Ohio, to replace a building recently destroyed by fire.

Western Pacific.—This company has awarded a contract to the W. Murcell Company, San Francisco, for the construction of an addition to its locomotive and car shops at Sacramento, Cal.

Mobile & Ohio.—This company has awarded a contract to Keeley Brothers Contracting Company, East St. Louis, Ill., for the construction of a roundhouse and shop building at Jackson, Tenn.

Pere Marquette.—This company has awarded a contract to M. Babbitt & Sons, Toledo, Ohio, for the construction of terminal facilities at Erie, Mich., including a 16-stall roundhouse and a machine shop.

Southern Pacific.—This company has authorized the construction of a locomotive assembly shop at Los Angeles, Cal., to cost approximately $500,000. Construction of the new building will start in the fall.

Fire damaged the shops of the Kansas City Southern at Shreveport, La., on July 11, destroying a building 500 ft. long and 85 ft. wide and 72 box cars at an estimated loss of $200,000. The origin of the fire was not determined.

Michigan Central.—This company has awarded a contract to the Ellington Miller Company, Chicago, for the construction of an 8-stall, reinforced concrete roundhouse, a boiler house, an office building and sanding facilities at Grand Rapids, Mich., to cost approximately $100,000.

Atchison, Topeka & Santa Fe.—This company has awarded a contract to the Truscon Steel Company for the material and erection of two of its standard steel buildings 50 ft. by 64 ft. and 32 ft. by 150 ft. respectively for its timber preserving plant now under construction at National City, Cal.

Pennsylvania.—An appropriation of $500,000 has been made for the construction of a masonry dam in Tipton Valley about ten miles east of Altoona, to supply the shops and railroad yards with an adequate quantity of water. Over nine million gallons of water are consumed every working day by these shops; almost double the quantity used by the entire city of Altoona, with its population of 70,000. The new dam will be about 400 ft. long, 78 ft. high and 60 ft. thick at the base. It will involve 18,000 cu. yd. of excavation and will make a lake 32 acres in extent, with a capacity of 250 million gallons. Tipton Run is a pure mountain stream very desrable for locomotive uses.

PERSONAL MENTION

General

F. I. [illegible]rberry, general fuel supervisor of the Missouri Pacific, with headquarters at St. Louis, Mo., has been appointed superintendent of fuel conservation, with the same headquarters.

G. N. DeGuire has been appointed manager of the Department of Equipment, United States Railroad Commission, succeeding Frank McManamy, who has been appointed Interstate Commerce Commissioner.

C. L. Dickert, master mechanic on the Central of Georgia with headquarters at Macon, Ga., has been promoted to superintendent of motive power with headquarters at Savannah, Ga., succeeding W. H. Fetner, resigned.

H. A. Macbeth, assistant superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Conneaut, Ohio, has been appointed superintendent of motive power and cars of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, succeeding M. J. McGraw.

Owen J. Brown, whose appointment as superintendent of fuel service of the Boston & Maine was announced in the July issue of the *Railway Mechanical Engineer*, was born on June 5, 1886, at Peoria, Ill. He entered railway service with the Illinois Valley Belt (the operation of which has since been discontinued) as a fireman in 1906 and a year later became a yard clerk. In 1911 he entered the service of the Wabash as a clerk in the company's general offices and the following year was appointed fuel inspector. Three years later he was promoted to fuel accountant and in 1916 he entered the service of the Boston & Maine as inspector of fuel service, which position he was holding at the time of his recent promotion. Mr. Brown had experience in coal mining before he entered railway service. He is a member of the executive committee of the International Railway Fuel Association.

O. J. Brown

Master Mechanics and Road Foremen

L. E. Sanders has been appointed master mechanic of the Louisiana Railway & Navigation Company of Texas, with headquarters at Greenville, Tex.

A. J. Flowers, master mechanic on the Central of Georgia with headquarters at Columbus, Ga., has been transferred to Macon, Ga., succeeding C. L. Dickert. W. A. McCafferty, assistant master mechanic, with headquarters at Macon, has been promoted to master mechanic, with headquarters at Columbus, Ga., succeeding Mr. Flowers. E. L. Cox has been appointed assistant master mechanic, with headquarters at Macon, succeeding Mr. McCafferty.

Oscar G. McPhail, whose appointment as master mechanic of the Cumberland & Manchester with headquarters at Barbourville, Ky., was announced in the July issue of the *Railway Mechanical Engineer*, was born on July 24, 1878, at Columbus, Ga. After graduating from school in 1894, Mr. McPhail took a special course in mechanical engineering and drafting, entering the employ of the Georgia, Midland & Gulf in January, 1896, as a machinist apprentice. In 1900, he became a locomotive engineer on the Southern Railway in which the Georgia, Midland & Gulf had been absorbed. From 1904, he subsequently served as roundhouse foreman on the Seaboard Air Line at Savannah, Ga., and air brake man and instructor on the Central of Georgia at Columbus, in 1907 returning to engine service on the Columbus Division of the Central of Georgia. From October, 1913, until his recent appointment, he was roundhouse foreman of the Atlanta, Birmingham & Atlantic under J. F. Sheahan, superintendent of motive power; general foreman at Fitzgerald, Ga., and master mechanic.

Car Department

E. G. Chenoweth, mechanical engineer of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to superintendent of the car department, with the same headquarters, succeeding J. H. Milton, who has been appointed general foreman, car department, of the Terminal division, with headquarters at Chicago. Mr. Chenoweth was born on December 18, 1875, at Union City, Ind., and attended Purdue University from 1895 to 1898. He entered railway service in 1895 as a special apprentice on the Erie at Huntington, Ind., and until 1901 was employed consecutively as machinist, air brake instructor and foreman of the air brake department. He was appointed draftsman on the Pennsylvania at Altoona, Pa., in 1901, later serving in the same capacity on the Pere Marquette, the Lake Shore & Michigan Southern and the Philadelphia & Reading. Mr. Chenoweth was appointed mechanical engineer of the Erie, with headquarters at Meadville, Pa., in 1906. In July, 1913, he was appointed assistant superintendent of the car department of the Chicago, Rock Island & Pacific, with headquarters at Chicago, being promoted a year later to mechanical engineer in charge of car design. He was appointed mechanical engineer in charge of locomotive and car design in November, 1918, which position he held at the time of his recent promotion to superintendent of the car department.

E. G. Chenoweth

Shop and Enginehouse

M. J. McGraw has been appointed superintendent of shops of the Seaboard Air Line, with headquarters at Jacksonville, Fla.

Purchasing and Stores

A. F. Schmidt has been appointed general lumber agent of the Pullman Company with headquarters at Chicago, succeeding A. F. Jones, assigned to other duties.

Obituary

L. W. Hendricks, mechanical superintendent of the Bangor & Aroostook with headquarters at Derby, Me., was killed in an automobile accident near St. Agatha, Me., on July 12.

William Moir, retired mechanical superintendent of the Northern Pacific, died on June 26 at Tacoma, Wash. Mr. Moir was born on July 7, 1851, at Dundee, Scotland. Previous to his employment with the Northern Pacific, Mr. Moir was associated with the Brooks Locomotive Works at Paterson, N. J., and with the Missouri, Kansas & Texas at Parsons, Kan. In 1881 he was appointed general foreman of the Northern Pacific at Sprague, Wash., and shortly after was promoted to master mechanic. He was then transferred to Spokane, Wash., in the same capacity and in 1903 was promoted to shop superintendent and after a short period was again promoted to general master mechanic of the Western district with headquarters at Tacoma. In 1906 Mr. Moir was appointed mechanical superintendent with headquarters at St. Paul, Minn., in which capacity he served for several years and on May 1, 1911, he retired from active service.

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The Labor Shortage

There has been much complaint on the part of industries in various sections of the country over the labor shortage. Many people are using it as an argument for the enactment of more liberal immigration laws. It may not be out of place to point out that a labor shortage of this kind is not an unmixed evil. Economists seem to agree that there is not now enough goods being produced in this country to allow all of the people to have all of those things which are regarded as necessary in the best interests of the community as a whole, even if these products were evenly distributed. It is extremely desirable, therefore, that the production be increased.

There are many labor-saving machines and devices of merit which have not been used as widely as they should be, because of the plentiful supply of labor in this country. There are many other labor-saving machines and devices which will be devised under the pinch of necessity, if the labor shortage continues. These devices not only will increase the production per capita, but in many cases will relieve the laborers of hard, tedious, distasteful work. An example of this may be seen in the wonderful development of the practices in the steel mills during the last generation, or in the road-building processes where the best types of machinery are used. There are many places in railroad shops, enginehouses and car repair yards where the production can be increased without adding to the force, if advantage is taken of labor-saving and material-handling devices of proven merit. Sometimes it takes a near catastrophe to force the adoption of improved practices and better machinery—in other words, to get out of the rut. The labor shortage may therefore prove to be "an angel in disguise."

Elimination of Waste Competition

There is a tremendous amount of waste in industry, as was most clearly pointed out in the investigation carried out by the Federated American Engineering Societies at the suggestion of Herbert Hoover. Probably no technical research in industry has attracted so much attention as has this study. Mr. Hoover made this significant statement in the foreword to the report: "We have probably the highest ingenuity and efficiency in the operation of our industries of any nation. Yet our industrial machine is far from perfect. The wastes of unemployment during depressions; from speculation and over-production in booms; from labor turnover; from labor conflicts; from intermittent failure of transportation of supplies of fuel and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it."

Most of the factors mentioned by Mr. Hoover are, of course, beyond the control of any one railway officer or group of officers. Fortunately, however, many agencies are at work to develop ways and means of controlling these larger factors. On the other hand, there are great possibilities for eliminating waste on the part of the individuals engaged in any one single industry, or even in a small department or section of that industry. The difficulty is that too many officers and men get into the rut of routine work or are content to go along and not give much constructive thought to making better use of their time or facilities. Sometimes this extends even to the actual waste or destruction of material. The *Railway Mechanical Engineer* believes that great good can be accomplished if a clearing house could be set up in the mechanical department where experiences could be exchanged as to actual accomplishments in eliminating waste, either by making better use of the time of the workers or facilities, or by doing away with practices which were responsible for the loss and waste of material or energy.

We have therefore decided to offer two prizes, the first one of $50 and the second one of $35, for the best two articles which are received on or before November 15, telling of actual instances of eliminating such wastes. The judges will award the prizes on the basis of the constructive value of the suggestions. The details should be clearly given and accompanied by illustrations wherever possible. Articles not awarded a prize, but which are used for publication, will be paid for at space rates. We have been delighted with the way in which our friends have entered the recent competitions which we have held; we have purposely made this one of a more general nature, in order that men from all sections and parts of the mechanical department may find an opportunity to enter it.

Adopt the Standard Cars

The most important question to be decided by the letter ballot of the members of the Mechanical Division this year is whether or not the box car designs proposed by the Car Construction Committee are to become the standards of the American Railway Association. The proposal that the railroads adopt and build box cars of standard design has been before the railroads for years. The question was brought to an issue and work actually started by the former American Railway Association, largely through the influence of the late E. P. Ripley, president of the Atchison, Topeka & Santa Fe, who was dissatisfied with the apparent lack of interest in the project shown by the Master Car Builders' Association. The work of the former A. R. A. committee was not completed, because of the war, and since the close of the war has come into the hands of the successor to the Master Car Builders' Association, the Mechanical Division, which is now an official organization acting for the American Railway Association.

With the report of the Car Construction Committee presented at the June meeting of the Mechanical Division, the development of standard box cars has been brought as near to a conclusion as it probably ever can be brought by any committee. The present Car Construction Committee is as widely representative as a workable committee can be made and the designs produced by a committee of different personnel, while they would undoubtedly differ from those now before the Mechanical Division, would probably come no nearer to completely satisfying all of the members. The discussion of the committee's report at the June meeting brought out the fact that the standards proposed leave competition unrestricted, within the limits of the standard details and limiting dimensions already adopted by the association, in the selection of proprietary devices now in general use. There has been no question but that the general designs will produce good cars—just how good relatively, is an open question that can be settled only after a period of service experience. Whatever reasons may be given by the individual members, therefore, should they not accept the committee's designs by letter ballot, will mean that it is practically impossible for the railroads voluntarily to establish standard box car designs. Any officer who believes that such designs ought to be adopted, cannot afford to let the present opportunity escape.

Specialization in Railroad Shops

There has been developed a high degree of specialization in the processes of many manufacturing industries. In some cases, especially where highly developed special machine tools are used, this has gone so far that little scope seems to be left for the exercise of the intelligence of the operator. However unsatisfactory this may be because of the social problems thus created, the fact remains that it has tremendously increased the volume of output in relation to the amount of labor required, with corresponding decreases in manufacturing costs.

On first consideration, there seems to be a very meager opportunity for the application of similar methods in the railroad shop. Here conditions differ from those found in industry, in that similar repair operations are seldom exact duplicates. Each locomotive, each car, and to some extent each similar detail presents special problems, the ultimate solution of which must be left to the intelligence of the workman.

But though the limits of specialization may be much more restricted than in manufacturing industries, there are increasing evidences of a marked tendency toward successful specialization in the locomotive and car repair shop. For some time there has been a growing disposition to replace the pit gangs, once so generally employed in the locomotive shop, with specialist gangs each responsible for a more or less restricted group of operations.

During the shop crafts' strike last year it was found possible to make satisfactory equipment repairs with organizations in which the entire force was made up of hastily trained specialists each of whom knew but one job. And further evidence that such an organization is not without merit is contained in an article, elsewhere in this issue, describing the methods employed by the Morgan Engineering Company in its contract locomotive repair shop. Without experienced locomotive men, either among the supervisors or in the ranks, this company successfully undertook the repairing of locomotives on a commercial basis with an organization in which a comparatively small percentage of the employees can even be rated as mechanics. Specialization has been developed to a high degree and in a large measure is responsible for the successful operation of the plant.

In calling attention to the success with which specialized methods have been employed in the repair shop, it is not the purpose to advocate that railroad shops be operated with complete forces of semi-skilled men whose competence is limited to one or two operations. We believe, however, that no fully qualified mechanic is capable of performing every operation in his craft with equal facility and that output increases with the steadiness of application to and the frequency of repetition of a given job by the employee. Furthermore, the highest degree of specialization practicable in the railroad shop leaves ample scope for the exercise of the highest degree of intelligence leading to the development of expert knowledge of the job and its relation to the serviceability of the equipment. In the locomotive shop it has been found that the specialist to a large extent becomes his own supervisor and a real assistant to the general foreman. All of this makes for well-balanced, smooth-running organization and has been found to spell "output" in railroad shops where specialization has become the practice.

The Engine Terminal Competition

Engine terminal management in many respects is the most difficult job in the mechanical department. The back shop, for instance, controls the balance between the classes of repairs under way at any time, the engine terminal takes whatever work comes in. Direct responsibility for keeping down engine failures lies with the engine terminal and not with the back shop; and yet the terminal has to turn the power to meet the requirements of the transportation department rather than its own need for time in which to make repairs. Most terminals have peaks of activity at certain hours during the day, and few of them are ever adequately equipped with time and labor-saving facilities, either for floor or machine work. Both of these conditions make it especially difficult to avoid the wasteful employment of labor.

It is because the management problems thus created are not readily solved that in last month's issue of the *Railway Mechanical Engineer* we announced a competition in which prizes of $50 and $35 will be awarded to the authors of the two papers containing the most constructive suggestions (1) for expediting the turning and dispatching of locomotives, (2) for simplifying inspection and repairs and (3) for keeping engine failures at a minimum when heavy business does not permit much time in the hands of the mechanical department. For instance, consideration has been given in some terminals to the development of a comprehensive schedule of running repair cycles by which the attention to be given each locomotive as it comes into the terminal can very largely be anticipated. And many simple shop-made devices have been developed with which the shortage of facilities has in a measure been overcome. What measures have you found successful in your terminal in meeting any one or all three of the conditions enumerated above? We are not interested in the operation of the ideal terminal layout, but in the methods of management by which you are getting the most out of the plant as it stands. There is still time to tell us, if you have not already done so, but the papers must be received at our office of publication, 30 Church Street, New York, not later than October 15. Any papers, other than the prize winners, which we publish will be paid for at space rates.

Training of Foremen

Some of our friends have criticised us for pounding so incessantly on the necessity of better training for foremen and others holding supervisory positions. Let it therefore be clearly understood that we have the greatest appreciation for the loyalty of the foremen and for the splendid records which they have made, especially during recent years. It is not our intention to criticise them, but rather to pave the way for increasing their opportunities and giving them a larger place in the mechanical department organization. Those supervisory officers who come in intimate contact with the rank and file are *key men.* That they have not always functioned as effectively as they might is in a large degree due to the fact that the managements have failed to recognize this and the foremen have been handicapped by not being fully informed as to difficulties under which the road was operating and as to the policies of the management; they have not even been educated as to the simple economics of railroad operation so far as it concerned the relations of their own department to the organization as a whole.

It is vitally important that the foreman should act as an interpreter to the men of the policies of the management and the difficulties confronting it, and to the management of the feelings and attitude of the men. To do this properly requires a very considerable amount of educational training along various lines. Real foremanship is not a job but an art. A foreman should be given every opportunity of learning those things which will help him to be a better and more successful leader. The task of having to lead and direct large numbers of men in industry is so comparatively new that it has not been very well understood until within recent years. There is ample material now available, however, so that there is no excuse for the foremen and officers not being fully informed in these respects.

It has been found that the development of foremen's clubs and foremen's get-together meetings can be approached with excellent results during the fall months and before the severe winter weather comes on. Programs should be developed now and meetings arranged for the coming months. Plans are being made along these lines on several roads. The movement can only be extended as generally as it should be, however, by having the co-operation of all of the men in supervisory positions. An expression on the part of the foremen at a shop, for instance, for the need of an educational program of this kind, would undoubtedly be greatly appreciated by many of the managements. It may not be out of place to suggest the rereading of the discussions by Messrs. Bentley and Demarest on shop management problems at the June meeting of the Mechanical Division, reported in the July number of the *Railway Mechanical Engineer.*

Drill and Reamer Grinders

A good workman is known by the condition of his tools, and machinists who attempt to perform drilling, reaming or milling operations with dull tools are either ignorant or careless and certainly cannot qualify as efficient workmen. Viewed in the aggregate, the amount of drilling, reaming and milling work in railroad shops is almost staggering and the loss to the railroads is proportionately great when the tools used for this work are maintained in any but the best possible condition for efficient cutting. Greater power is required to operate dull tools; the time required for a given operation is longer, and the resultant work produced is inferior in quality. In view of these facts, it is apparent that too much attention cannot be given to the condition of cutting tools.

It is impossible for the proper attention to be given to cutting tools without suitable equipment in the toolroom in the way of drill, reamer and cutter grinders. Probably few railroad shops worthy of the name are without twist drill grinders, since the practice of re-conditioning twist drills by hand grinding is long since out-of-date. Great care should be taken, however, to see that these grinders are properly adjused to turn out satisfactory work. There are only a few essential requirements in grinding a twist drill to make it cut efficiently. These requirements are absolutely essential, however, and the modern twist drill grinding machine is so designed as to take care of these requirements automatically, producing a drill which—as relates to the shape of the two cutting lips—is practically perfect. Present twist drill grinding equipment in railroad shops should be carefully examined to see if it is turning out work of this character and if not, it will unquestionably pay to install the more modern type of twist drill grinder.

The maximum effective service or life of reamers and milling cutters cannot be obtained unless they are sharpened on one of the plain or universal grinding machines which has been built for that purpose in accordance with correct principles of design. Plain cutter and reamer grinders are available for simple operations such as grinding straight, spiral, or angular milling cutters; straight or taper reamers; shell or end mills, and similar tools. Universal grinders are used to sharpen straight, taper or rose reamers; bevel, spiral, form, or end-milling cutters; taps, countersinks or counterbores. Universal grinders can be used for grinding straight or taper arbors and also for small internal grinding jobs. The universal tool grinder is essential wherever there is a variety of cutting tools to be kept in serviceable condition and its cost of installation will be repaid many times in the increased production or longer life of cutting tools, decreased power consumption and cost of operation; also a noticeably better morale among the workmen who have not the incentive to get results when handicapped by dull tools. In general, it will pay railroad men to benefit by the advice of the manufacturers as to type of grinding wheel and method of set-up and it is particularly important to secure all the attachments needed for their efficient use.

What Our Readers Think

Additional Comment on C. M. & St. P. Method of Center Sill Analysis

Butler, Pa.

To the Editor:

In the August issue, L. K. Sillcox takes exception to the writer's assumptions relative to center sill analysis which appeared in the November, 1922, issue.

The writer wishes to call attention to the fact that these assumptions were not put forward dogmatically but were merely suggested for the consideration of your readers. The assumptions, however, are not unwarranted, as Mr. Sillcox states; in fact they are more logical than those submitted by him in the original article which called forth the discussion. Flat car center sills were not discussed; the sills in question are those of a gondola car with trussed sides and ends. These members are very rigid in comparison to the rigidity of the center sills and so the assumption that the center sills of this type of car may be considered as a beam fixed at its points of support, is quite reasonable. Moreover the writer's assumptions show greater stress at the bolsters and less at the center of the car while those of Mr. Sillcox show less stress at the bolsters and more at the center. If the latter were nearer the truth than the former, we should find the center sills damaged at the center instead of at the bolsters; the evidence found in any repair yard confirms the former.

The A. R. A. requirements for center sill area have been changed from 20, to 25, to 30, and to 28 sq. in. during a short period of time. What the area should be is still an open question, for even at the recent A. R. A. convention this subject received considerable discussion without any definite conclusion. Requirements for prescribed fibre stresses due to given loads, are meaningless unless the assumptions for computing the stresses are also laid down.

Mr. Sillcox states that the clattering observed in a string of cars upon which a car has impinged, indicates the initial blow to be transmitted from one car to the other down the track. This statement is correct but it should be noted that the clattering subsides as the end of the string is reached, showing that each car has taken part in dissipating the energy of the initial impact. The important point, however, is that the clattering between the first and second cars of the string, does not take place until after the first car has received its maximum blow; the clattering between the second and third cars does not take place until the second car has received its maximum blow; and so on until the energy has been dissipated. This statement may be verified by a study of the diagram on page 160 of "Draft Gear Tests of the U. S. Railroad Administration." The diagram shows that at the time of maximum compression, the struck car has moved only 1.10 in. from the point of initial contact while the impinging car has moved 6.49 in. from this point. The clattering between the struck car and its neighbor would just about begin with a movement of 1.10 in., especially if the slack was not bunched. Even though some clattering were present at this instant, the force between these cars could not be great because when the unresisted slack is deducted from the 1.10 in. of total movement there is left very little resisted movement. The writer did not assume the entire end shock to be dissipated within the car structure but used the accepted load of 250,000 lb.

There surely was no intent to offend anyone by making the statement that the field of research in car design has hardly been touched. The choice of construction in present-day designing is largely a matter of precedent which in many cases antedates the use of steel cars. Even Mr. Sillcox, in his August communication, states that "in publishing the articles describing the C. M. & St. P. designs there was not the slightest intention of producing something new which heretofore has not been done. . . ." The amount of loss and damage charged to defective equipment on Class I railroads for January and February was $865,361. The April issue of the National Geographic Magazine contains some statistics which divides the life of a freight car per year as follows: About four weeks running loaded, eleven weeks running empty, six weeks in switching service, five weeks in repair yards and the balance in idleness due to various factors. The number of cars in the United States is given as 2,348,000. It is true that parts of the car such as truck side frames and bolsters, draft gears, wheels and brake shoes have been carefully investigated. However, the comparatively short life of the car, the damage charged to its defects and the time spent in the repair yard compared with the time running loaded, are direct indications that there is room for more intensive, constructive research. The profit of such research to the railroads becomes obvious when the number of cars and their invested value are considered.

Wendel J. Meyer.

A Stitch in Time

Kansas City, Mo.

To the Editor:

On page 236 of the April, 1923, *Railway Mechanical Engineer*, L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul says in part: "What the mechanical department expects from the locomotive terminal is to derive from it a medium by which locomotives may be cared for and maintained properly, promptly and cheaply and from which locomotives may be consistently delivered to the transportation department with the result that the serviceable hours per locomotive per day and the serviceable days per locomotive per year may be increased to a maximum." There is no doubt that many railroad men hold the same view as Mr. Sillcox. In fact, it is easy to understand what it means to transportation to increase the number of hours or even minutes that a locomotive can haul its tonnage without interruption. The astonishing figures given by G. S. Goodwin in the 1915 proceedings of the American Railway Master Mechanics' Association showed that engines actually were moving tonnage only 4 hr. and 16 min. out of each 24 hr. of the day.

The following instances of typical roundhouse experience illustrate by inference what could be done with a little forethought and co-operation on the part of all concerned to improve conditions and increase locomotive revenue hours.

Referring to the roundhouse records at a certain large terminal on July 8, 1915, an engineer reported the following work: Change water in boiler; right injector will not work. The transportation department requested that this locomotive be returned to service as soon as possible, and the injector was therefore repaired and the boiler filled with fresh water and fired. With the steam at 60 lb. the injector was tried but did not work right. The tank was examined and found with very low water. It was decided to move the locomotive to a water crane, fill the tank and raise the steam pressure to 100 lb. the crew in the meantime being called. Finally, with 100 lb. of steam and the tank full of water the injector still would not work properly. As the injector had been examined, the trouble was plainly with the feed water apparatus which was a syphon with a strainer on the bottom of the suction pipe inside the tank. The strainer was found clogged with foreign matter, which could not be removed without draining the tank of 7,000 gal. of treated water.

The second instance selected at random occurred on December 4, 1918. The right tank hose nut on a locomotive dropped off the feed pipe end and the crew tried to close the tank valve which was of the socket type. The valve stem could not be turned so they attempted to couple up the hose while the water was running and failing in this applied a plug. After all their efforts and getting wet to the skin the crew measured the water in the tank and found that there was not enough water to run the locomotive to the next water station! Their feelings can be readily imagined! Another engine was ordered to pick up the train and defective engine and proceed to the terminal. As this was on a Saturday with a Sunday layover there were not enough men on duty to make repairs and the locomotive laid over until Monday causing a shortage of one locomotive on Monday morning.

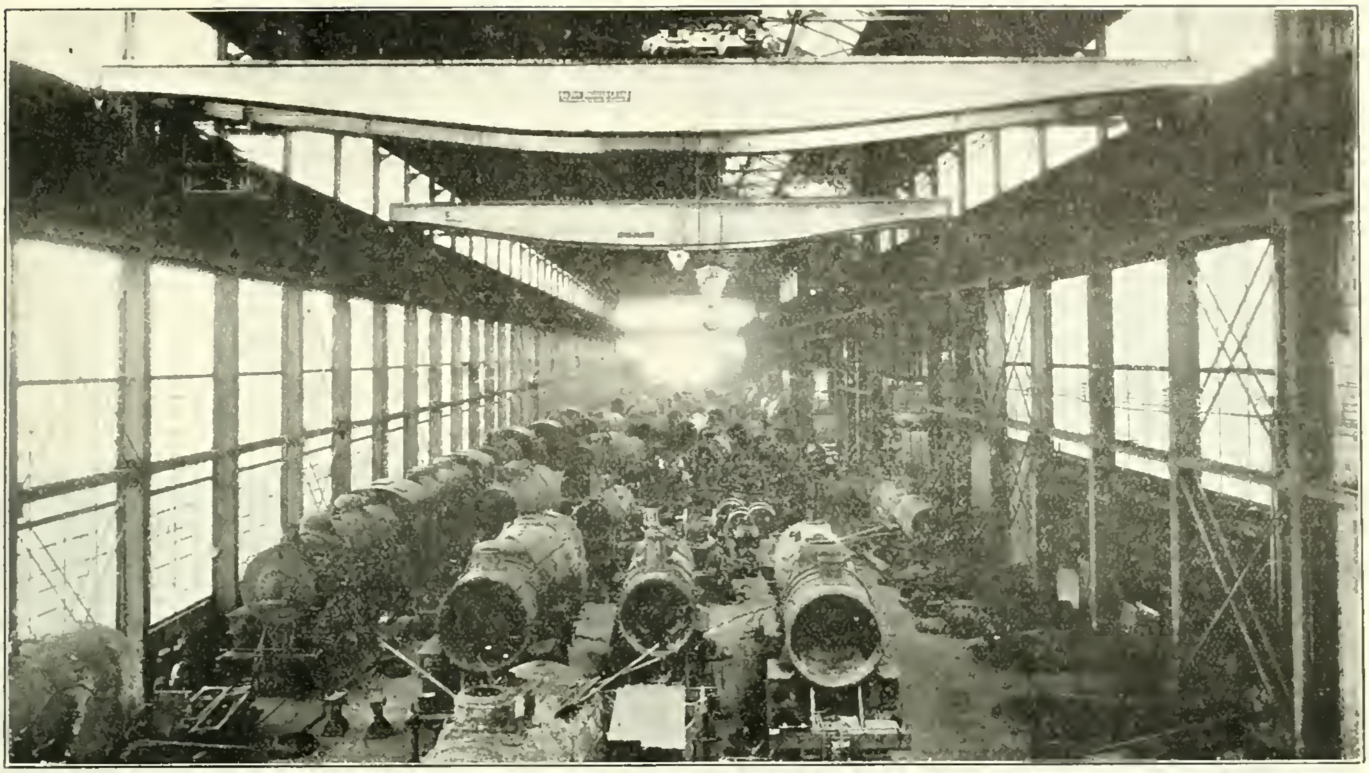
Delays and troubles similar to those mentioned are largely avoidable. They can be prevented by the development of competent, careful inspectors and repair men at the terminals and by the co-operation of all in reporting and correcting conditions which may cause delays.

W. F. Potts.

New Books

Car Lighting by Electricity. *By Charles W. T. Stuart, 352 pages, 6 in. by 9 in., 250 illustrations, bound in cloth. Published by Simmons-Boardman Publishing Company, 30 Church Street, New York.*

This book has been written to meet the need of the practical man as well as the engineer and the student. For those engaged with the construction, operation, inspection and maintenance of car lighting equipment it provides a practical discussion of the subject couched in language intelligible to the average non-technical reader. The text gives a brief history of railway car lighting; a general description of the three electric systems used—straight-storage; head-end, and the axle-generator systems—and a detailed description of the construction, installation, and operation of the various axle-generator systems, with the regulating apparatus, transmission, storage batteries, lighting circuits and fixtures. The testing and inspection of car lighting equipment is also discussed and many of the special tools developed for use in repair work are described. The present stage of development of direct-drive equipment for the axle-generator system of car lighting is described briefly, and there is also appended the specifications covering the car lighting standards and Recommended Practices of the American Railway Association. The term "profusely illustrated" may very properly be applied to this work; the many photographs, drawings, and charts, directly "tied-in" with the text, give a very comprehensive presentation of the subject. The book should prove immensely valuable to men interested in car lighting.



There Are No Working Pits in the Morgan Locomotive Erecting Shop

Ordnance Plant Makes Locomotive Repairs

Morgan Engineering Company Adapts Buildings to Railroad Contract Work with But Few Changes

FOLLOWING the war, the Morgan Engineering Company, manufacturers of overhead cranes and other heavy mill equipment, Alliance, Ohio, found itself with a large plant, unequipped except with cranes, that had been built for the manufacture of heavy ordnance. The demand for outside capacity for heavy locomotive repairs, which developed after the drastic curtailment of mechanical department forces on the railroads in 1921, led to consideration of the utilization of this plant as a contract locomotive repair shop. Accordingly, after a satisfactory form of contract had been worked out, which required the development of a base sufficiently detailed to cover all usually performed operations while still retaining a degree of flexibility which would take care of all work the need for which becomes evident only after a locomotive has been stripped, an organization was developed and operations started.

The first engines were repaired during the latter part of 1921. Owing to unsettled labor conditions, however, operations did not actively get under way until the fall of 1922.

A floor plan of the building in which the locomotive repair work is conducted, is shown in the drawing. The building consists of what may be termed a header bay, 840 ft. long by 90 ft. wide, from one side of which opens a series of parallel bays extending out at an angle of about 34 deg. from the header bay. As these bays all terminate in a single end wall, they vary in length from about 115 ft., in the case of the short bay opening into the header bay nearest its southern end, to about 530 ft. for the east bay opening from the north end of header bay. The building is of steel frame construction with brick curtain walls at the lower portion of the sides of the building, above which there is an unbroken expense of steel sash. Additional light is admitted through glazed openings in the roof.

This building is located in an enclosure adjoining the south end of the main plant yard, in which its manufacturing operations are conducted. The two enclosures are separated by a street, but communication is maintained between them by continuous industrial tracks and by the plant roadways, over which material is transported by motor truck.

The Erecting Shop

The most interesting feature of the locomotive repair shop is the method of handling erecting shop work. The erecting shop occupies the long bay from which open the parallel bays, and has floor space for 70 locomotives in addition to those on the stripping and wheeling tracks. This building originally was not equipped with pits and had but two tracks running through it, one along either side. With practically no changes in the floor construction it has been adapted to effective use as a locomotive erecting shop by the portable structural steel stools on which the locomotives are supported. These are of sufficient height to permit work to be done under the engines after they have been stripped and placed on their "spots" without the necessity of floor depressions and with better lighting under the locomotives than normally found where they are set over pits. The only change in this shop has been the construction of pits along the track on the east side, which is used as a wheeling and finishing track. As will be seen from the illustrations, the locomotives are placed on their spots in "echelon" so that the tubes may be removed from the front end of one locomotive without interference from the locomotive next in front of it.

At the north end of the erecting bay is what is known as the testing block. Here the first spot in each of the four rows between the stripping and wheeling tracks is devoted to the making of hydrostatic tests.

The erecting bay is served by three Morgan cranes, all operating on the same ways. The capacity of the first toward the north end of the shop is 75 tons, of the next, 40 tons, and of that toward the south end of the shop, 25 tons. Slings are used at both ends of the locomotives when lifting with the cranes. In moving a locomotive about the shop, the sling from the 75-ton crane is placed around the barrel of the boiler just ahead of the firebox, while the 40-ton crane lifts the front end.

The stripping track accommodates six locomotives. Here the engines are completely stripped, the parts removed to the lye vat, cleaned and delivered to the machine shop by the stripping gang. After stripping, the locomotive is unwheeled and moved to the "spot" assigned to it, where the boiler, frame and cylinder work is done. When ready to be assembled, the boiler and frames are moved by crane to the wheeling track. This track has a capacity for ten engines, on seven stations. The first two pits, starting from the north end of the building, are devoted to wheeling. After the binders have been put up, each engine is moved from one of these two pits to the next station. Here one pit is devoted to the application of piping, superheater units, lagging and jackets. One pit is also assigned to the next station, where the cab is put on and the motion work, crossheads, pistons and main rods applied. The locomotive is then moved to one of the next two pits, which constitute the valve setting station. Here rollers are put under the engine and the valves set. At the next station the grate, grate rigging, ash pans and brake rigging are put up. Then, on the next pit, the cylinders are closed, piping completed and the steam piping and superheater units subjected to hydrostatic test. The locomotive is then moved to the final station inside the building where the tank is coupled up and the engine pulled out of the shop, ready to be fired up.

Locomotives are broken in on the tracks of the Morgan Engineering Company, some of which are long enough to permit of thorough testing. When accepted by the inspectors representing the railroad company, the rods are taken down and the engine prepared for shipment.

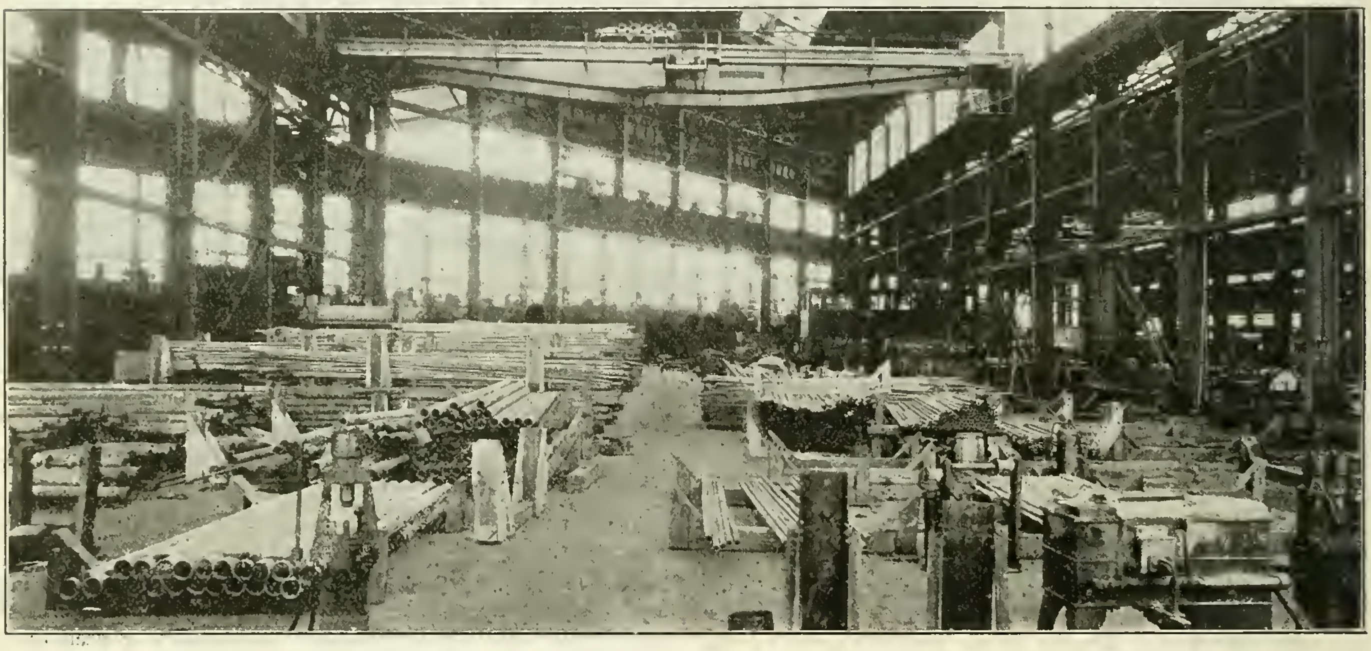
The progress of the engine from the wheeling pit to the outside of the shop usually requires from five to six days. Should any unexpected delay hold up the progress of an engine on this track, it is moved out of the way by the cranes so that those behind it are not thrown off schedule.

Boiler Shop and Fittings Department

The drawing shows the general arrangement of the departments which occupy the parallel bays opening into the erecting shop. Like the erecting shop, each of these bays is well equipped with overhead cranes, and a comparatively small amount of special equipment has been installed.

Starting at the south end of the erecting shop, the first of these bays is occupied by the flanging department. This bay is about 50 ft. wide and is served by one 40-ton overhead crane. It is equipped with an annealing furnace, three open fires and one hand and one pneumatic flanging clamp.

The next bay, which is about 90 ft. wide, is occupied by the flue shop, the arrangement of which is shown in one of the photographs. The equipment includes three welding sets, each consisting of a Draper hammer and a Ferguson furnace. One of these is used on superheater flues and the other two on tubes. These facilities are arranged along the south wall of the bay. Two Ryerson flue rattlers of the wet type have been placed on the shop floor at the east side of the bay near the erecting shop, one of which can be loaded and unloaded by crane, while the other requires manual loadings. The flues are tested under 100 lb. air pressure, submerged in water.



Looking Down the Flue Shop

Owing to the practice of the Morgan Engineering Company of taking in as many locomotives as the available erecting floor space will permit, irrespective of the number on which work is actually being performed, a large number of sets of tubes are stored in the flue shop. Instead of progressing from one operation to another with no intermediate handling, the practice is to complete each operation on each set of tubes, after which the entire set is moved by crane to the station of the next operation.

The outer end of the third bay is occupied by the boiler shop for laying out firebox sheets. The remainder of this bay is devoted to the repair of detail fittings. On the west side are located a battery of six small engine lathes, a small shaper and one Lassiter-Milholland staybolt machine. The latter machine gives an output of 350 staybolts, turned and threaded, in 12 hours. On the east side are located two planers which are used on shoes and wedges, as well as one small combination open-side planer and shaper. This bay is approximately 50 ft. wide and is served by one 10- and one 25-ton crane, the heavier crane being located toward the erecting shop end.

The next bay to the east, which is approximately 90 ft. wide, is devoted to heavy boiler work. Here the work on all boilers requiring new fireboxes or back ends is completed before the boilers are returned to the erecting shop. This department is provided with one vertical and one horizontal punch, a vertical shear and a radial drill for drilling tube sheets. The shop is not equipped with a heavy bending roll and all firebox or boiler shell sheets requiring bending are sent outside. On the east side of this bay is located a testing block for superheater units. Here all units are tested and inspected as they are removed from the locomotive, to locate those requiring renewal. After the units have passed this test, they are stored in sets in the next bay, so piled that all header joints are accessible. The joints are ground with a portable machine as they lie in the pile.

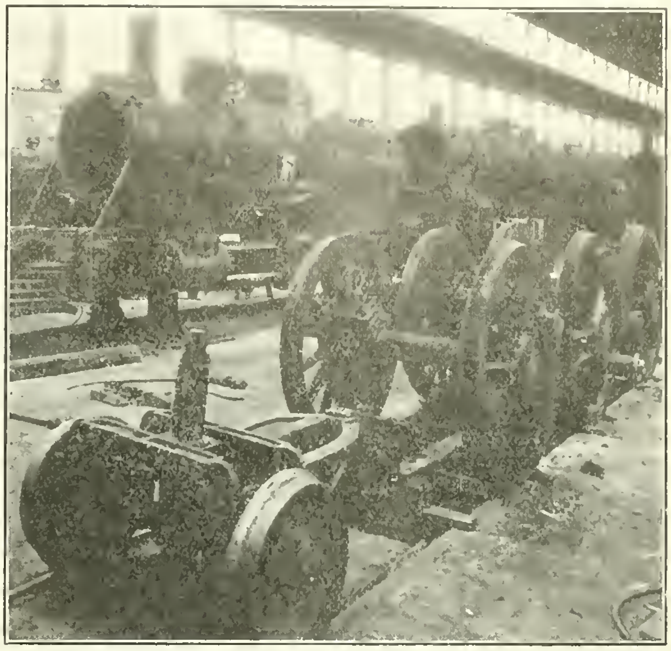
This bay is equipped with one 25-ton crane toward the south end, and a 40-ton crane toward the erecting shop end. The floor space at the inner end of the bay is available for spotting a number of locomotives. Engines to be placed in this space, after being unwheeled, are moved by the erecting shop cranes to the wheeling track on the east side of the erecting bay, and placed on two car trucks provided with heavy timber bolsters. The engine, thus mounted, is then hauled into the lateral bay, over the track shown in the drawing, by using a cable attached to the 40-ton crane. This brings it under the cranes of the lateral bay, by means of which it can be moved to its assigned space on the floor.

The outside bay is about 50 ft. wide. It is devoted to engine truck repairs, cabs, and superheater unit storage. Space is also provided in this bay, just off the erecting shop, for lagging storage and reclamation. No provision is made for remolding broken lagging. Broken material is pulverized and tempered for bulk use in plastic form.

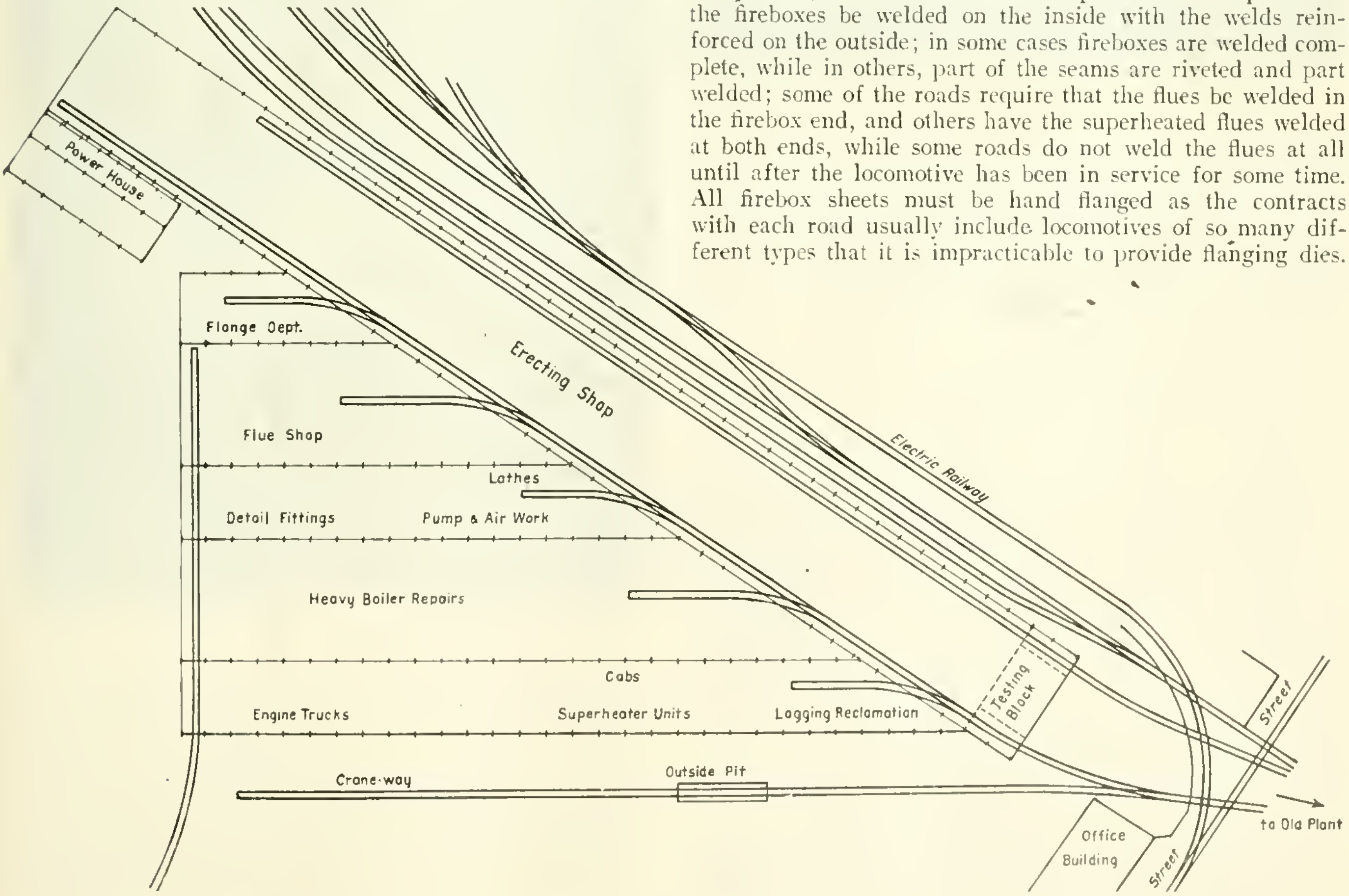
This bay, which is equipped with two 10-ton cranes, was formerly used as a tender repair shop. Tender work, however, has now been transferred to one of the buildings in the manufacturing plant, which was formerly occupied by the iron foundry.

Work Can Not Be Standardized

The work of the shop is necessarily affected by the fact that the shop is usually working on locomotives for from seven to ten different railroads, each of which has its own standards, not only as to the type and size of details, but as to shop methods. This is particularly true with respect to the boiler work. All boiler welding is done by the electric process, but in some cases the specifications require that the fireboxes be welded on the inside with the welds reinforced on the outside; in some cases fireboxes are welded complete, while in others, part of the seams are riveted and part welded; some of the roads require that the flues be welded in the firebox end, and others have the superheated flues welded at both ends, while some roads do not weld the flues at all until after the locomotive has been in service for some time. All firebox sheets must be hand flanged as the contracts with each road usually include locomotives of so many different types that it is impracticable to provide flanging dies.



Pits Have Been Provided Under the Wheeling Track

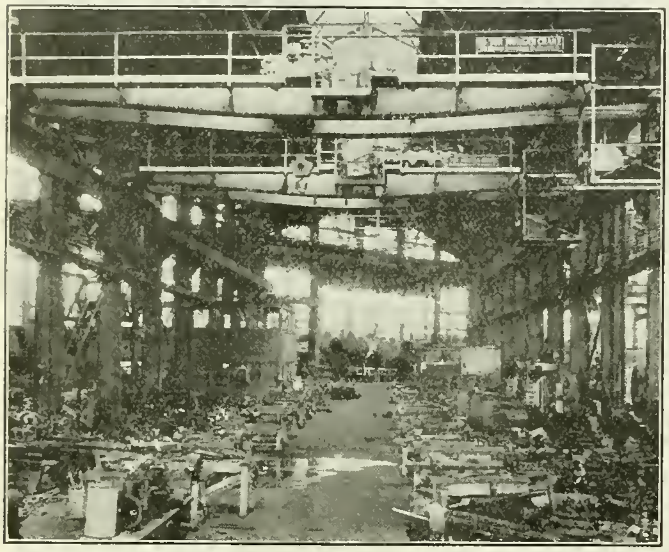


Layout of Morgan Engineering Company Locomotive Repair Shop

Each railroad has its own inspection organization, and both the Morgan Engineering Company and the railroad inspectors are provided with complete sets of drawings of the locomotives passing through the shop. Much of the material, particularly brass and iron castings and all special fittings, are furnished by the railroad. Each railroad is provided with its own storehouse in charge of its own storekeeper. These stores are housed in small buildings of frame construction, adjoining the south wall of the parallel bays.

Shop Organization

All heavy machine work, such as that required on running gear parts, motion work, cylinders and other castings, is handled in the machine department of the manufacturing plant, where the parts are routed through the shop and assigned to machines along with the material going through the plant on production jobs. All blacksmith operations, as well as machine operations, are also handled at the manufacturing plant.



Detail Fitting Department, Looking Toward the Erecting Shop

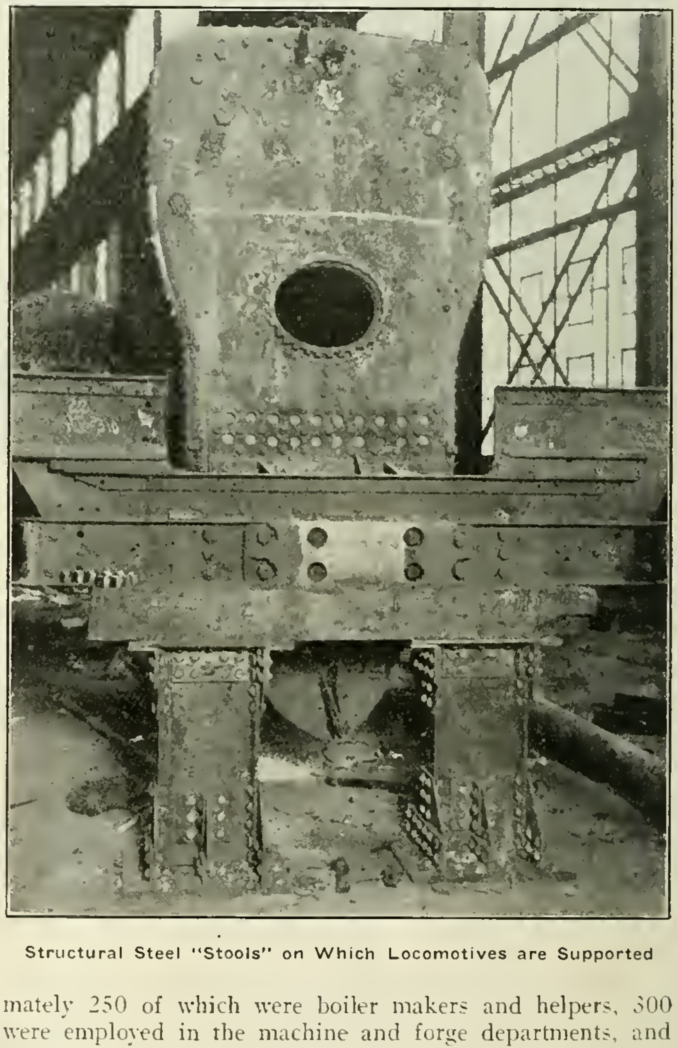
To a large extent the employees engaged in locomotive repair work, aside from those in the manufacturing departments, are semi-skilled men, rather than fully qualified mechanics. The work is, therefore, specialized in all departments under the jurisdiction of the superintendent of the locomotive repair department.

In the erecting shop, most of the gangs are small and highly specialized, working under gang leaders. The stripping gang, to which brief reference has already been made, is one of the largest, including a foreman, two gang leaders and 25 men.

A special gang is organized to handle work such as boring cylinders, valve chambers, putting on new cylinders and frames, etc. Motion work, shoes and wedges, spring rigging, brake rigging, lagging, jacketing, pipe fitting, rods, wheeling and binders, headlight and lighting equipment, truck repairs, tank repairs, and running test work is each in charge of a separate gang. The detail fitting department, in which about 75 men are employed, is in charge of a foreman, who has two assistant foremen, one in charge of the machines and the other of the fitting. All work pertaining to wheeling the locomotives and the motion work is in charge of one foreman. Another foreman supervises the spring rigging and shoe and wedge work. A third is in charge of all other work on the wheeling track. All welding and cutting work is handled by one gang, which is in charge of a foreman. There is one general foreman in charge of the machinist and floor work and another in charge of the boiler department. Practically none of the supervisors, or of the employees have had previous railroad shop experience. The organization has been built up from the Morgan Engineering Company's own personnel.

Eighty per cent of the men in the boiler department are also semi-skilled specialists. In this department, one gang does nothing but remove sheets which are to be renewed. The sheets are then taken to the laying out department, where the new ones are laid out, punched, sheared and made ready for the fitters. The fitting gang then assembles the sheets ready for the welders or riveters. The welding is performed first, after which the remaining joints are riveted and caulked. The staybolts are then applied, followed by the crown bolts, each operation being performed by a separate gang. The boilers requiring new fireboxes or back ends are removed to the boiler shop. After the above operations have been completed, each boiler is sent to the test block, where it is washed out and the tubes applied. It then receives a hydrostatic test and is placed back on its assigned "spot" on the erecting floor where a miscellaneous gang cleans up any work developed as a result of the test. The testing block gang takes care of all boiler work which develops during the running test after the locomotive has left the shop.

During the month of June, there was an average of about 1,000 men actually working on locomotive repairs, approximately 250 of which were boiler makers and helpers, 300 were employed in the machine and forge departments, and 450 on the erecting floor, air brake repairs and tank shop.



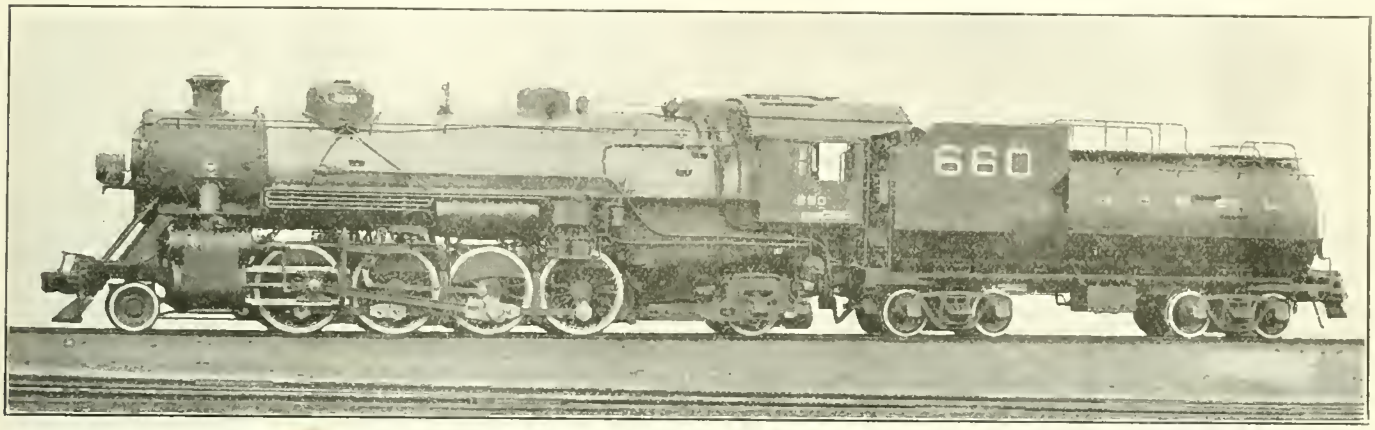
Structural Steel "Stools" on Which Locomotives are Supported

During the month of June the output was 36 locomotives, none of which, of course, required less than Class 3 repairs—many of them running very heavy. Of the 40 engines completed during the month of July, two boilers required complete new back ends; seven required new fireboxes; 20 required new back tube sheets, door sheets and inside side sheets. The remaining 11 required either new back flue sheets or new side sheets and patches.

Locomotive Service Tests on the N. C. & St. L.

Engine with Nicholson Thermic Syphons Runs Against One of Similar Design Not So Equipped

During the early part of the present year the Nashville, Chattanooga & St. Louis made a series of road tests of two Mikado type locomotives of similar dimensions, one of which was equipped with Nicholson thermic syphons, to determine a comparison of the performance of thermic syphon-equipped locomotives with others not so equipped. The results of these tests are of interest in that they confirm the results which have been obtained in similar tests on other railroads, in which the locomotives equipped with the syphons have invariably shown a reduction in fuel consumption per one thousand gross ton miles.



N. C. & St. L. Locomotive No. 660 Equipped with Nicholson Thermic Syphons

A comparison of the principal dimensions of the two locomotives is shown in one of the tables. It will be seen that, while they are generally similar, there are a number of slight differences. The cylinders of engine No. 651 are of slightly larger diameter than those of engine No. 660, the syphon-equipped locomotive, while the driving wheels of the latter locomotives are three inches larger in diameter than those of the non-syphon locomotive. These differences in dimensions account for the difference in the tractive effort, which is 58,300 lb. for locomotive No. 651 and 54,800 lb. for locomotive No. 660.

The only other difference worthy of comment is in the distribution of the heating surface. Engine No. 660, which is one of 12 new Mikado type locomotives equipped with thermic syphons delivered to the Nashville, Chattanooga & St. Louis in November, 1922, has five more superheater units than the earlier class to which engine No. 651 belongs, and 26 less 2¼-in. tubes. The result of these differences is that the new locomotive has 139 sq. ft. less tube and flue heating surface and 110 sq. ft. more superheating surface. Both locomotives have the same size firebox, the only difference in firebox heating surface being that resulting from the application of two syphons, which are installed with two of the four arch tubes used in the older locomotives. Including arch tubes and syphons, engine 651 has a total of 317 sq. ft. of firebox heating surface, while engine 660 has a total of 371 sq. ft. of firebox heating surface.

Owing to the fact that a smaller tender is used with the new locomotives, there is a difference in the total weight of engine and tender of approximately 16,000 lb. in favor of the new locomotive.

The syphon-equipped locomotive had been in service about 60 days prior to the beginning of the tests. Locomotive 651 was turned out of the back shop about 40 days prior to the tests and was in good condition. Throughout all of the test runs the same crews operated both locomotives, which are equipped with stokers, and were fired by a traveling fireman.

The tests were made on the Chattanooga division between Nashville, Tenn., and Cravens, a district 149 miles long. Southbound, there are two ruling grades, one about five miles long, of 0.92 per cent and the other about seven miles long, of 0.93 per cent. Northbound, there is one ruling grade of 0.94 per cent, six miles long. In addition to these grades, there are pusher grades, where a helper is used in both directions, over the Cumberland mountains.

A dynamometer car was used for recording the speed, drawbar pull and the location of throttle and reverse lever positions. Water calculations were made by measuring the water before and after filling the tank and coal calculations were made by measurement of the amount of coal in the tank before the beginning and after the completion of each run. The tests were made with through tonnage freight trains, with a tonnage rating southbound of 1,800 tons and northbound of 1,600 tons. The tonnage was calculated by using the stenciled weight of empty cars and the scale weights of loads, taken from the bills.

Dimensions of Locomotives Used in N. C. & St. L. Thermic Syphon Tests

	Without syphons	With syphons
Locomotive No.	651	660
Type	Mikado	Mikado
Tractive force, lb.	58,300	54,800
Weight on drivers, lb.	220,000	220,000
Weight of engine and tender in work. order, lb.	481,340	465,000
Cylinders, diameter and stroke, in.	26 5/16 by 30	26 by 30
Diameter driving wheels, in.	60	63
Heating surface, sq. ft., 5½-in. flues	1,090	1,231
2½-in. tubes	2,407	2,127
Firebox	290	290
Arch tubes	27	12.5
Syphons	....	68.5
Total, evaporating	3,814	3,729
Superheater	882	992
Firebox, length and width, in.	114⅛ by 84¼	114¼ by 84¼
Grate area, sq. ft.	66.7	66.7
Tender capacity, water, gal.	10,187	9,739
Coal, tons	16	16

Test data were compiled for three trips southbound and four trips northbound. The average results of test trips in both directions are shown in one of the tables. Southbound, the average conditions were favorable for the non-syphon locomotive. The trip with this locomotive included an average of 1 hr. 15 min. less dead time than those with the syphon-equipped locomotive and the atmospheric temperature averaged more than 12 deg. higher. Both the average trainload handled by the syphon-equipped locomotive and the average speed while running was higher than for the other locomotive, and the fuel consumption per thousand gross ton miles was 9.91 per cent less. Comparing the performance on a drawbar horsepower-hour basis, the syphon locomotive showed a fuel consumption of 4.02 per cent less than the other locomotive, while the equivalent evaporation per pound of coal was 14.26 per cent greater.

On the northbound trip the conditions as to delays favored the syphon-equipped locomotive; the average dead time of 2 hr. 35 min. per trip with this locomotive was 52 min. less than the average for the other locomotive. The difference in average tonnage on the northbound trip was slight, although the number of cars averaged one less per train for the syphon-equipped locomotive than for the non-syphon-equipped locomotive.

On these test trips the syphon-equipped locomotive showed an average fuel consumption 11.52 per cent less per thousand gross ton miles than the other locomotive. On these trips the fuel rate per drawbar hp.-hr. of the syphon-equipped locomotive was 8.57 per cent less than that of the non-syphon-equipped locomotive, while the equivalent evaporation per pound of coal was only 7.01 per cent greater.

Comparison of Average Performance of Syphon and Non-Syphon Equipped Locomotives

	Southbound			Northbound		
	Loco. 651, without syphons	Loco 660, with syphons	Difference, per cent	Loco. 651, without syphons	Loco. 660, with syphons	Difference, per cent
Atmospheric temperature, deg. F.	62.6	49.0	....	58.0	41.2	....
Total time on road, hr., min.	10–34	11–26	....	10–04	8–43	....
Total running time, hr., min.	6–52	6–33	....	6–37	6–03	....
Total dead time, hr., min.	3–42	4–53	....	3–27	2–35	....
Speed, m. p. h.	21.81	22.81	+4.59	22.64	24.76	+9.36
Number of stops	12	13	....	12	12	....
Tons per train	1,763	1,806	+2.38	1,569	1,555	—.89
Cars per train	42	42	....	40	39	....
Gross ton miles, thousands	262.6	270.0	+2.82	235.3	231.8	—1.49
Total ft. lb., millions	12,838	12,351	—3.79	10,206	9,887	—3.13
Total coal fired, lb.	39,927	34,155	—7.51	31,148	27,392	—12.06
Total water, lb.	222,639	235,580	+5.81	195,403	183,453	—6.12
Coal per hr., per sq. ft. grate area	81.2	78.4	—3.46	70.7	68.1	—3.68
Equivalent evaporation, lb. water per lb. coal	6.03	6.89	+14.26	6.27	6.71	+7.01
Coal per 1,000 gross ton-miles, lb.	140.2	126.3	—9.91	133.7	118.3	—11.52
Water per 1,000 gross ton-miles, lb.	847.9	872.3	+2.88	829.8	792.2	—4.53
Coal per drawbar hp.-hr., lb.	5.72	5.49	—4.02	6.07	5.55	—8.57
Water per drawbar hp.-hr., lb.	34.52	37.83	—9.59	37.82	36.86	—2.54

In neither case was there any difficulty in maintaining boiler pressure. The temperature of the steam entering the cylinders, however, averaged 19 deg. higher in engine 660 than in engine 651, the temperature being 607 deg. and 588 deg., respectively.

Combining the runs made by each locomotive in both directions, it will be seen by referring to the table that the syphon equipped locomotive handled a slightly larger average train load over the division in an average of almost one-half hour less time, with 10.7 per cent less fuel per one thousand gross ton miles.

Average Performance of Combined Northbound and Southbound Runs

	Loco. 651, without syphon	Loco. 660, with syphon	Difference
Average running time, hr.	6.742	6.3	—6.55
Average speed, m.p.h.	22.225	23.785	+7.0
Tons per train	1,666.0	1,680.5	+0.9
Gross ton-miles, thousands	248.95	250.9	+0.8
Lb. coal per 1,000 gross ton-miles	136.95	122.3	—10.7
Lb. water per 1,000 gross ton-miles	838.85	832.25	—0.8
Average drawbar hp.	867.0	889.5	+2.59
Lb. coal per drawbar hp.-hr.	5.87	5.48	—6.6

Combustion Chamber Boilers*

Owing to the importance of the subject your committee sent inquiries to those members who have had the longest experience with the combustion chamber. The inquiries included: General efficiency of chamber. Defects that were first to develop and remedies applied. Number of broken bolts per engine per month, and kind of bolt. Defects developing in the various parts of the chamber, and the life of the parts. Size or length of chamber. The diameter, length and number of tubes and flues. Whether equipped with brick arch or not. Hand fired or stoker? If chambers were not a success what was done to make them so?

There is a remarkable difference in the efficiency and life of the chamber on the various railroads using them. Some railroads are equipping old power with the chamber, others are removing the chamber and applying the straight box, also ordering new equipment with the straight box. There also is a great difference in the length of chambers. Those mentioned in our correspondence varied in length from 24 in. to 56 in.

The majority agree on the fact that the chamber is the cause of breaking many more staybolts than were broken in the straight box. Although most of this has been taken care of by the application of flexible bolts, one writer says: "We renewed as many as 35 to 40 staybolts per engine per month, and although we applied a full installation of flexible bolts, we still find many broken bolts."

Another member wrote: "Since applying a full installation of flexible bolts we have little trouble with broken bolts."

Other defects that develop are cracks at rivet holes of circular seam and wings of throat sheet, the former sometimes extending into the base of flange.

Pits, grooves and cracks, occur along both top and bottom base of flue sheet flange and from base of flange to flue holes. These cracks often extend in both a vertical and horizontal direction, sometimes extending through bridges.

Cracks at arch tube holes. Cracks at front row of staybolt holes in bottom of chamber extending from 18 to 30 in. in length. Cracks at base of throat sheet wings.

Excessive pitting and grooving of wrapper sheet back of flue sheet seam and over front portion of crown.

Staybolt leakage in bottom of chamber.

To remedy the trouble with circular seams and wings flanges and wings of new throat sheets were extended and autogenously welded.

Defective flue sheets were renewed in some cases at the end of two years' service; in other cases at the end of three or four years. One member wrote: "Back flue sheets in our Pacific type engines with 72-in. shell and 36-in. combustion chamber last seven years. With straight standard firebox flue sheet gave four years' service." Two other members wrote: "Our combustion chambers are seven years old, but we have not renewed any flue sheets." The tendency to crack at arch tube holes was taken care of by one member by additional bracing when renewing throat sheet. The cracks at base of throat sheet wings were remedied by increasing the radius of the flange in new applications. The leakage of bolts in bottom of chamber was stopped by applying a layer of fire brick over the affected part.

A majority of the writers agreed that the tubes and flues were more efficient in the chamber type boiler, and their mileage was increased from 50 to 100 per cent.

There is considerable difference in the number and length of tubes and flues in the combustion chamber boilers. The smallest has 158, 2-in. and 22, 5½-in., length 16 ft. 2 in., the largest has 275, 2¼-in. and 50, 5½-in., length 21 ft. 0 in.

The report was signed by H. J. Raps (I. C.) chairman and Emil Ziegenbein (M. C.).

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*Abstract of a report submitted at the Annual Convention of the Master Boiler Makers' Association, Detroit, Mich., May, 1923.

Power Plant Equipped to Burn Fuel Oil

Flexible Boiler Operation and Labor Saving Secured by Burning Oil in Enginehouse Power Plant

THE power plant at the Boston (Southampton street) enginehouse of the New York, New Haven & Hartford supplies steam and compressed air not only for the enginehouse needs but for the South Bay passenger car yards. Steam is generated at 200 lb. pressure by two 300-hp. boilers, the steam pressure in the yard being reduced to 80 lb. The air pressure carried is 110 lb. Up to December 1, 1922, these two boilers were fired with bituminous coal, arrangements being made on that day to change over from coal burning to fuel oil-burning equipment, the apparatus for which had been installed.

When operated coal burning, the two boilers consumed 30 to 35 tons of coal in 24 hours and in view of the increased demand for steam, it was practically impossible to keep up pressure especially when one boiler was shut down for cleaning the fire which occurred every 8 hours. It was, therefore, a question of increasing the number of boilers at Southampton street, installing some equipment which would give the boilers a greater overload capacity, or rendering the boiler operation more uniform by eliminating the necessity for cleaning fires. The latter alternative was chosen and oil-burning equipment installed, not only eliminating the difficulty formerly found in cleaning fires, but greatly reducing the labor costs of handling coal and ashes. The boilers, as equipped to burn fuel oil, were operated continuously for a period of several months and at no time was there demands for steam in excess of the boiler capacity.

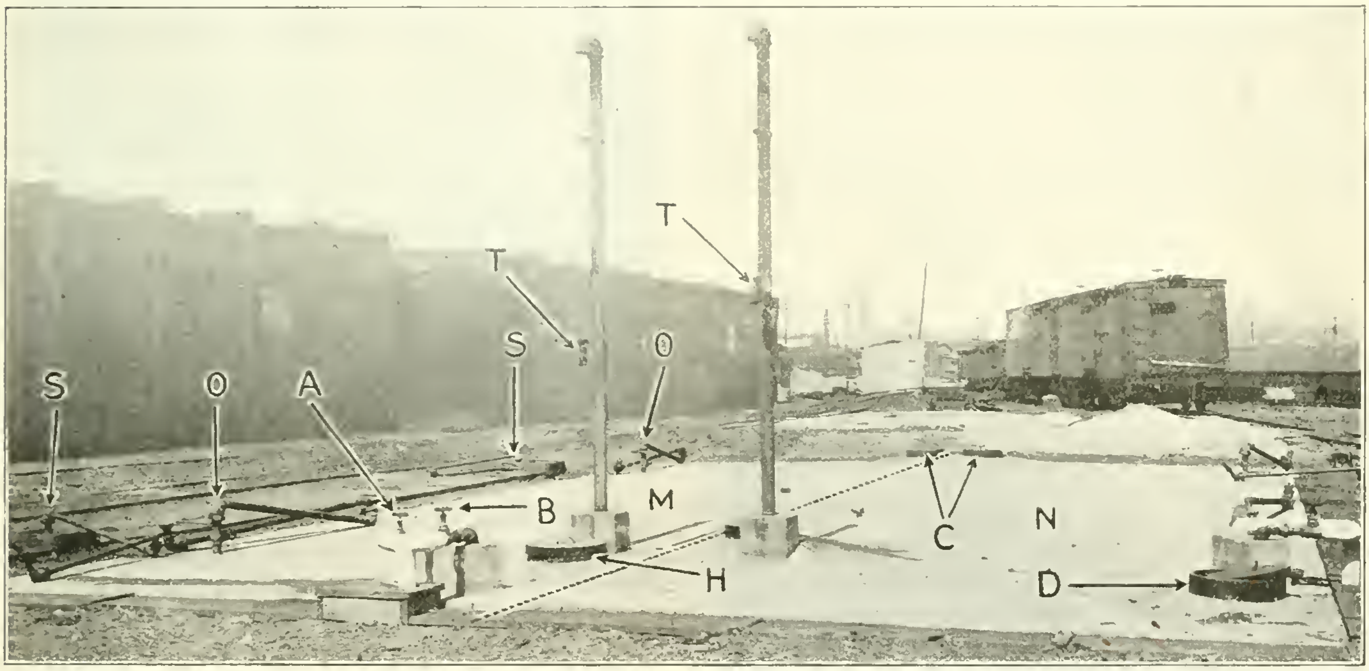


Fig. 1—General View of Oil Storage Tank with Telltales Indicating the Two Sections to Be About One-Half Full of Oil

Material Reduction in Labor Costs

The saving in labor may be appreciated from the fact that in winter eight men were ordinarily required for unloading coal, with three firemen and two coal passers. The services of nine of the thirteen laborers, coal passers and firemen are no longer required, there now being employed with the oil-burning equipment only three firemen and one laborer. This force is the same for both summer and winter.

Description of Storage Tank

An important part of any oil-burning equipment is the storage tank for holding oil which in this case has some features of special interest. The Southampton street enginehouse is located largely on made land and it was necessary, therefore, to secure a solid foundation for the storage tank and make it of some material which would resist the action of ground water at high tide. The problem was solved by excavating and driving piles below low-water level, six concrete supporting ribs being cast on these piles and the tank itself, of reinforced concrete, resting on these ribs. The outside dimensions of the tank are 30 ft. by 50 ft. by 5 ft. deep, the top being flush with the surface of the ground as shown in Fig. 1. The tank is divided lengthwise into two main sections, *M* and *N* (indicated by the dotted line), each of these sections being separated into a cold and hot well by an additional cross partition. The hot wells are comparatively small, located in the nearer ends of the two sections and provided with heating coils to keep the oil at a temperature for ready circulation. Holes near the bottoms of the cross partitions enable oil to flow from the cold to the hot wells.

Sections *M* and *N* are practically duplicates so a description of only one (section *M*) will be given. Referring to Fig. 1, section *M* is filled with oil from tank cars through pipes *OO*, the oil in the car being kept at approximately 100 deg. F. so that it will flow readily by means of steam from pipes *SS*. It will be noted that a similar set of oil and steam pipes is provided at the right in Fig. 1 for section *N*. Manholes *CC* give admittance to the cold wells and *H* to the hot well. Manhole *D* leads to a small dry tank in the nearer end of section *X* used for purposes of inspection. Telltales *TT* indicate the level of oil in the two tanks respectively. The hot well in each case is provided with six coils of 1¼-in. pipe 6 ft. long, laid 4 in. above the bottom of the tank to keep the oil in this section at the proper temperature so that it will readily flow to the pump in the power house. All of these pipe joints are welded and tested before application. Valve *A* controls the steam supply to the hot tank and consequently its temperature. Valve *B* admits steam to a blanket line to be used in case of fire. A by-pass is provided from one tank into the other for possible use in emergency.

Vacuum Heating and Pumping System

From the tank, oil is piped to the Worthington vacuum heating and pumping system, illustrated in Fig. 2. This consists of two duplex pumps, one heater *H*, two oil strainers *SS*, two thermometers *TT* and a Bowser oil meter *M*. The temperature is raised by means of this heater to 180 deg. F., the steam pressure on the heater being 30 lb. The exhaust from the pumps is fed to the heating system.

The particular feature of this pump is its arrangement in duplicate throughout with by-passes at each important point so as to provide for continuous operation of the boilers in all emergencies. The by-pass around the oil meter is shown at *B*. The upper gage (not shown in the illustration) registers steam pressure at 30 lb., the lower gage *G* showing oil pressure at 40 lb. Oil is delivered to the boilers at 35 lb. pressure. On an average, 1,144 gal. of fuel oil are used in eight hours as registered by meter *M*. Ordinarily 15,000 gal. of water are used, more being required in cold weather.

Engo Oil Burners Used

The burners used with this equipment are known as Engo oil burners made by the Engineer Company and installed as shown in Fig. 3. The burners themselves are in operation, being hidden by the guard plates *GG* which serve to protect firemen against the heat from the boiler. The draft gage for the boiler is shown at *D* and the oil pressure gage at *O*, *S* being a steam gage and *T* a thermometer for registering the temperature of the oil. Referring to the oil-burning unit at the left, which is a duplicate of the one at the right, *A* is the valve for controlling steam to the burner and *B* the valve controlling the oil supply. Valve *C* controls the amount of mixture fed to the furnace and therefore the intensity of the flame. Adjusting handle *E* controls the amount of air admitted to the boilers by opening or closing a fan-shaped ventilator. In the illustration this ventilator is well open giving a view of the intense flame in the furnace through the openings.

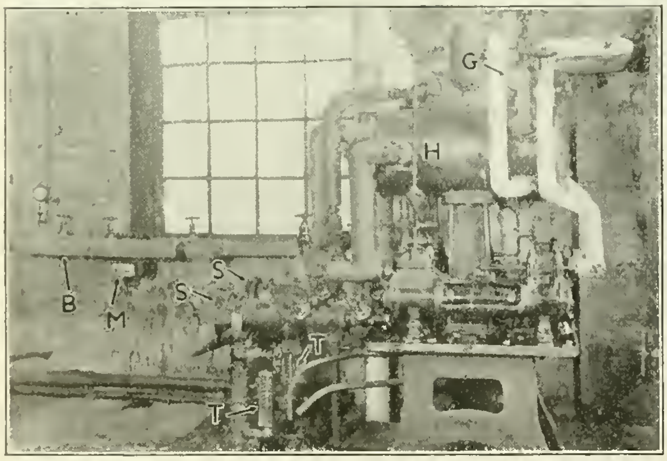


Fig. 2—Worthington Vacuum Heating and Pumping System

Certain precautions must be observed in operating oil-burning equipment. In the first place, in the hot well of the storage tank oil must not be overheated or it will vaporize with resultant danger of explosion. As a further precaution, all open lights must be kept away from the storage tank. In the boiler room it is not advisable to depend upon hot brick for igniting a burner which has gone out in view of the possibility of explosion. The operation of the boilers must be watched a little closer when burning oil than coal for this reason. It is important to see that the burners are not forced to such an extent that flames enter the tubes, evaporating the water so fast that adequate protection is not afforded the tubes which as a result burn out.

One man should be on the watch continuously with oil-burning furnaces especially when each furnace has only one burner. Otherwise that burner might accidentally go out and the accumulated oil spray fed into the furnace create an explosive mixture.

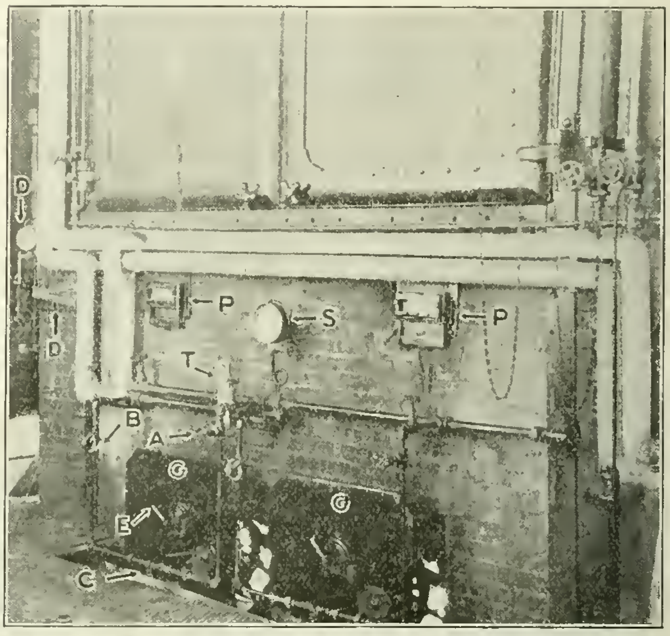


Fig. 3—300-Hp. Boiler Equipped with Engo Oil Burners

Advantages from Burning Fuel Oil

The results secured at the Southampton street enginehouse power plant with oil-burning equipment have demonstrated the following important advantages: There is an increase in boiler capacity owing to more continuous operation and greater capacity for overload. The cost of fuel oil is roughly about the same as the cost of coal but there is a material saving in the labor formerly required to handle coal and ashes. Owing to the intense heat of the fuel oil flame, fire brick burn out, but not more rapidly than they are knocked out with the slice bar when burning coal. Boiler operation is more flexible with fuel oil, allowing a quicker response to sudden demands for steam. More accurate control of smoke is afforded, a particular advantage in the vicinity of large cities having smoke ordinances. The fire can be put out instantly with no loss of fuel such as occurs in banking a coal fire. It is possible to get more heat with less draft, the stack draft in this case being .15 in. and the furnace draft, .07 in. In addition, the boiler room can be kept in a much cleaner and more presentable condition with a favorable effect on the morale of the boiler room force.

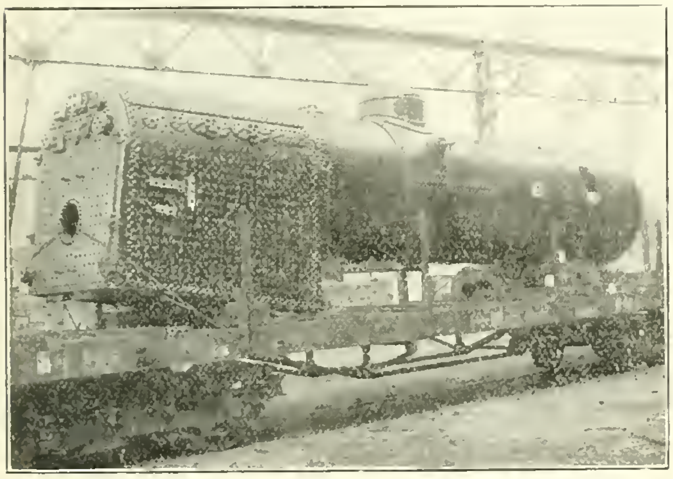
THE BRITISH SECRETARY OF STATE for the Colonies has given his approval of the construction of a new railway in the central province of the Gold Coast Colony, according to Department of Commerce cables.

Consolidation Locomotive for the Polish State Railways

By J. Dabrowski

THE new plant of the first Polish Locomotive Works at Chrzanow, Poland, a brief description of which was given in the *Railway Mechanical Engineer*, September, 1922, has been completed and locomotives are now being delivered. The Polish Government placed an order with this company for the construction of 1,200 locomotives, deliveries to extend over a period of 10 years. The order included several types of locomotives for both freight and passenger train service. The first locomotives to be built are of the Consolidation or 2-8-0 type for handling freight traffic.

As the boiler shop of the locomotive works was not completed for operation as soon as the machine and erecting shops, the boilers for these Consolidation type locomotives are being built by the oldest boiler construction plant in the country, W. Fitzner and K. Gamper, Sosnowice, Poland. The photograph of one of these boilers loaded for shipment shows them to be of a good modern type.



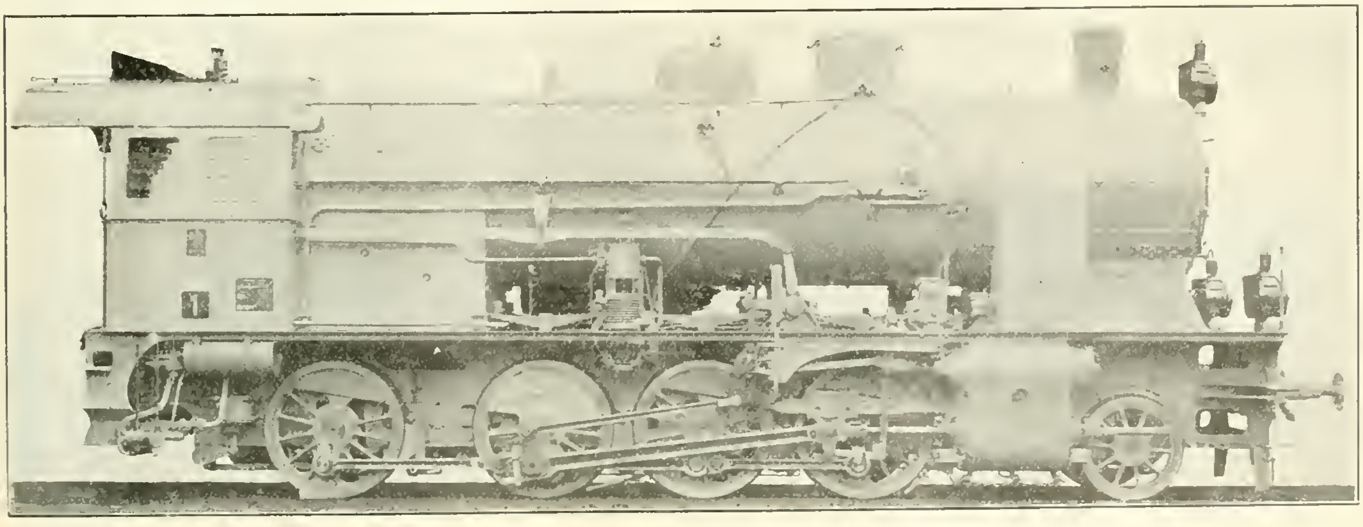
Boiler for One of the Polish Consolidation Locomotives

The 2-8-0 type locomotive is used extensively in Poland. An order for 150 locomotives of this type was given to the Baldwin Locomotive Works in 1920, and 25 additional locomotives of the same design were ordered subsequently. In the future, new locomotives will probably be built in Poland provided the capacity of the local plants is sufficient.

As conditions of track and bridges limit the axle load to 17 metric tons, the weight on the driving wheels of a Consolidation locomotive can not exceed 150,000 lb. New bridges, however, are being designed for axle loads of from 20 to 25 tons. The tendency in Poland is toward larger freight cars and heavier train loads than in most other European countries. A considerable number of 30-ton freight cars are in service, many of them having been furnished by American builders.

The new Polish locomotive illustrated is equipped with a Schmidt superheater and a Knorr feedwater heater. Westinghouse air brakes for drivers and train are also provided, the air brake now being applied to all new locomotives and cars, both passenger and freight. It has a greater cylinder horsepower, tractive effort and heating surface than the Baldwin locomotive, although the weight on the drivers differs but little. A comparison of the leading dimensions of the two designs is given in the accompanying table:

Dimensions Weights and Proportions:	Polish Consolidation Locomotive	
Builder	Polish Works	The Baldwin Locomotive Works
Track gage	4 ft. 8½ in.	4 ft. 8½ in.
Cylinders, diameter and stroke	24.2 in. by 26 in.	21 in. by 28 in.
Weights in working order:		
On drivers	149,914 lb.	148,650 lb.
On front truck	26,456 lb.	15,150 lb.
Total engine	176,370 lb.	163,800 lb.
Tender	1[illegible]5,820 lb.	117,500 lb.
Wheel bases:		
Driving	16 ft. 7 in.	15 ft. 6 in.
Total engine	24 ft. 11 in.	23 ft. 8 in.
Total engine and tender	55 ft. 5 in.	57 ft. 3⅞ in.
Wheels, diameter outside tires:		
Driving	53½ in.	56 in.
Front truck	39⅜ in.	33 in.
Boiler:		
Type	Straight top	Straight top
Steam pressure	184.9 lb.	191.7 lb.
Diameter, first ring, outside	71 in.	70 in.
Length over tube sheets	15 ft 3⅝ in.	13 ft. 9¼ in.
Grate area	44.3 sq. ft.	32.1 sq. ft.
Heating surface:		
Total evaporative	2,250 sq. ft.	1,862 sq. ft.
Superheating	633 sq. ft.	420 sq. ft.
Comb. evaporative and superheating	2,883 sq. ft.	2,282 sq. ft.
Tender:		
Water capacity	5,546 gal.	5,400 gal.
Fuel capacity	17,600 lb.	23,140 lb.
General data estimated:		
Rated tractive force, 85 per cent	45,180 lb.	35,925 lb.
Cylinder horsepower (Cole)	1,945	1,520
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	85	90.7
Weight on drivers ÷ tractive force	3.32	4.14
Total weight engine ÷ cylinder horsepower	90.7	107.8
Boiler proportions:		
Comb. heat. surface ÷ cylinder horsepower	1.48	1.50
Tractive force ÷ comb. heat. surface	15.67	15.74
Tractive force × dia. drivers ÷ comb. heat. surface	834	882
Cylinder horsepower ÷ grate area	43.9	47.4



First Locomotive Built in Poland for the Polish State Railways

Will It Pay to Burn Oil Instead of Coal?

By W. F. Schaphorst

The accompanying simple and handy chart will assist in deciding this question. To use the chart it is merely necessary to zigzag across as indicated by the dotted lines and line *G*, which is pointed at by the arrow at the right tells the number of B.t.u. obtained for each cent spent for coal or oil. In figuring oil begin at the top and zigzag down to line *G*. In figuring coal begin at the bottom and zigzag up to line *G*.

If the oil, for instance, costs five cents per gallon, contains 20,000 B.t.u. and the specific gravity is 0.9 and if the boiler efficiency with oil fuel is 80 per cent the zigzag dotted line shows that each cent will buy 24,000 B.t.u. Begin at 5 cents, line *A*, and run through 80 per cent, line *B*, with a straight line projected to intersect line *C*. From this intersection project a line through 20,000 B.t.u., line *D*, until it intersects line *E*. From this last intersection go through 0.9, line *F*, and the final intersection with line *G* gives the answer—24,000 B.t.u. for each cent.

Now comparing with coal, if coal costs $8 per ton of 2,000 lb. and if the boiler efficiency, using the same boiler as above, is 70 per cent with coal and if each pound of coal contains 11,000 B.t.u. each cent will buy about 19,200 B.t.u. as shown in line *G*. As will be noted the $8 is found in line *L*, and 70 per cent boiler efficiency in line *K*. Run a straight line through both points and locate the intersection in line *J*. Run a straight line through 11,000 in line *H* and the intersection with line *G* gives 19,200 B.t.u. for each cent.

In other words the solution of this problem indicates that the use of this oil at 5 cents per gallon will furnish nearly 5,000 B.t.u. more for each cent than will coal at $8 per ton.

In using line *A* the cost per gallon should include all costs—cost of hauling, cost of storing, etc.

It is well known that boiler efficiencies with oil are usually greater than with coal. The difference often is as much as 10 per cent as in this problem where we use 80 per cent in line *B* and 70 per cent in line *K*.

Regarding the specific gravity given in line *F*, an easy way to determine this is to take any vessel such as a pail, jug, or bottle, and weigh it. Then fill it with water and weigh again. Empty out the water, fill with oil and weigh once more. Subtracting the weight of the empty container, the weights of the water and of the oil are determined. Dividing the weight of the oil by the weight of the water, the quotient is the specific gravity. The less delicate the scales used for weighing the greater should be the size of the vessel.

Where a sample of the oil is not available and where the density of the oil is given in degrees Baume, the following table will be found useful in connection with line *F*.

Degrees, Baume	Specific gravity	Degrees, Baume	Specific gravity
10	1.0	55	0.76
15	0.97	60	0.74
20	0.93	65	0.72
25	0.90	70	0.70
30	0.88	75	0.68
35	0.85	80	0.67
40	0.82	85	0.65
45	0.80	90	0.64
50	0.78	95	0.62
..	...	100	0.61

To calculate the specific gravity, knowing the degrees Baume, simply add the degrees Baume to 130 and divide the sum into 140. The quotient is the specific gravity.

The cost of coal, line *L*, is similar to line *A* and must include all costs such as hauling, storing, pulverizing, and if purchased some time ago the interest on the purchase price.

This chart may be used in several ways for solving various problems. Thus by zigzagging clear across from line *A* to line *L* knowing the cost of oil and all the necessary intermediate factors, line *L* gives the equivalent cost of coal. Or zigzagging up from line *L* we get the equivalent cost of oil. Thus with coal at $6 per ton and the boiler efficiency at 70 per cent we would find that a heat value of 10,300 B.t.u. per pound of coal would give us no advantage in using oil as regards cost of oil. But oil has other advantages such as less labor needed for firing, less storage space required, etc. All of these points, must be given consideration before one can decide that oil should be used in preference to coal or vice versa.

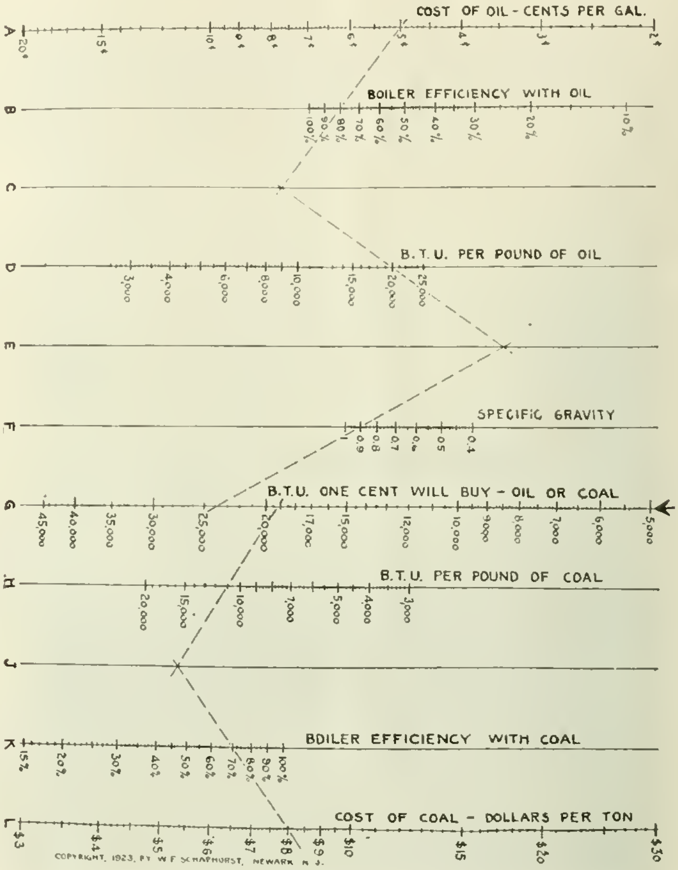


Chart for Determining Relative Value of Coal and Fuel Oil

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Ohio Electro Magnet Proves Value In Handling Tangled Scrap

Rules Governing Care of Stationary Boilers*

1. Safety Valves: Great care should be exercised to see that these valves are ample in size and in working order. Overloading or neglect frequently leads to the most disastrous results. Safety valves should be tried at least once every day to see that they will act freely.

2. Pressure Gage: The steam gage should stand at zero when pressure is off, and it should show the same pressure as the safety valve when that is blowing off, if not, then one is wrong, and the gage should be tested by one known to be correct.

3. Water Level: The first duty of an engineer before starting, or at the beginning of his watch, is to see that the water is at the proper height. Do not rely on glass gages, floats or water alarms, but try the gage cocks. If they do not agree with water gage, learn the cause and correct it. Water level in Babcock & Wilcox boilers should be at center of drum, which is usually at middle gage. It should not be carried above.

4. Gage Cocks and Water Gages: Must be kept clean. Water gage should be blown out frequently, and the glasses and passages to gage kept clean.

5. Feed Pump or Injector: These should be kept in perfect order, and be of ample size. No make of pump can be expected to be continuously reliable without regular and careful attention. It is always safe to have two means of feeding a boiler. Check valves and self-acting feed valves should be frequently examined and cleaned. Satisfy yourself frequently that the valve is acting when the feed pump is at work.

6. Low Water: In case of low water, immediately cover fire with ashes (wet if possible) or any earth that may be at hand. If nothing else is handy use fresh coal. Draw fire as soon as it can be done without increasing the heat. Neither turn on the feed, start or stop engine, nor lift safety valve until fires are out, and boiler cooled down.

7. Blisters and Cracks: These are liable to occur in the best plate iron. When first indication appears there must be no delay in having it carefully examined and properly cared for.

8. Fusible Plugs: When used, must be examined when boiler is cleaned, and carefully scraped clean on both the water and fire sides, or they are liable not to act.

9. Firing: Fire evenly and regularly, a little at a time. Moderate thick fires are most economical, but thin firing must be used where the draught is poor. Take care to keep grates evenly covered, and allow no air holes in fire. Do not "clean" fires oftener than necessary.

10. Cleaning: All heating surfaces must be kept clean outside and in, or there will be a serious waste of fuel. The frequency of cleaning will depend on the nature of fuel and water. As a rule, never allow over 1/16-in. scale or soot to collect on surfaces between cleanings. Handholes should be frequently removed and surfaces examined, particularly in case of a new boiler, until proper intervals have been established by experience.

The Babcock & Wilcox boiler is provided with extra facilities for cleaning. For inspection and washing, remove handholes at both ends of tubes, and by holding a lamp at one end and looking in at the other, the condition of the surface can be fully seen. Run the rotary flue cleaner through the tube until it is clean and free from sediment. In replacing hand-hole caps, clean surfaces without scratching or bruising, smear with oil, and screw up tight. Examine mud-drum and remove sediment therefrom.

The exterior of tubes can be kept clean by the use of blowing pipe and hose through openings provided for that purpose, and must be given frequent attention. In using smoky fuel, it is best to occasionally brush the surfaces when steam is off.

11. Hot Feed-Water: Cold water should never be fed into any boiler when it can be avoided, but when necessary it should be caused to mix with the heated water before coming in contact with any portion of the boiler.

12. Foaming: When foaming occurs in a boiler, checking the outflow of steam will usually stop it. If caused by dirty water, blowing down and pumping up will generally cure it. In cases of violent foaming, check the draft and fires.

13. Air Leaks: Be sure that all openings for admission of air to boiler and flues, except through fire, are carefully stopped. This is frequently an unsuspected cause of serious waste.

14. Blowing Off: If feed water is muddy or salt, blow off a portion frequently, according to condition of water. Empty the boiler every week or two, and fill up afresh. When surface blow-off cocks are used, they should be often opened for a few minutes at a time. Make sure no water is escaping from the blow-off cock when it is supposed to be closed. Blow-off cocks and check valves should be examined every time the boiler is cleaned.

15. Leaks: When leaks are discovered, they should be repaired as soon as possible.

16. Blowing Off: Never empty the boiler while brickwork is hot.

17. Dampness: Take care that no water comes in contact with exterior of the boiler from any cause, as it tends to corrode and weaken the boiler. Beware of all dampness in seatings or coverings.

This report was prepared by a committee consisting of J. J. Davey, N. P., chairman; Charles Zeitz and George C. Nicol, A. T. & S. F.

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* From a committee report of the Master Boiler Makers 'Association, submitted at the May, 1923 convention, Detroit, Mich.

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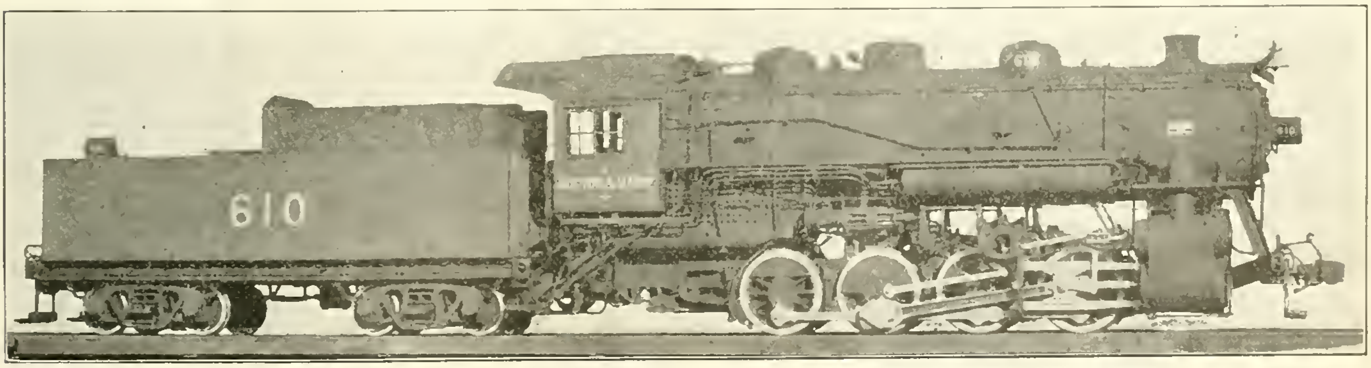
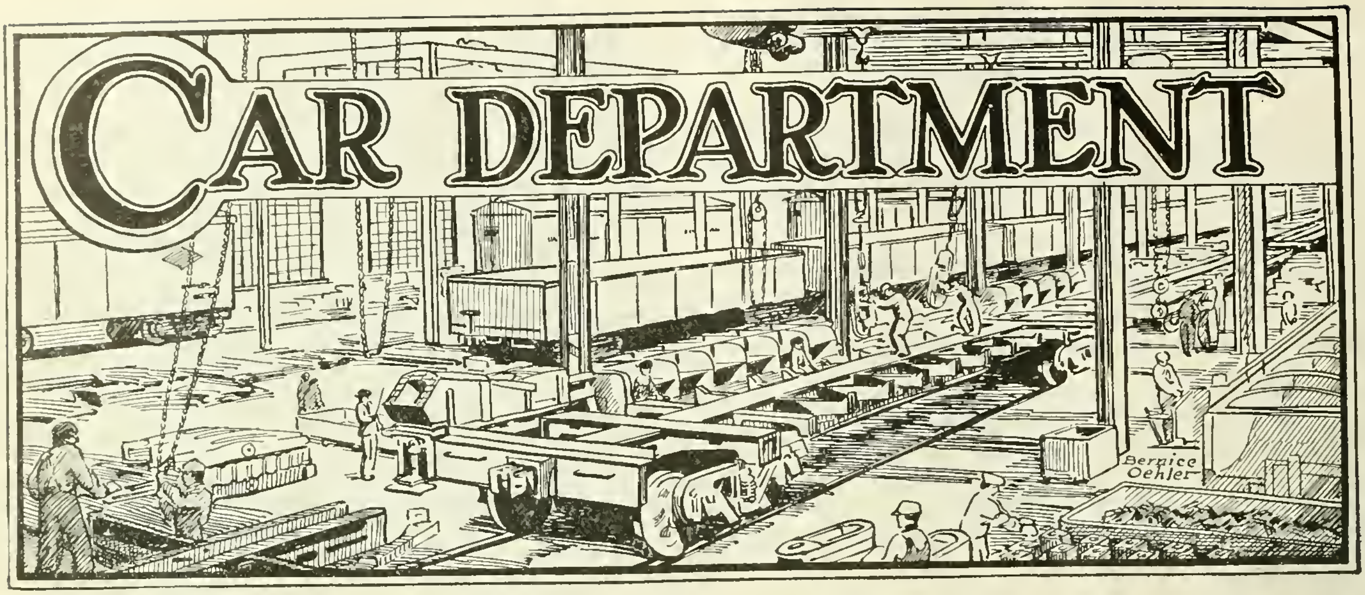


Eight-Wheel Switcher for the Boston & Maine, Built by the American Locomotive Company

CAR DEPARTMENT



Recent Developments of the Motor Coach*

Reasons for Renewed Interest—Advantages and Disadvantages of the Various Types—Performance Data

By C. E. Brooks

Chief of Motive Power, Canadian National Railways

THE motor coach is not a new departure but is one which has sunk back from a promising start 15 years ago into obscurity due essentially to high maintenance and operating costs. During the past three years, however, interest in the subject has been actively revived as a result of

a The ever-increasing encroachment of the motor bus on railway earnings

b The improvement in the design of the motor and its appurtances, and

c The attitude of the public, which the automobile is rapidly convincing that plush seats are not necessary when traveling short distances.

In order to enter into a discussion of present-day developments it will be necessary to outline briefly the service requirements, and in doing so the motor coach is presented as a "unit car" and not as a train of cars or a driving car hauling a trailer. The latter methods of operation may be possible on small interurban or suburban lines, but for practical transportation purposes they are not being considered by many large railways. The reason for this is that up to the present time it has not generally been found to be economical to replace a necessary train service with a motor coach hauling one or more trailers on account of motor-capacity limitations.

On the other hand, high train-mile costs for small returns have forced railway officials to turn to the motor coach for relief in the following classes of service:

a Giving a frequent passenger service on sparsely settled branch lines or parts of main line adjacent to market towns or junction points

b Connecting junction points on important main lines with the town or small city situated within a few miles of the main line

c Giving a group of towns situated on a main line or important branch lines a frequent connecting service over and above through main-line trains

d Connecting small summer resorts, golf clubs, etc., to branch-line or through main-line service

e Handling milk of a limited amount to a distributing or connecting point

f Providing connections to small suburbs.

Among the first real developments of the motor coach was the gas-electric car, the use of which spread rapidly 15 years ago but which unfortunately did not solve these problems successfully on account of high maintenance cost of the heavy-duty gasoline motor, uncertain service, complications of equipment, and great weight of the coach itself.

About the same time steam units having considerable weight and all the complications of the locomotive appeared, but were discarded for much the same reason.

Classification of Present-Day Developments

Present-day developments are generally to provide for traffic requirements which for the purpose of discussion are subdivided as follows:

Class A—A seating capacity of from 24 to 40 persons and provision for approximately 100 sq. ft. of baggage space. The light weight of such a car to be from 18,000 to 30,000 lb., or not to exceed 750 lb. per single seat (with baggage space) or 500 lb. per seat if no baggage space is allowed.

Smaller cars have been made and are in daily use, but considering the rapid development of traffic after cars are put into service, it is believed that the above-mentioned limits are reasonable.

Class B—Units seating from 40 to 60 passengers and providing for baggage space a minimum of 100 sq. ft. and maximum of 200 sq. ft. These cars weigh from 800 to 1,200 lb. per single seat, but it is thought that the weight must be kept down to the same limits as those prescribed for Class A in order to get fuel economy and keep maintenance costs at a reasonable figure.

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* Abstract of a paper presented at the Montreal meeting of the American Society of Mechanical Engineers, May, 1923.

Speed Requirements. Schedule speeds of 15 to 25 m.p.h. including stops. Consider a 5-mile run between stops and 1 min. for stops: Acceleration from 0 to 30 m.p.h. in 2 min. on level track, 30 to 35 m.p.h. at end of third minute, an average speed of 35 m.p.h. for the next 3¾ miles and 0.5 min. to travel 0.21 mile and come to a stop, means that in order to run 5 miles and make one stop the elapsed time is 10.9 min., or an average schedule speed including stops of 27½ m.p.h. This allows nothing for loss of time on gradients, slow orders, etc.

Generally speaking, Class A units have been gasoline-driven, and experience goes to show that this class of equipment is an economical and lasting development which will be improved to the point of high-grade automobile reliability within a short time. Already in many places these cars have retrieved business which had been lost to bus lines on the highways and also to the privately owned car, and it has been the usual thing to find that passenger traffic develops to a marked extent after a service has been instituted.

The failures have been rather heavy due to conditions described later in this paper, to the overexacting requirements of time tables, and to non-realization of the limitations of the gasoline motor.

For the purpose of description Class B units may generally be subdivided into (*a*) storage-battery, (*b*) steam, (*c*) heavy-duty gasoline-engine, and (*d*) gas-electric cars.

Class A Cars

Gasoline-Engine-Driven Motor Coach. For Class A cars weighing approximately 30,000 lb. light weight, the general practice has been to use a 4-cylinder truck engine running at a maximum speed of approximately 1,600 r.p.m. and developing a maximum of 70 hp. Wherever this type of engine has been used it has transmitted its power through clutches, transmissions, and universals to gears, most of which are of standard truck or even heavier design.

A general description of a typical power plant such as mentioned above is as follows:

Engine, 4-cylinder, 4¾ in. by 6 in.
Pressure oiling system.
Pump water-cooling system.
Primary and secondary transmission.
Primary ratio: first speed, 4 to 1; second speed, 1 to 1.

The secondary increases the ratio from 26 m.p.h. for normal engine speed to 35 m.p.h. The first provides for ruling-grade and the second for level-track conditions.

To a much less extent the automobile-type six-cylinder engine of the following general description has been experimented with:

Engine, 6-cylinder, 3[illegible]/16 in. by 5 in.
Pressure oiling system.
Gear ratio, 4.7 to 1 between engine and wheel.
Nominal engine speed at 30 m.p.h., 1,450 r.p.m.
Horsepower developed, 50 at 2,200 r.p.m.
Maximum speed, 2,200 r.p.m.
Pump water-cooling system.

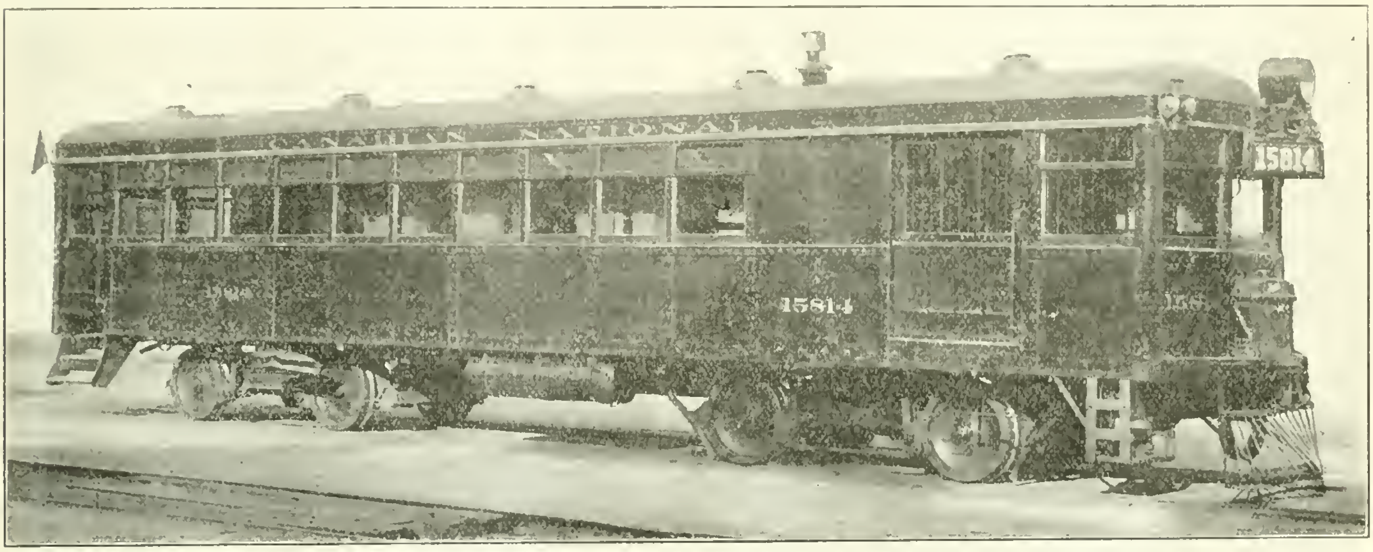
In general its power has been transferred through standard automobile clutches, transmissions, etc., which are used with the same type of engine in automobile service.

So far as the actual power plant is concerned, it is the opinion of many that the automobile engine has in almost every way demonstrated its superiority over the truck engine for Class A cars and for general service because of its ability to run over rated speed without serious loss of balance and consequent excessive vibration, and its economy under light load conditions. The first of these reasons undoubtedly embraces conditions which are vital to the successful maintenance of any machine or engine.

Practically any high-grade automobile engine designed for a rated engine speed of approximately 1,450 r.p.m. at 30 m.p.h. with a gear ratio between 4 to 1 and 5 to 1 may be driven at engine speeds of 2,200 r.p.m. and car speeds of from 50 to 60 m.p.h. without any noticeably serious vibration. Experience indicates that a similar flexibility cannot be expected from truck engines for any length of time without serious engine trouble developing and possibly resulting in a complete breakdown.

When a motor coach is being operated where there are schedule connections to make and where there are meeting points designated by train orders and by time card, it is certain that, regardless of the framing of a schedule, which should not develop an engine speed over that coinciding with the rated speed of 35 m.p.h., the operator will frequently exceed this by 15 or 20 m.p.h. in order to meet the requirements of the service after a delay. There is nothing parallel to this in highway work with either the automobile or the truck, but it is such an accepted fact on a railway that the only safe course is to provide the type of power plant which will meet these requirements daily without breaking down. Railway gradients even accentuate this condition, as there is practically no opportunity for letting the engine cool off as there is on the highway.

The automobile engine has been designed not only for easy and economical low-engine-speed conditions, but also for those outlined in the preceding paragraph, and the experience of several railways with a number of cars operating



Canadian National Gasoline-Driven Motor Coach Built by Service Motor Truck Company under extremely different conditions seems to bear this out, which leads to the conclusion that the lightweight, high-speed gasoline engine is a satisfactory power plant for the lightweight cars.

Class B Cars

Storage-Battery Car. The general data of a typical unit are as follows:

Car. Interior arrangement to suit purchaser; weight, 60,000 lb.; length, 53 ft.

Trucks. Two 4-wheel standard M.C.B. axles, except that journals are fitted with roller or ball bearings.

Electric Motors, Etc. Four 25-hp. motors (250-300-volt) mounted with a gear ratio of 16 to 91. Standard series and parallel controller and circuit breaker installed at each end and in baggage compartment; provided with voltmeter, ampere-hour meter, underload circuit breaker and switches for control of air compressor and lighting.

Storage Batteries. 250 cells, capacity 450 amp.-hr. at 300 volts, or 145 kw.-hr. (580 amp.-hr. have been obtained with a minimum of 150 volts).

Battery Charging. Direct current at 250 or 500 volts may be used for charging, and the car is equipped with switches for arranging the battery cells in either series or parallel. Normal rate of charging, 90 amp. Time required for a normal full charge, 5 to 7 hr. A higher rate of charging may be employed provided temperature of battery does not exceed 115 deg. F.

Radius of Operation. Maximum 140 miles on a full charge, figuring on level or rolling grade. Recommended not to exceed 100 miles without obtaining a boosting charge.

Power Consumption. Power required, 35 watt-hr. per ton-mile. Acceleration, ½ m.p.h. per sec. Maximum speed, 45 m.p.h. on level track. As the car weighs approximately 60,000 lb., 35 watt-hr. per ton-mile is equivalent to 1.05 kw.-hr. per car-mile for level track and normal conditions.

Within the above-mentioned radius of operation this car has been extremely satisfactory and is being operated successfully under low-temperature conditions with no appreciable trouble. Its tractive effort of 2,400 lb. makes it possible to use a trailer if necessary. The cost of operation, including all maintenance and transportation charges, power, etc., is 17 cents per car-mile. The maintenance has been extremely light, and all indications are that the life of the batteries will be eight to ten years at least.

Steam Cars. The steam power plant was probably the first to be tried for self-propelled cars, but unfortunately its development has not kept pace with requirements. Medium-pressure (300 to 400 lb.) boiler plants with comparatively low superheat (100 deg. F.) were introduced to a considerable extent in continental practice several years ago, but the use of the steam car has not developed, due principally to excessive weight and complications of equipment, and inefficiency of the boiler plant.

Recent developments indicate that while the seriousness of these defects has been noted and improvements have been made, they have not yet been overcome to the point where steam power may be considered to be the most satisfactory unit car power, and it may be well to consider these defects more in detail as they appear to exist in modern equipment.

Insufficient boiler capacity is a defect directly coupled with excessive weight of equipment. Boiler plants of approximately 70 boiler hp. nominal rating have been applied to cars with a total net weight in running order of from 50,000 to 60,000 lb. and providing for 100 sq. ft. of baggage space. The total live load will bring this equipment up to a gross weight of approximately 65,000 lb. or a load of 650 lb. per boiler horsepower.

Experience indicates that for a boiler of this capacity the weight should be reduced by approximately 15,000 lb., and this should be possible as the entire power plant may be carried on the leading (driving) truck and the remainder of the body lightened proportionately. Total absence of vibration should be a great advantage in lightening the car equipment.

Practically all the first cars of continental make indicated that high pressure and high superheat were necessary in order to provide for a gear ratio sufficient for starting and at the same time for a piston speed of 800 ft. per min. at 40 m.p.h. The engine developed to meet these conditions has no doubt been a great mechanical success, but the boiler plant supplying it has not yet been developed to the point where it can exceed the schedule previously outlined, even under the most favorable conditions. The causes of this deficiency appear to be due mainly to the two following defects:

a Insufficient header volume, resulting in carrying over an emulsion into the superheater units, with a consequent total loss of superheat and excessive water consumption, and

b Unequal distribution of heat to all generating units, resulting in steam pockets and thereby destroying both circulation and evaporative qualities.

The problem of providing sufficient surface-condenser capacity for hot-weather conditions coupled with protective appliances which will be operated by thermostat in cold weather has not been solved, with the result that under maximum conditions the water loss is as high as 45 lb. per car-mile, necessitating replenishing at frequent intervals and a consequent loss of time.

Automatic control of the oil flame has been highly developed but is not yet perfected. Generally speaking, this automatic feature must have two distinct functions: Namely, (*a*) cutting off or reducing the fuel supply when maximum boiler pressure is reached, and (*b*) cutting off fuel under low-water conditions. The first is undoubtedly perfectly developed but the second is not, due to the varying quality of the steam coincident with the condition (maximum load) which most often causes low water.

The least considered of all conditions in connection with the steam car are probably those affecting the comfort of the operator, and in this respect it is unpopular on account of the extreme heat which may be experienced and also the noise of the oil flame. The latter is by far the most serious, and it is apparently impossible to control it when using high-velocity jets of steam for atomizing.

Space does not permit a further study of the steam plant, but the following general data of a steam car now being tested may be of interest.

Space required for boiler plant, sq. ft.	640
Heating surface of boiler, sq. ft.	385
Heating surface of superheater, sq. ft.	44
Gross weight of car, lb.	60,000
Net weight of complete power plant without oil and water, lb.	13,000
Quantity of water supply, U. S. gal.	200
Quantity of oil supply, U. S. gal.	180
Gallons of oil per car-mile, average	1
Boiler pressure, lb. per sq. in.	800
Superheat, average, deg. F.	200
Engine dimensions	6½ in. bore by 8 in. stroke
Gear ratio between crankshaft and axle	1 to 1.46

Heavy-Duty Gas Car. The general data of a car of this type are as follows:

Car. Length, 55 ft.; weight, 66,000 lb. loaded.

Engine. 6-cylinder, 6¾ in. stroke. Power, 116 hp. at 800 r.p.m. and 225 hp. at 1,600 r.p.m.

Transmission. Four speeds forward, three reverse; geared to give 56 m.p.h. forward at 1,400 r.p.m. in high and 37 m.p.h. in third speed.

This class of car has not been tested to the point where any accurate data may be given, but it is evident that the gasoline consumption will be at least twice that of a Class A car per car-mile. The problem of handling through transmission and clutch the mechanical drive from a gasoline engine of possibly 200 hp. has not yet been solved unless it may be through the medium of the oil transmission so successfully used in navy work. However, the complication of this transmission or magnetic control makes it doubtful at the present time whether gasoline power plants will successfully exceed 70 hp. in capacity.

Gas-Electric Car. Mention has already been made of the car of this type which came into prominence about fifteen years ago and which was practically discarded on account of its unreliable power plant and general complication.

The first-mentioned cause of failure has undoubtedly been overcome and reliable constant-speed units are now in general use for generating purposes. If it were possible to eliminate the starting troubles when using types of engines suited for low-grade and cheap fuels, there would be no doubt about the general use of this type of equipment on account of unit power costs. The difficulties mentioned are such an important factor in the successful operation of a motor coach that we must necessarily turn to the gasoline engine.

The gas-electric system provides double-ended control and an efficient starting torque but still retains all the complications of a dual power plant.

The general data of a modern gas-electric car may be started as follows:

Car. Length, 55 ft.; width, 10 ft.; seating capacity, 54 with 100 sq. ft. of baggage space; weight leaded, 65,000 lb.

Engine. 6-cylinder, governor-controlled, 7 in. bore by 8 in. stroke; develops 150 b.hp. at 900 r.p.m. and drives a 100-kw. 700-volt generator which in turn drives two motors on forward truck. Fuel consumption (estimated), 0.25 gal. per mile.

It is thought that there may be a possibility of employing a smaller-capacity constant-speed gasoline engine (average running power consumption approximating 25 hp. for cars weighing 60,000 lb. loaded) which will drive a generator charging a limited battery capacity. Theoretically this might provide the starting torque desired and at the same time eliminate the undesirable features of the large power plant, but it could not be an economic consideration where cheap power could be purchased.

Ball and Roller Bearings have been one of the important factors in the development of the motor coach. Exhaustive tests indicate that the ball bearing has reduced starting friction under summer conditions to approximately 15 per cent of that of plain bearings, or in other words has reduced friction of approximately 20 lb. per ton to 3 lb. per ton. At the same time the average rolling friction at speeds up to 30 m.p.h. has been reduced by approximately 40 per cent, or from 3.6 lb. per ton to 2.2 lb. per ton.

Experience indicates that the ball bearing is suitable for Class A cars, but that the areas and sizes for designed industrial work should be at least doubled for railway work due to excessive shocks and side thrusts. It is not possible at present to say whether side thrusts are more destructive than vertical rail shocks, but it is certain that for poor rail conditions the bearings should have a side-thrust capacity of 100 per cent of the vertical load.

For Class B equipment it may be necessary to use roller bearings for vertical loads in connection with special bearings for side thrusts.

Transmission and Type of Drive

While it has been stated that the automobile engine is most suitable for the light motor coach, it must nevertheless be admitted that experience indicates that standard automobile transmissions, clutches, universal connections and driving gears are entirely inadequate for motor-coach service and are the cause of probably 75 per cent of the breakdowns. Similar parts which have been developed for truck engines are generally much superior due to their greater size and strength per horsepower transmitted.

The argument has been advanced that the parts are designed for the engine and will handle all the power developed by it; but this contention is not sound, because the greater inertia to be overcome at starting requires a momentary torque much in excess of anything experienced in automobile work.

Account must also be taken of the fact that in this country and the northern part of the United States cars have to be operated in snow storms, resulting in clutch slippage and shocks to transmission which are much in excess of those experienced in automobile service.

The method employed in transmitting the power to the wheels has generally been one of the following:

1. Through a standard transmission to one driving axle which supports the entire two-wheel rear truck and which can move in a vertical plane only. While this is the simplest method of driving, it is not the opinion that it will ever be generally acceptable as experience indicates that safety and good riding qualities are almost proportionate to the number of wheels in the trucks. This is particularly applicable to cars operating on cheaply maintained lines.

2. To both axles of the front four-wheel truck by gearing and universal connections from a transmission located behind the truck. Experience on some railways goes to show that this method is successful, and although the number of universal connections is not reduced, the shafts are all short and the driving forces are removed from the passenger-carrying part of the cars, thereby reducing vibration.

3. To a transmission located at about the center of the car and from there to nearest axle of each four-wheel truck or to both axles of two-wheel trucks. The advantage claimed is that the entire weight of the car is available for adhesion (where the trucks are of the two-wheel type) but general experience indicates that this is not necessary and is harder on the engine than where part of the momentum of rotating parts may be taken up by slippage. Where four-wheel trucks are used this method has been found to give better adhesive qualities than connecting to both axles of one truck, but the advantage seemingly is not sufficient to warrant the extra complication.

4. To leading axle of rear four-wheel truck. The chief advantage of the drive to the rear truck is that the engine may be aligned in such a manner as to have its shaft center line pass through the center line of the main driving axle, thus reducing wear on the universals and friction. The disadvantage is that it necessitates the use of one or more supplementary bearings between the engine and the point where the drive shaft is coupled to the front universal. The maximum lateral motion of a truck of 48-in. wheel centers and 18-in. truck centers on an 80-ft. radius curve is shown to

Canadian National Motor Coach Driven by a Reo Six-Cylinder Automobile Engine average ¾ in. at a radius from the center of 24 in., so that it is apparent that the swing of the truck has but little effect on the universals. The torque arms supporting the housings of such an arrangement should have both vertical and lateral swing. Only when the load on the main axle is not sufficient for adhesion it may be conceived that driving power acts on the second axle. Under ordinary conditions transmitting power to the second axle generates no more friction than that due to the weight of rotating parts.

Methods of transmitting power from the front axle to the rear axle of rear truck may be subdivided as follows:

a Chain Drive. Chain drive has the disadvantage of rapid wear, noise, and the complication of shields and covers which more than overcome the advantage of the straight drive to the rear truck.

b Gear Drive. Gear drive to the second axle no doubt appears to be the best mechanical means of transmitting power, but it has all the disadvantages of rapid wear due to difficulty of adjustment of contact and the maintenance of extra universals.

c Side Rod and Cranked Wheels. Side-rod drive to the second axle, along with many other locomotive developments said to be crude and inefficient, in actual practice is a thoroughly reliable and easily adjusted and inspected arrangement, and is operating successfully at high and low speeds and with no appreciable friction.

d Miscellaneous, including oil transmissions that are still being experimented with.

Summary

There is no doubt a great difference of opinion regarding what type of motor coach will fulfil the requirements best. It is apparent that there will be important developments in railway motor cars, both as regards design and field of service, and therefore the following conclusions may be considered as preliminary only.

Class A Cars (30,000 lb. max. light weight), driven by automobile-type, 6-cylinder gasoline engines, should have the following general characteristics and limiting conditions: 1.6 hp. per 1,000 lb. light weight of car at engine speed of 2,100 r.p.m., giving a car speed of 35 to 40 m.p.h. Rolling friction, 2.2 lb. per ton of weight on rail, and wind resistance of 5 lb. per sq. ft. cross-sectional area of car at 40 m.p.h. Weight of car per passenger seat, maximum 750 lb.; weight of car per maximum hp., 600 lb. Gear ratio between engine and wheel for ruling grades not exceeding 1.25 per cent, 4.7 to 1. (In hard operating conditions this may be increased to 5.5 to 1.)

Class B Cars. It is difficult to come to a general conclusion with regard to this class of equipment, as it appears that only one class of car has actually passed the experimental stage. One Canadian railway has found the battery car to be a reliable and economical unit to operate, provided that the schedule will permit of charging time. Severe weather conditions have had little effect on the operation, and the simplicity of the power-controlling devices eliminates any chance of opposition from the operators.

The chief obstacles in the development of this type are the first cost and, in some regions, high power costs, but it is felt that the great advantage it possesses of double-ended operation without complication more than offsets any serious disadvantages.

In conclusion, it seems safe to say that there is a fairly large field for the motor coach in railway work and that it will not be developed from without but rather from within—slowly, conservatively, by motor manufacturers and railway engineers, as the traveling public will never tolerate from railway companies the difficulties and disappointments which have been visited on them by automobile manufacturers. The railway engineer to do his part in this problem must be familiar not only with operating conditions but also with the labor problems which are sure to arise in such a development, making it necessary and advisable to give consideration to the employee operating this equipment and to the public using it.

Discussion

L. Klopman (Railway Storage Battery Company): I agree with all that the author has said in favor of the storage-battery car, but that the paper did not go quite far enough in presenting its proved utility and service.

The author has divided self-propelled cars into two classes placing the storage-battery car in the heavier class (B) but excluding it from the lighter (A), or that for cars having a seating capacity of 24 to 40 passengers, a baggage space of approximately 100 sq. ft., and a car weight of from 18,000 to 30,000 lb. Storage-battery cars answering this description had been in successful operation since 1917 on the Chattahoochee Valley, on the Long Island since 1914, and elsewhere, which had a seating capacity of 32 to 40 passengers, a baggage space of 80 sq. ft., and a weight, including battery, of 28,000 lb. These cars had been equipped with two 25-hp. 175 to 250-volt motors, double and series-parallel control with a gear ratio of 5.29 to 1, and 150 A-12 Edison cells.

There was no reason why a storage-battery car such as this could not meet every test which had been successfully met by the gasoline-engine-driven motor coaches designated under Class A, and not only meet these conditions, but more economically and with greater reliability in operation than the gasoline car.

The multiplicity of troubles and complete failures which were inevitable with any kind of combustion engine and drive after considerable service necessitating shopping of equipment and consequent substitution, were matters worthy of serious thought.

This was to be compared with the simple, effective electric motor and control of the storage-battery car, which was as nearly absolutely foolproof as any mechanism yet devised. The four-motor drive permitted in the remote contingency of failure of even two motors, of the remaining two motors propelling the car. A mechanical or electrical failure of the battery was so remote as to require no consideration. Its initial cost was admittedly higher, but in a comparatively short period the low cost of maintenance both for the battery and the electric motors soon equalized the difference in the initial cost.

The life of the storage battery has proved to be over 10 years in this class of service and, in fact, cars were now in operation in Canada the batteries of which had been installed as far back as 1914. The condition of a gasoline engine started in the same service in that year could easily be immagined.

It was to be remembered that all storage-battery cars were equipped for double-end control, which meant both economy of time and money in operation. The author had cited the use of these cars to connect junction points, small summer resorts, golf clubs, etc. This service would hardly warrant the cost of installation of a Y or turntable such as the one-end operation of a gasoline motor car made necessary, and it was only fair that the cost of such installation be deducted from the initial cost of storage-battery operation.

So far as Class B cars were concerned, in stating the maximum radius of operations, the author had limited himself to the statement that its maximum radius of operation was 140 miles on a full charge. This statement was correct as far as it went, but cars of this size had made and were making up to 235 miles a day where facilities were available and operating schedules permitted time for intermediate charging. This would give the storage battery car a mileage which, for all practical purposes, was equal to that afforded by a gasoline engine driven car.

R. G. Gage (Canadian National) said that one of the chief items that should be watched in connection with storage batteries was the first cost—not perhaps in the car itself, but in the different facilities for making low cost of operation. The charging facilities sometimes were difficult to procure. The question of operation of the storage battery car in Canada was important. At certain times of the year, with the temperatures which they had, it was absolutely necessary to start the car out properly charged, but in such cases it had been his experience that there was little trouble. That was one of the serious things that must be given consideration as regarded the proper scheduling, which those having to do with transportation were not always ready to realize.

J. A. Shaw (Canadian Pacific) stated that the railway company with which he was connected had installed four gasoline-engine-propelled cars, to transport passengers from the station to its hotel. They operated for four months each summer and carried all the supplies and fuel as well as passengers. The cost of gasoline for operation per annum was about $1,000.

Mr. Brooks, in closing, said that the chief reason why he believed that the gasoline-driven car was the most suitable to fulfil the requirements outlined for Class A cars was the requirements of the service.

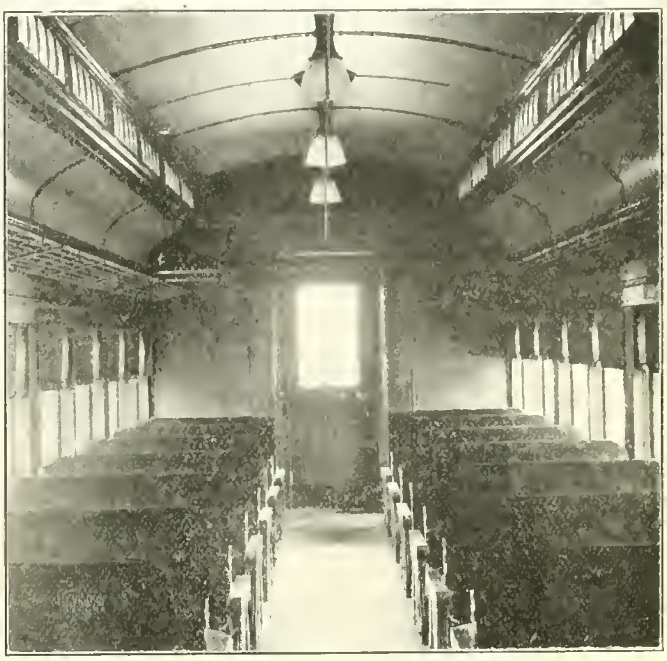
These small units were often used in sparsely settled parts where the only hope railway companies had of making anything out of the service was in its frequency. His company had driven cars fitted with automobile engines on regular schedules which necessitated covering 360 miles per day, up to 50,000 miles before any appreciable repairs had been necessary to the engine.

It was necessary to differentiate between experience derived from highway-run service and mechanical equipment driven on steel rails. He felt sure, from what he had seen, that the life of a gasoline car motor running on steel rails would be five or more times that of a gasoline automobile motor on highway service.

It was necessary to remember that in Canada, where car batteries had to be imported, their cost would run close to $20,000. If necessary, the complete gasoline power plant in one of the Class A cars could be junked every year for practically the interest on that amount alone, without repayment of the cost of the batteries. It might appear at first that it was wise to figure on writing off the value of an automobile engine driving one of these small units after, say 50,000 miles. Experience had indicated, however, that it would be proper to allow 150,000 to 200,000 miles on that kind of service. But even if conditions were such as to make it advisable to junk the engine at the end of 50,000 miles, he still thought it would be better to do this rather than to incur the heavy expense for the storage battery, which necessitated a large investment in the charging equipment where cheap power could not readily be tapped. He appreciated the value of the storage-battery car, but felt that for certain classes of service it was necessary to have something cheaper and more flexible.

P. R. R. Combination Car

THE new all-steel combination cars for the Pennsylvania, Class PB-70, built at the Harlan plant of the Bethlehem Shipbuilding Corporation, Wilmington, Del., have a passenger compartment 34 ft. 9⅝ in. long, with seats for 44 persons and a baggage compartment 35 ft. 6 in. long. The length of the body is 77 ft. 8¾ in. The weight of the car is 134,600 lb., of which the two trucks constitute 45,900 lb. These trucks, which are of the Pennsylvania patented six-wheel type, Class 1-D, have 36 in. steel wheels, 5½ in. by 11 in. journals and a wheelbase of 11 ft. 0 in.

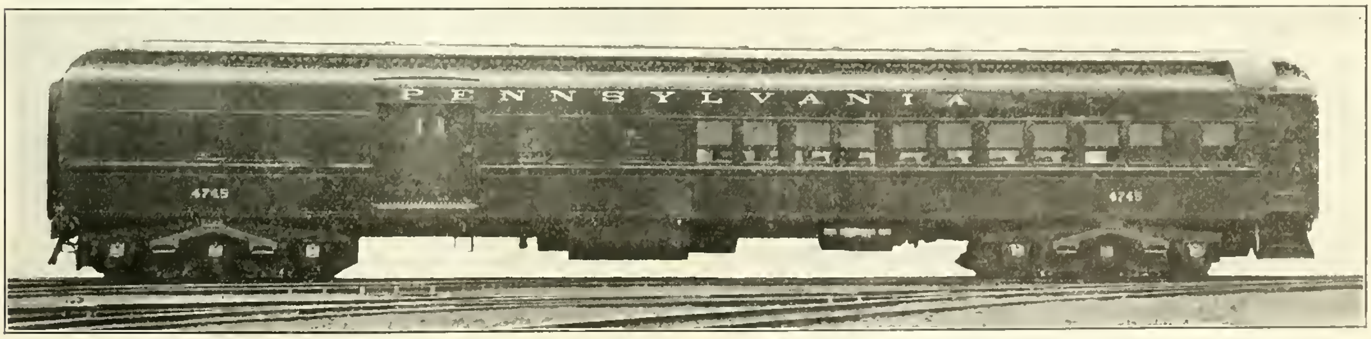


Interior of Pennsylvania Combination Passenger and Baggage Car

The interior finish, including the ceiling, is in steel with Ceilinite on the back. The flooring is of Flexolith composition. The seats are Hale & Kilburn No. 194. Parcel racks of the continuous type are provided. Window fixtures and trap doors are of O. M. Edward's design.

The Gold Car Heating & Lighting system of steam heat is used in the passenger end and the Vapor Car Heating & Lighting system in the baggage end. The lighting equipment was furnished by the United States Light & Heat Corporation, the batteries being of the Edison type.

The couplers are type D, with Westinghouse type N-11 friction draft gear. Fowler upper buffer springs also are applied. The brake equipment is of the U C type, with 16-in. cylinders. The foundation rigging is of the Pennsylvania clasp-brake design furnished by American Foundries.



Pennsylvania Combination Passenger and Baggage Car Built at Harlan Plant of the Bethlehem Shipbuilding Corporation

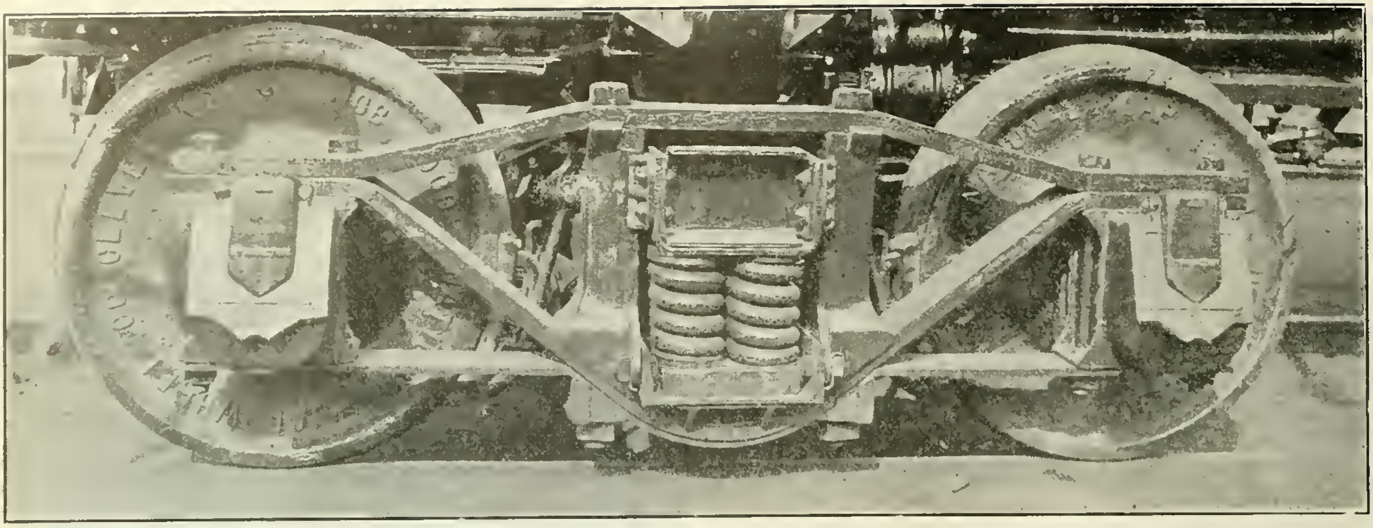


Fig. 1—Fifty-ton Truck with Improved Arch Bar Side Frame

Tests on Different Shaped Arch Bar Side Frames

Slight Changes in Design Reduce Unit Stresses from Over 40,000 Lb. to About 20,000 Lb.

By Louis E. Ensley
Professor Railway Mechanical Engineering, University of Pittsburgh

THE purpose of the tests described was to determine the stress set up in different shaped arch bar truck side frames under direct vertical load, transverse load and twisting load. The loads used were—for the 50-ton trucks, 68,500 lb. vertical load, transverse load of 9,000 lb. and a twisting load of 6,000 lb., applied at the center of the truck spring seat. For the 70-ton truck tested the load was for the direct vertical load, 95,000 lb., transverse load 12,600 lb., twisting load of 8,400 lb., applied at the center of the truck spring plank.

Machine and Instruments

The tests were conducted at the plant of the Pressed Steel Car Company, located at McKees Rocks, Pa. The machine used was their 600,000 lb. Olsen testing machine. A photographic reproduction of the frame under test is shown in Fig. 2. A direct vertical load was transmitted to the spring seat of the side frame by a cast steel foot *A* to a 1-in. by ⅜-in. by 10-in. strip of iron lying over the center line of the spring seat. The load then acted through a 1½-in. by 6-in. by 8-in. filler block to a circular ball bearing which rested on the spring seat. A wooden block about ¼ in. thick was used above and below the ball bearing to take up any irregularities on the surface of the casting or in loading.

The method of supporting the ends of the frame is clearly shown in Fig. 3. The block *L* took the place of the wedge in the journal box, the block just below that taking the place of the brass. This lower block was also knife edged by a circular groove in the short axle *J* which is supported by filler blocks on the casting *K*. Great care was taken to insure the line of force passing through the center of the arch bar and half way between the two journal box bolts.

A transverse load was obtained by manually applying the load to the calibrated spring *B* at each end of the beam which was anchored to the frame by means of bolts *D* and *E* and transmitted by beam *C* to the column casting *F* through a knife edge at the center of the column. To apply a twisting load, the calibrated spring *G* received a load and transmitted it to the ball-crank *H* turn buckle *I* and thus to the spring plank.

The instruments used for determining the stress throughout the frame under the different loads were the Berry strain gages. These are clearly shown clamped on the frame in Fig. 3. These gages are so constructed that the elongation per inch can be accurately determined to .0001 of an inch.

Description of the Side Frames

This report covers the tests of five different arch bar side frames, four of them were for 50-ton and one was for a 70-ton car. No. 1 was a 50-ton standard ARA frame which had top and bottom arch bars 5 in. by 1½ in. and a ⅝-in. tie bar. An outline of the frame is shown in Fig. 4.

No. 2 frame shown in Fig. 5 was a Pennsylvania standard 50-ton arch bar side frame with a top and bottom arch bar of 5 in. by 1¼ in. and a ⅝-in. tie plate. This frame is much like the ARA frame but the bars are only 1¼ in. thick instead of 1½ in. as in the ARA 50-ton frame and the radius at the bottom bend of the lower bar is 2⅞ in. instead of 1½ in. as in the standard ARA arch beam frame.

No. 3 frame was a new 50-ton design shown in Fig. 6 which had a lower bar that had a 19¾-in. radius in the bottom part of the frame, this radius being tangent to the diagonal tension part of the bar at the outer point of contact with the column. On top of this bar and under the spring plank was a small malleable iron filler block on which the spring plank rested. As the column bolts passed through the bottom bar at an angle a small V-shaped malleable iron washer was placed between the tie bar and the column bolt nut. The top and bottom arch bars on this side frame were 5 in. by 1¼ in., and the tie bar was ⅝ in. thick.

No. 4 side frame was a 50-ton arch bar frame very similar to No. 3 but as shown in Fig. 7, the radius is only 11 in. at the bottom and the straight portion of the lower arch bar extends to the bottom or inner edge of the column and the bottom of the column is a diagonal straight line instead of a curve as in Fig. 6. It will also be seen that the malleable iron filler block is somewhat thicker in the 11-in. radius frame.

Frame No. 5, shown in Fig. 8 was a 70-ton arch bar side frame. It also had 11-in. radius at the bottom and a malleable iron filler block. However, in this frame the V-shaped washers are located between the bottom bar and the tie bar and the column bolt nut comes up against the bottom tie bar. The size of bars in this frame is 6½ in. in width and the thickness of the top bar is 1½ in. while the bottom bar is 1¼ in.

Method of Testing

Each bar was laid out at the points of reading on each edge ⅛ in. in from the upper and lower sides of the bar. Some readings were also taken at the tie bar as shown in the figures. Small holes were drilled at each point with a 3/64 in. drill about 1/16 in. deep. These holes were used for placing the points of the Berry strain gage.

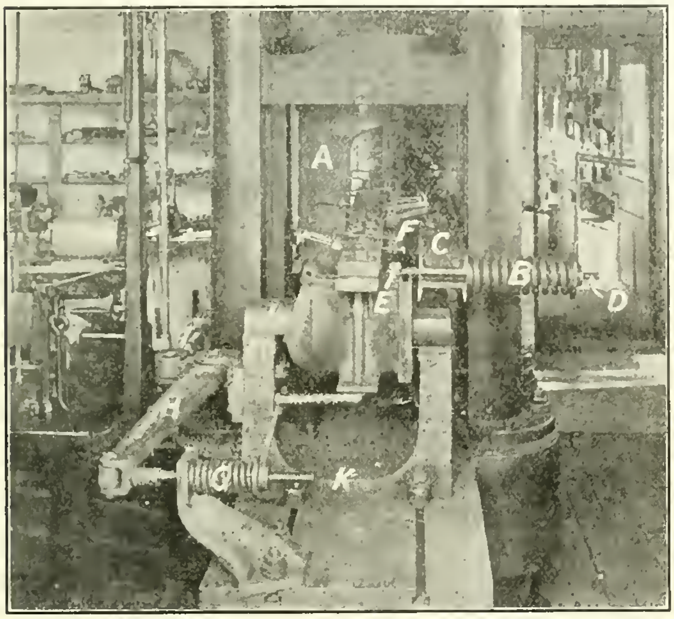


Fig. 2—End View of Truck Frame in Testing Machine

The frames were mounted and centered on the testing machine as already described and a load of something greater than that for which the test was made was applied to the frame to be sure that all parts were seated after which the load was reduced to 5.000 lb. Several Berry strain gages were clamped at different points on the side frame. The direct vertical load was then increased to 73,500 lb. on the 50-ton frames and on the 70-ton frames 100,000 lb., making an effective load of 68,500 lb. on the 50-ton frames and 95,000 lb. on the 70-ton frames.

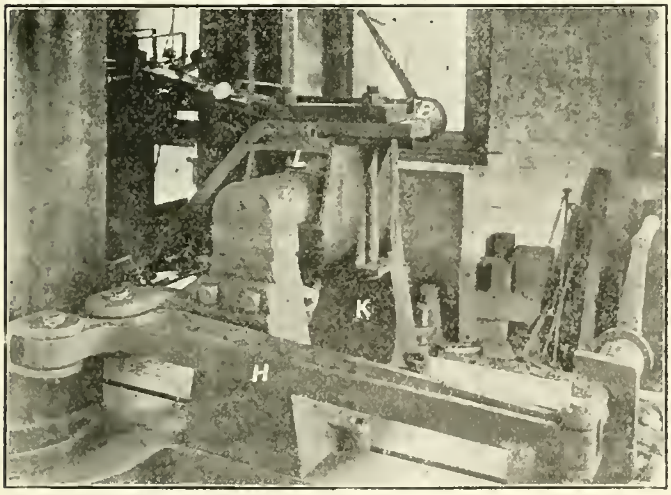


Fig. 3—Side View of End of Frame in Testing Machine

The transverse loads of 9,000 lb. and 12,600 lb. on the 50- and 70-ton frames were respectively applied and the Berry strain gage again read after which twisting loads of 6,000 lb. for a 50-ton frame and 8,400 lb. for a 70-ton frame were applied and the fourth reading was taken on the gage. The instruments were then placed at a new position and set to zero with all loads acting. The three loads were then successively removed in a reverse order to which they had been applied, that is the twisting load first, the transverse load second, and finally the direct vertical load. By continuing this method of taking the four readings at each point, the stress equivalent to each of the loads was determined until all points where readings were desired with a 2-in. Berry strain gage on the 50-ton frames, were covered. However, in the test of the 70-ton frame a somewhat more sensitive and accurate gage of the Olsen type was used at the most important points where readings were taken. All frames were tested in identically the same manner as described above.

Results Obtained

Figs. 4, 5, 6, 7 and 8 give the results of maximum stress obtained at any point, the arrow indicating the middle of the point where the gage was seated, the figure representing either tension or compression at this point. The stress here arrived at was the average of the four identical points on the frame, that is, there were readings taken on both ends of the frame and on both sides of each bar. The stress here given has the sign either tension or compression of the direct vertical load. To this was added the average of the other four readings taken, which were produced by either the twist or transverse load. While the transverse and twist load acted only in the one direction in these tests, it might in actual service act in either direction. This might add to the direct vertical stress if it was either in tension or compression so that the stresses here shown are the average maximum stresses in pounds per square inch that would come at any point on the side frame in service under these loads. Where there is no indication before the number, it is tension, but where there is a minus sign before the number, it indicates compression.

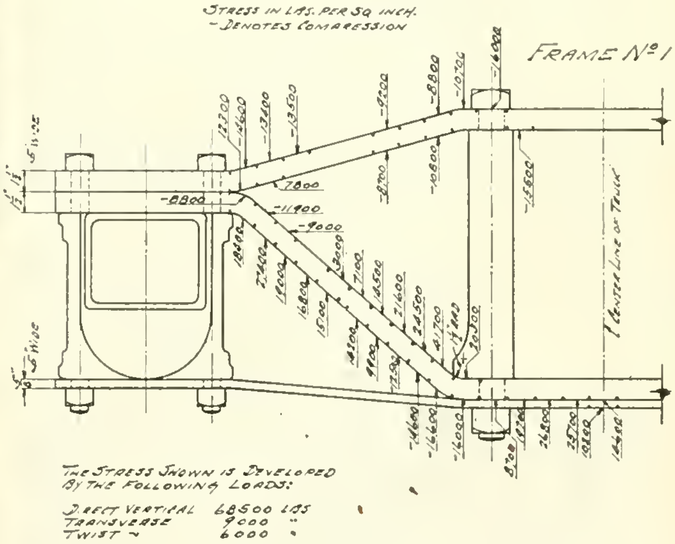


Fig. 4—ARA Standard 50-Ton Arch Bar Side Frame No. 1

From a survey of these five figures, it will be seen that the ARA standard 50-ton truck has one point at the radius at the bottom which indicated a maximum tension stress of 41,700 lb., and another point at the bottom of the bar between the column posts of 26,800 lb., while with the Pennsylvania standard 50-ton frame this maximum stress at the inside on the bottom corner was reduced to 36,700 lb. on the top but was increased at the bottom of the frame to 37,200 lb. These stresses, in great measure, show why arch bar trucks in the past have broken near these points. It will be seen in Fig. 6, showing the results obtained on the truck, that with the 19¾-in. radius, the maximum stress on this frame is 25,400 lb. in the center at the bottom, while on the top at a point close to the column bolt, the maximum stress is 24,000 lb. It will be seen that this frame has a much lower stress than either frames Nos. 1 or 2. However, No. 4, which is a 50-ton arch bar frame with 11-in. radius, has a maximum stress of 22,800 lb. This is at the bottom of the compression member near the column bolts and it has a maximum stress in tension of 19,200 lb., which is at the top of the lower bar at the bottom. All other points on the tension member are less than 19,000 lb.

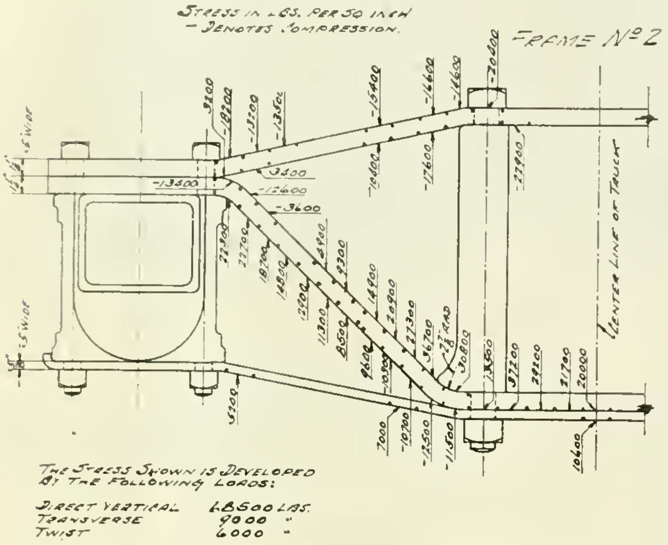

Stress in Lbs. per sq. inch
- Denotes Compression.
Frame No 2
Center Line of Truck
The Stress Shown is Developed by the Following Loads:
Direct Vertical 68500 Lbs.
Transverse 9000 "
Twist 6000 "

Fig. 5—Pennsylvania Standard 50-Ton Arch Bar Side Frame No. 2

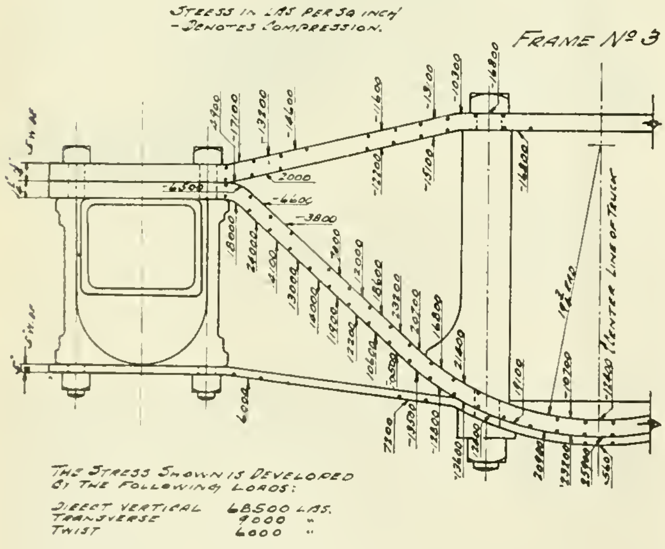

Stress in Lbs per sq inch
- Denotes Compression.
Frame No 3
Center Line of Truck
The Stress Shown is Developed by the Following Loads:
Direct Vertical 68500 Lbs.
Transverse 9000 "
Twist 6000 "

Fig. 6—Experimental 50-Ton Arch Bar Side Frame No. 3

Frame No. 5 which is a 70-ton 11-in. radius bottom bar has a maximum stress in tension of 20,400 lb. and this is at the same upper bend of the lower arch bar as the last frame described. No other point on the frame shows over 20,000 lb. stress. From the results here obtained it is evident that Nos. 4 and 5 frames have a very much lower stress than either one of the first three tested.

While only the results of five frames were given in this report there were in all 12 different designs of frames tested and sometimes two or three of the same design, but the other frames in most cases fell between the maximum and minimum results here given and were not interesting except to the student to cross analyze the results of the different designs of frames. The last two frames given are well within the strength of the metal to last the life of the car.

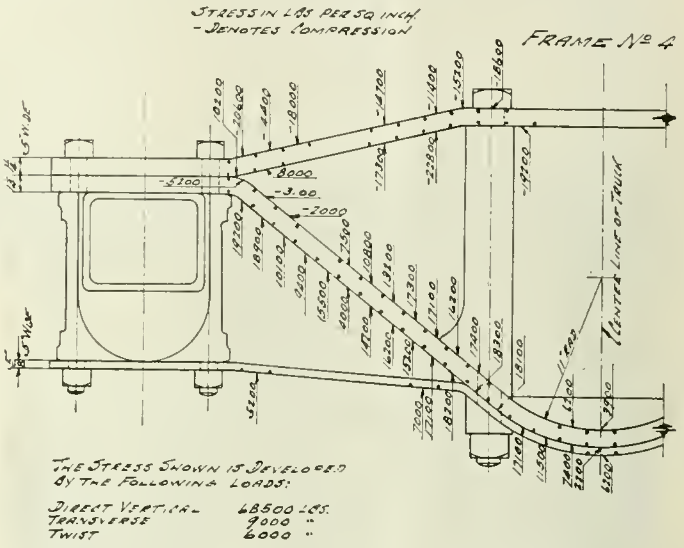

Stress in Lbs per sq inch
- Denotes Compression
Frame No 4
Center Line of Truck
The Stress Shown is Developed by the Following Loads:
Direct Vertical 68500 Lbs.
Transverse 9000 "
Twist 6000 "

Fig. 7—Improved Arch Bar Side Frame No. 4 for 50-Ton Trucks

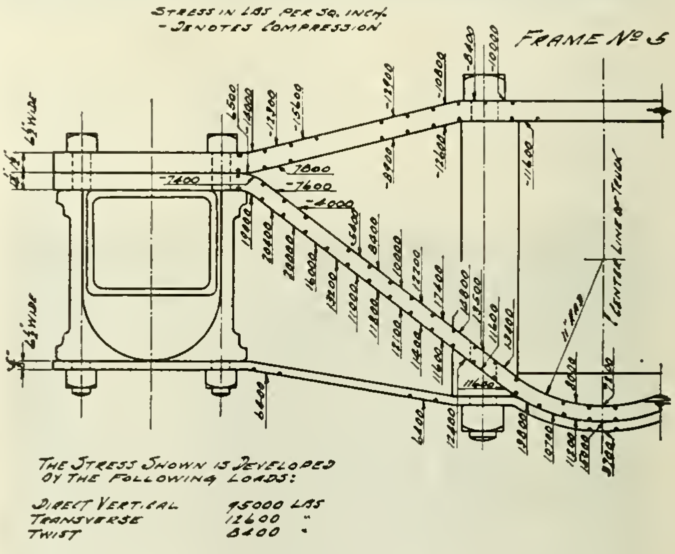

Stress in Lbs per sq. inch
- Denotes Compression
Frame No 5
Center Line of Truck
The Stress Shown is Developed by the Following Loads:
Direct Vertical 95000 Lbs
Transverse 12600 "
Twist 8400 "

Fig. 8—Improved Arch Bar Side Frame No. 5 for 70-Ton Trucks

Approximately 4,000 cars were built in 1915 and 1916 of a design very similar to that of frame No. 4 of the 50-ton capacity and these frames on these cars are still in service after approximately eight years and from a careful check of all these cars by the officials of the roads having them in use, no arch bar failures or cracked bars have ever been discovered. A photograph of one of these trucks is shown in Fig. 1. There are now being built some cars with the frame No. 5 shown in Fig. 8, and as the stress in the 70-ton frame is no greater than that in the 50-ton frame, which has been in service for eight years, equally satisfactory service without failure doubtless will be obtained from the trucks used under these 70-ton cars.

Some Good Freight Car Inspection Practices*

Inspector's Work of Vital Importance; Things to Be Remembered and Parts to Be Examined

By D. P. Crillman

General Car Foreman, Michigan Central, Detroit, Mich.

IN the first place good judgment must be exercised in selecting car inspectors. A man to be eligible should be not less than 21 years of age, should have had one year or more of experience at car repairing or car building, be able to read and write and pass examination as to eyesight and hearing.

A man working as an inspector in the car department should be not only a car man, but also what is commonly termed a company man. He should have in mind at all times the welfare of his company, as all the railroad has to sell is service and he is just as an essential cog in the wheel as the superintendent. He can help greatly in keeping freight moving across the country by careful inspection of cars for defects which render them unsafe or interfere with their safe movement to destination without accident or being shopped for repair. Inspectors should not shop cars for minor defects where repairs can safely be made in train yards, as this is not only costly but causes delay to freight and makes another dissatisfied shipper.

An inspector should at all times be watchful for defects that may create claims, especially on open top equipment those affecting hopper doors and when lading, such as coal, etc., is found to have been leaking from the car. Have the leakage stopped, also report the car to the yardmaster so that it may be weighed; make a leakage report for same and send a copy of the report to the claim agent. Side doors and side door protections must be given close attention not only on account of loss of freight but also for the safety of passenger trains that they may not be raked by side doors being forced out.

An inspector should become familiar with the clearance of each division of the road on which he is employed. If in doubt as to height and width of a loaded car, measurements must be taken to assure that same are within prescribed published clearance limits of the lines over which they are to pass.

A careful study of and a close adherence to A.R.A. loading rules will prevent accidents.

Interchange Inspection

Where cars are being received in interchange from a connecting line, a close inspection should be made to insure their safe movement and every effort made to move the loaded cars without transfer of contents, as this has a tendency to invite claims, to say nothing of delays to freight and added expense to the railroad which is a loss in net revenue earnings.

Where cars have been received in interchange with delivering company defects that cannot be repaired while the car is under load, but which are safe to run in service, see that all such defects are properly covered by a defect card. Empty cars must be in a serviceable condition to load. The inspector should be familiar with all equipment of the road on which he is employed, watch for wrong repairs which have been made on cars offered home and when wrong repairs are found fill out a joint evidence card covering all such wrong repairs, sending the car to the shop for proper repairs. By so doing he will be helping the upkeep of the equipment and will greatly add to the life of the car. All empty cars should be carefully inspected and classed for commodities in accordance to their conditions. Those found fit for grain or cereal loading should be so carded, although grain cars should not be selected at night. All such cars found in need of repairs should be shopped and repairs made before being placed for loading. This will insure the prompt delivery of lading to destination. Shippers can see no reasonable excuse for placing a defective car for loading.

In freight yards where it is the practice to have two inspectors working together, one on each side of train, one inspector should never work ahead of the other. This inspection should cover all parts of the cars, although the parts requiring the most careful inspection are those such as seams in throat of wheel flange—this defect being difficult at times to discover, loose wheels and broken or chipped flanges. Where inspectors are working opposite to each other they should watch the wheels at the hub on the opposite side from which they are working, as the journal box may hide the loose wheel from the inspector working on same side of the car as the loose wheel. There is a possible chance of a broken flange being hidden from the view of the inspector by a brake shoe, but still in plain view of the inspector working on the opposite side. Close attention must be given to detect cracked wheel plates, especially on refrigerator cars, on account of a crust forming on the metal caused by brine leaking from the car. This is a dangerous defect as refrigerator cars are handled over the lines at a high rate of speed. In many cases such cars are equipped with light capacity wheels which are apt to crack because of brakes sticking and heating the wheel. This is more easily found when the wheel cools off, although the inspector must not depend on the wheel showing signs of heating as cracked plates will be found on wheels with defective material, caused by pressing the wheel on the axle. Sharp flanges should also be gaged to know that they have not worn below the limit of standard gage. If wheel defects are not detected they may cause serious and expensive accidents.

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*Paper submitted in Prize Contest on Car Inspection.

Other important defects to look for are cracked arch bars—which are usually found to crack or to have flaws at bends or column bolt holes of bottom bar—missing or loose nuts such as column or box bolts, carrying iron or brake hanger casting bolt nuts, cotter keys missing from brake rigging and coupler cross keys.

Lubrication and Draft Gear

Lubrication must be maintained to prevent failure in service, thereby avoiding expense and delay of freight on account of setting out cars on the lines for repairs. When making inspection of journal boxes, lids must be lifted—especially those opening with more than ordinary force—even though it be necessary to remove the lid, as these are the boxes that receive little or no attention.

Inspection should cover draft gear attachments, cracked coupler shanks, knuckle pins tested by touching bottom of pin to assure that they are not defective, coupler yokes and yoke rivets, couplers and their parts to insure that they are operative. Couplers must not be less than 31½ in. or more than 34½ in. from top of rail to center line of coupler shank. Inspectors need not bother to lay a board across the rails to measure the coupler height, but can conveniently carry a piece of string long enough to reach across the rails with a small nut tied to each end. By putting this string across the rails, the height of coupler can be ascertained with a 3-ft. rule.

Air Brakes and Safety Appliances

Air brake hose, pipe and other parts must be inspected and maintained. Cylinders, triple valves and retaining valves should be cleaned and tested and so stencilled within nine months of the last cleaning. All out-going trains should have at least 85 per cent of the air brakes operative. Inspectors must know that air hose are properly coupled and angle cock handles are in the proper position, that all leaks have been stopped and that piston travel has been adjusted to from 5½ in. to 6½ in. When adjusting piston travel, live levers should be equally divided on both trucks.

Inspectors must understand that railroads are subject to fines for handling cars with I. C. C. safety appliance defects, this for the protection of trainmen. Therefore, all parts of safety appliances such as hand brakes, hand holds, ladders, sill steps, running boards, uncoupling levers and end clearances must be maintained to proper location and clearance.

Trucks and Brake Beams

Trucks with steel side frames such as Andrews, Bettendorf and others must be inspected carefully to detect cracks or flaws. Side bearing clearance should be watched and, where cars are balanced on center plates, should have 1/16 in. to ⅛ in. clearance between all four side bearings. If a car is found to be bearing hard on one side, the clearance should not be more than ¼ in. on the opposite side.

Rigid inspection must be given to brake beams, brake hangers, brake heads—particularly to eye and key bolts—to see that these parts are not worn to a limit which would make them unsafe.

Sills

Sills, both steel and wood, should be inspected to see that they are not decayed, split, buckled, cracked or spread. This applies especially to draft sills.

No part of the body or truck frame or attachments shall be less than 2½ in. above top of rails. The body of the car should be inspected, including roofs. Roofs found in leaking condition should be shopped for repairs for protection of freight. Close attention should be given to side and end doors. Defective doors should be repaired to prevent swinging out and striking employees or passing trains or falling from the car and causing accidents or possibly loss of freight. Moreover, defective doors or their fixtures encourage pilfering of cars. With a defective door hasp you could not have a clear seal record, thus inviting claims from which your road has no protection.

It is also the duty of inspectors to become familiar with the I. C. C. regulations for the handling of explosives, gasoline, etc. It is important when he finds tank cars leaking to keep open flame lanterns away from such, notify the yardmaster so he in turn can keep all engines at a safe distance until such time as the inspector has made an inspection by the use of an electric flash light and taken every effort to stop the leak. Where a quantity of oil is found on the ground it should be covered with dry earth.

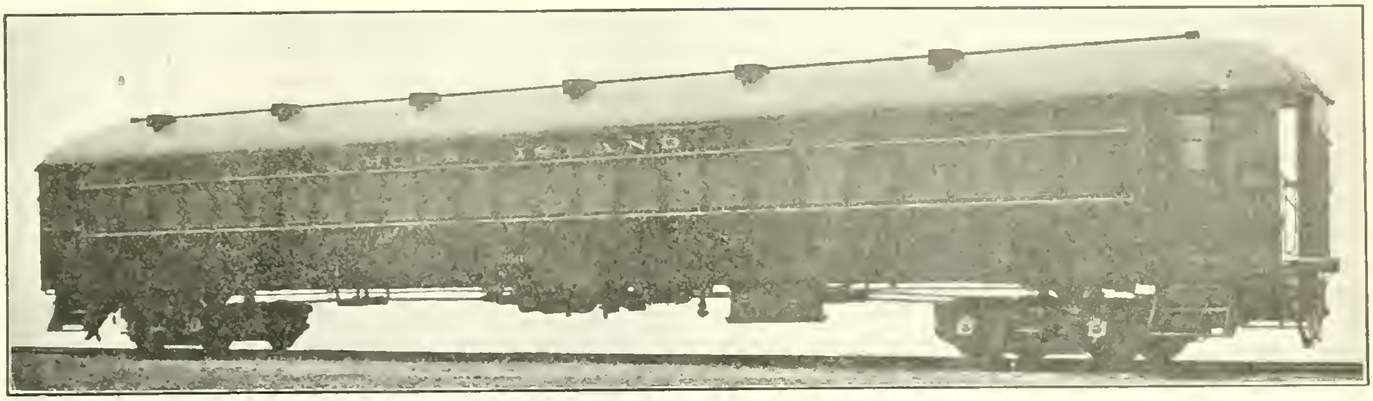
The inspector of today comes under the classification of a carman, also classed as a mechanic; therefore, to meet the qualification of carman the same as must be done in learning any other trade, he should study A. R. A. rules, loading rules, specifications of tank cars and pamphlets that are furnished by the Bureau of Explosives, to be able to pass examination before he can be considered eligible as an inspector. In the larger terminals where a number of inspectors are employed, they can greatly help themselves by holding meetings for the purpose of going over rule books, thus getting a uniform understanding and a proper interpretation of the rules.

As under present rules the inspector's report is of great importance, especially where cars have been damaged under A. R. A. Rule 32. To facilitate the interchange of cars it is necessary to have uniformity of practice in repairing and inspecting and owner's responsibility from that of the handling line; also in making repair bills to give the owner proper information, such as location, reasons, etc., as per A. R. A. rules. Inspectors must furnish correct information as it must not be assumed but must be determined by actual inspection; therefore, inspectors should know the requirements of the rules.

Safety First

Safety should be the first consideration of every railroad employee. One of the most positive and absolute rules is the one that requires car inspectors to protect themselves by a flag or light when working about cars. The necessity and reasonableness of this rule is apparent to everyone.

Safety appliances are all right but what is needed is a safe man to inspect them and see that they are safe. Injure an experienced man and a new man must take his place. A new man is an experiment; therefore, it is an inspector's duty as well as his protection to report unsafe conditions.

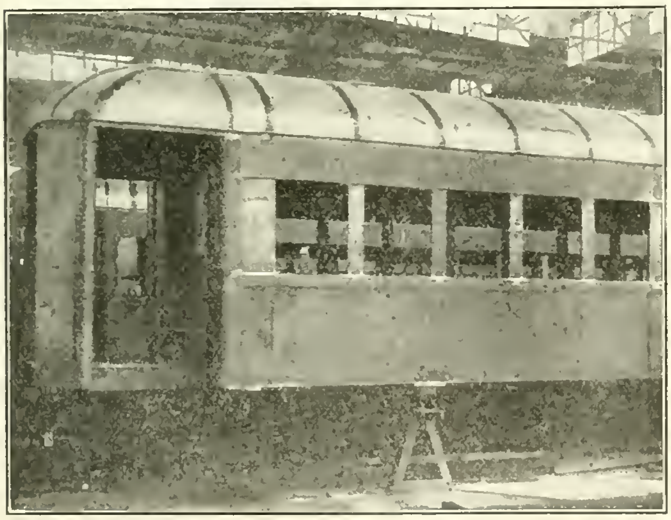


Seventy-Foot Steel Suburban Car Built for the Chicago, Rock Island & Pacific by the Standard Steel Car Company

Suburban Car Featured by Low Unit Weight

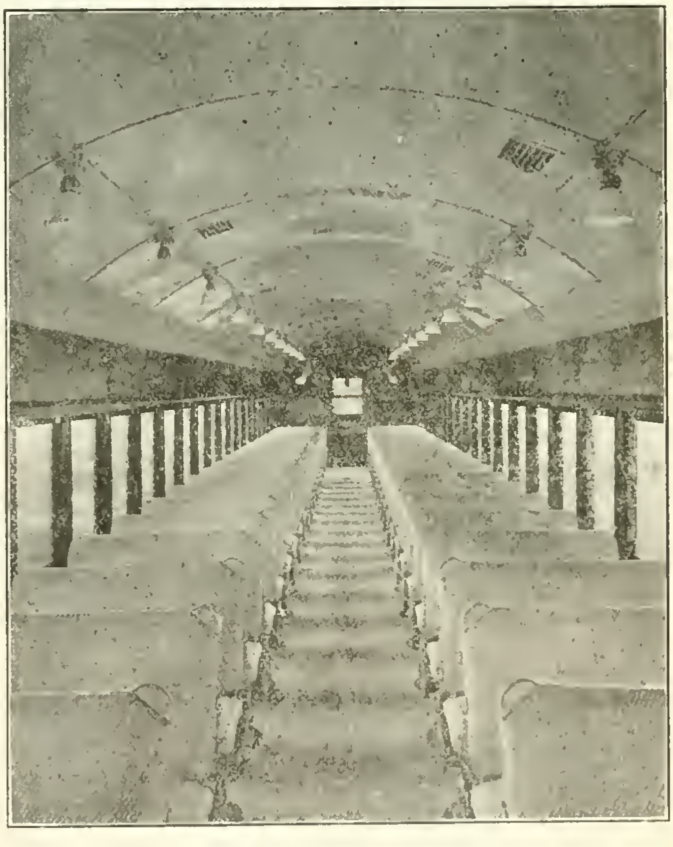
New Rock Island Steel Coach Weighs Only 920 Lb. Per Seated Passenger—Special Lighting Equipment

As a part of a program calling for the expenditure of $1,000,000 this year in new equipment, the Chicago, Rock Island & Pacific early in the year placed an order for 50 steel suburban cars with the Standard Steel Car Company. These cars, designed by the Standard Steel Car Company in accordance with specifications prepared by the Chicago, Rock Island & Pacific, are now being delivered and mark an important step forward in the design of this type of car. Without sacrificing strength, the weight of the car has been kept down to 92,100 lb., the body weighing 66,400 lb. and the trucks 25,700 lb. The seating capacity is 100, thus making the weight per seated-passenger approximately 920 lb. These cars are believed to weigh less per seated passenger than any heretofore built.



Erecting Work Completed—Car Ready for Application to Trucks

Particular attention has been given to the comfort and convenience of the passengers as will be seen in many features of the design. The rattan cross-seats, of the Walk-over type, have been made wider than usual in suburban cars and are designed to give maximum comfort to two passengers in each seat. The seat backs are equipped with neat brass handles next to the aisle and 10 hand straps are provided in each end of the car for the convenience of passengers who may be standing in front of the longitudinal seats. The window arrangement has been worked out so as to provide an unobstructed view, and there is a full window to each seat. The window sills are at a convenient height and form comfortable arm rests for passengers sitting next to the windows.

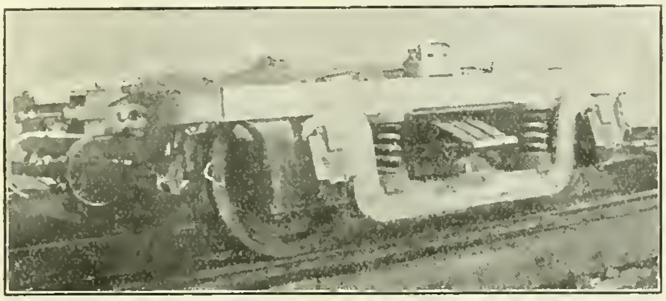


Interior View of the Car Completely Equipped Ready for Service

In order that passengers may be protected from cinders as much as possible, these windows have been arranged so that they can be raised but 10 to 12 in. At the same time, the bottom rail of the sash does not interfere with the view of an adult passenger. The end doors, as well as the platforms and steps, have been considerably widened over those of other cars of this character so that two lines of passengers can pass out of the doors and down the steps at the same time. End hand rails extend from the door posts to the side of car, parallel to the platforms and slope of the steps. These features, together with the longitudinal seats at each end of the car and the absence of arm rests on the aisle ends of seats, will permit an unusually rapid loading and unloading of passengers. Platforms are provided with safety gates that automatically lock in either open or closed position.

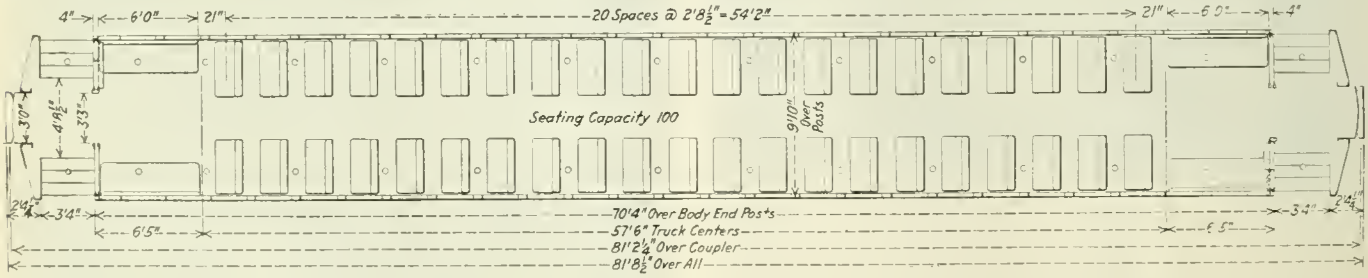
The electric lighting system is designed to afford the best distribution of light that it is possible to obtain, by means of a row of 13 lamps, mounted on each side of the car, each row being located approximately over the center of the cross seats. One lamp is also mounted above each platform step.

The heating system is of the vapor type with double automatic thermostatic control. This control is entirely automatic and does not need the attention of train crews or yard men to operate it. It automatically keeps the temperature of the car between 70 and 73 deg. F. while in train service and at 50 deg. F. while standing on steam in the yards.



Four-Wheel Truck Equipped with Cast Steel Frame and Clasp Brakes

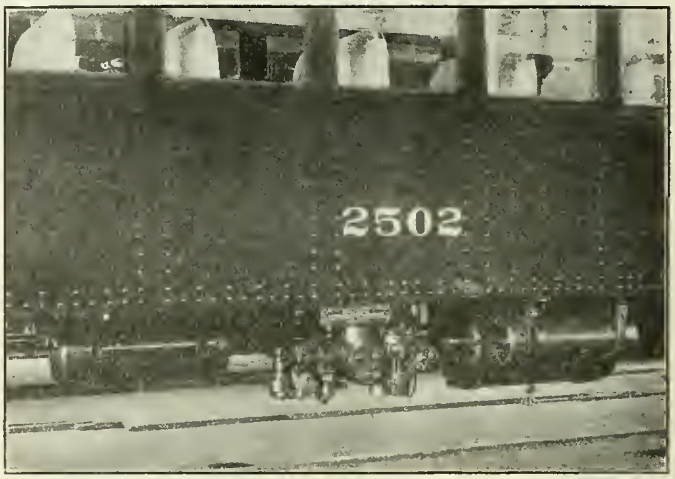
While it is true that the ratio of live to dead load has been given little consideration in passenger service, these cars represent decided progress towards establishing a desirable relation from the operating viewpoint. The light weight plus the use of clasp brakes and arrangements for rapid loading and unloading will permit of decreases in the time increments required for acceleration, deceleration and station stops.



General Arrangement of New Rock Island Steel Suburban Cars Built by the Standard Steel Car Company

The length of the car over the body end posts is 70 ft. 4 in. and the width over the roof sheets, 10 ft. 0⅛ in. The total height above the rail is 13 ft. 7¾ in. There are 42 cross seats each seating two persons and four longitudinal seats, each seating four persons. The ease of entrance and exit are readily apparent from the drawing which shows the end doors to be 3 ft. 3 in. wide and the steps 3 ft. 4 in. wide. The two end doors are of the sliding type with latches similar to those used on subway cars. The doors can be readily moved by a pull on the handle, but as soon as the handle is released, the door is automatically held in position to prevent slamming. No doors are provided in the vestibules of these cars, gates being used instead.

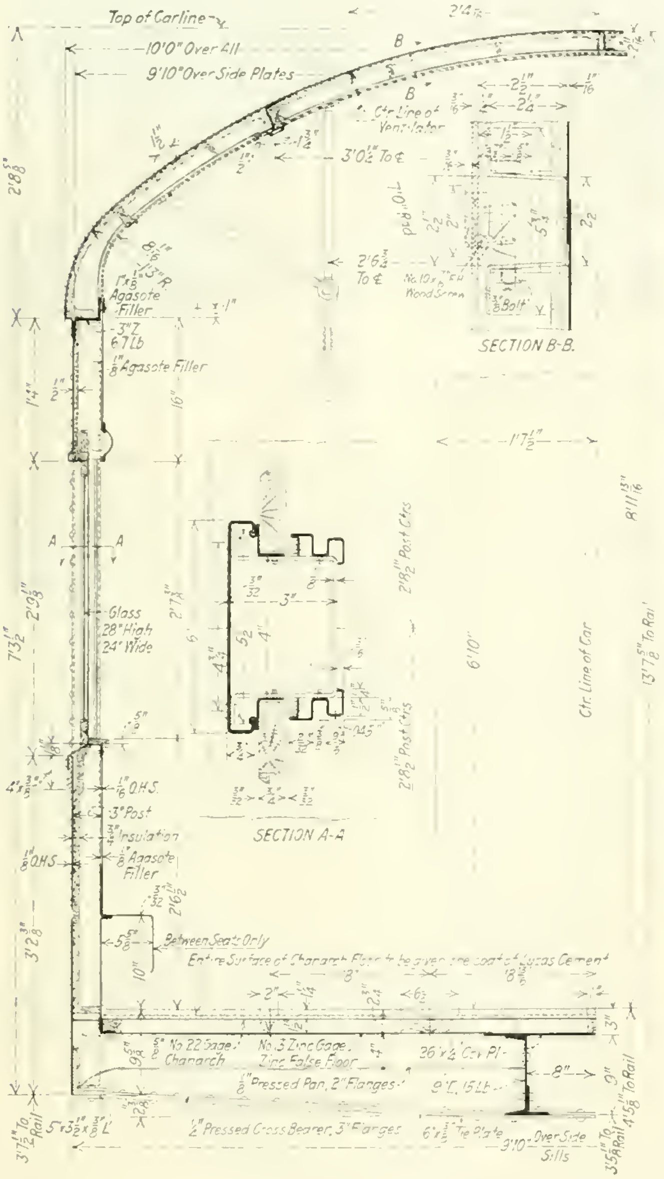
The light weight of these cars was made possible solely by careful analysis and calculation, no use being made of light weight non-ferrous metals. With the exception of the zinc bottom floor sheet and galvanized roof sheets the cars are constructed throughout of copper bearing steel insofar as all sheets, plates and structural members are concerned. The side girder type of construction is used with the sides from belt rails to side sills designed to carry the vertical loads. Vertical loads imposed upon the floating center sills are transmitted to the side girders by three substantial cross-bearers. Cast steel combined body bolsters and platform castings are used. The roofs are of the elliptic type, the design making use of a relatively long middle ordinate so as to provide a pleasing roof contour from both inside and outside. The car bodies are equipped with friction draft gears and friction buffers.



Application of Westinghouse Type U. C. Brake Equipment

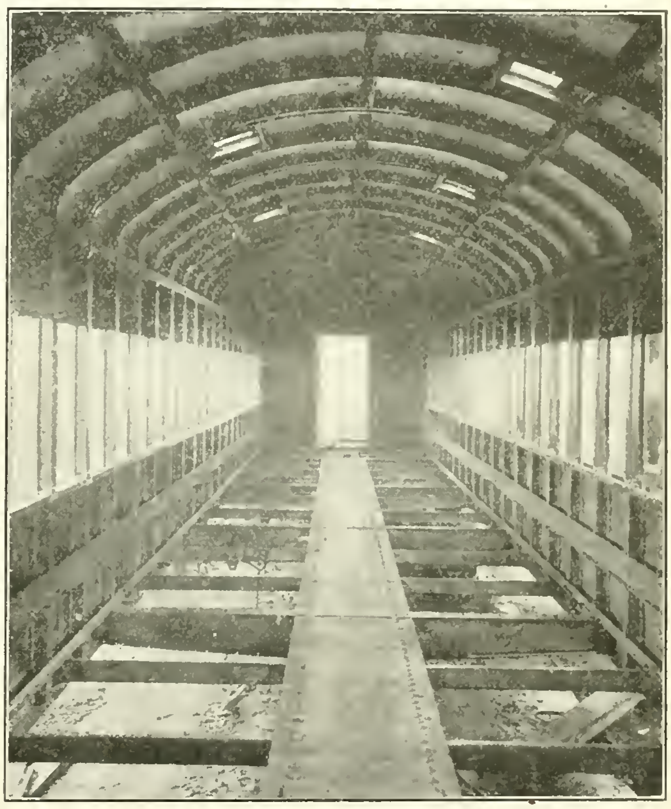
The equipment includes four-wheel equalized trucks having cast steel truck frames with integral pedestals, 33-in. solid wrought steel wheels, axles with 5-in. by 9-in. journals, roller side bearings and clasp brakes. The wheelbase of the trucks is 6 ft. 4 in. and the distance between truck centers is 57 ft. 6 in.

The electric lighting equipment is of interest because of the provision made to prevent a complete light failure at any time, and also because of the provision made to enable the use of either 64 or 32-volt current supply. The Rock Island standard car lighting service utilizes a 7½-kilowatt 64-volt turbo-generator with the necessary control devices placed on the suburban locomotives, using three-wire train lines for distribution to the cars. However, it is occasionally desirable to attach a suburban car to the rear of a regular main line train, at which time the lighting equipment of the car must be so designed that the car will automatically make the proper connections for utilizing 32 volts on the lighting circuit instead of 64 volts. To this end, each of the new steel suburban cars is equipped with an especially designed automatic selector switch. This switch automatically causes the proper voltage to be impressed upon the lamps, regardless of whether the current supply to the car through its train line connector is 64 or 32 volts. This switch operates in conjunction with a manually controlled switch which is the only part of the entire equipment that is accessible to the trainmen. This is a four-position switch with the lever operating in one direction from the first step, which is the off position. The second step is the full-on position, the third step is the first emergency position and the fourth step is the second emergency position. This switch is plainly stenciled to insure proper operation by the trainmen.



Partial Cross Section of the Chicago, Rock Island & Pacific Steel Suburban Car

Each car is equipped with a 32-volt, 80-ampere-hour emergency storage battery floated on the train lines through a resistor. This battery is so connected that in case of failure of the current supply from the engine, its current is automatically made available for the lamp circuits, it only being necessary for the trainmen to throw the four-position trainmen's switch into one of the two emergency positions. The connection of the wiring to the trainmen's four-position switch is such that should he fail to secure light when he places the switch handle in the first emergency light position, he has only to push it on a little further to the second emergency light position when light will be secured. The lamps are so connected in series parallel in alternate pairs that when the four-position switch is in either of the two emergency positions that only one-half of all the lamps in the car are lighted. An even distribution of the lighting, however, is maintained due to the method of wiring and location. This emergency lighting arrangement affords ample lighting for the car by having all the lamps in the car connected to one or the other of the two emergency circuits. It is always possible in case of failure of one circuit to still supply ample light to the car with the other circuit and at the same time maintain an even distribution of the light.


Interior View, After Assembly of Underframes, Sides and Roof

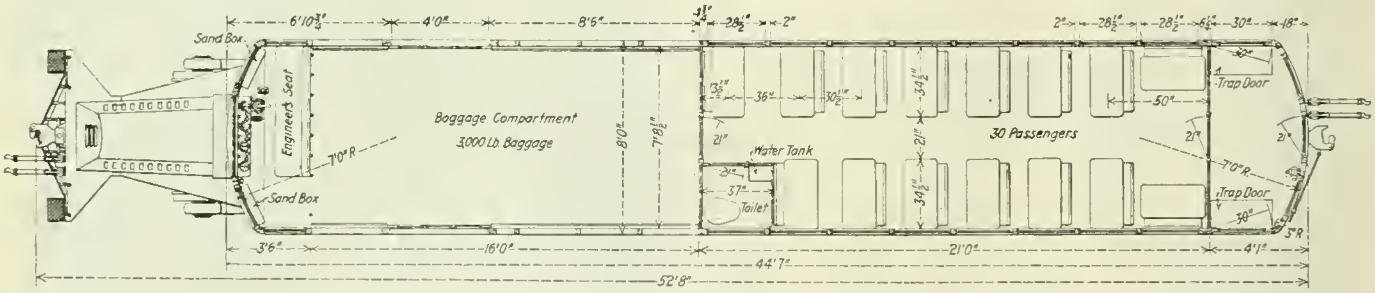
Inasmuch as the battery with which these cars are equipped is used primarily to control the heating system, and only serves in an emergency for lighting, a small size, lightweight battery is used. The heating equipment includes an air operated switch that disconnects the lighting circuit from the battery, when there is no air on the car, so that the battery cannot be bled when cars are standing in yards.

The American Engineering Standards Committee have recently approved as tentative American standards, a number of methods for the routine analysis of paint pigments, yellow, orange, red and brown pigments containing iron and manganese and of dry red lead as a basis for analysis, and in order to eliminate as far as possible the many controversies now existing. The specifications for these methods of analysis were presented for the approval of the American Engineering Standards Committee by the American Society for Testing Materials under whose auspices the specifications were developed. The specifications in more detail include methods of determining specific gravity, tinting strength of the colored pigments, moisture, and detailed methods for various chemical determinations.

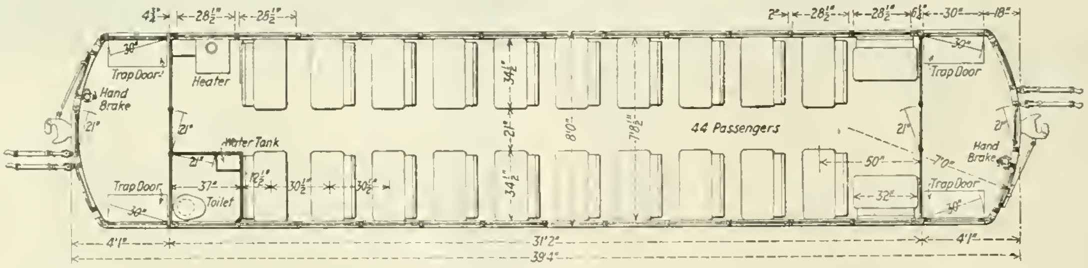
Sykes Motor and Trailer Car Seats 74 Passengers and Carries 3,000 Pounds of Baggage

Powerful Gasoline Motor Driven Train

Sykes Company Demonstrates Two-Car Train Driven by 245 Hp. Engine and Seating 74 Passengers



Floor Plan of Motor Coach Showing Baggage and Passenger Compartments



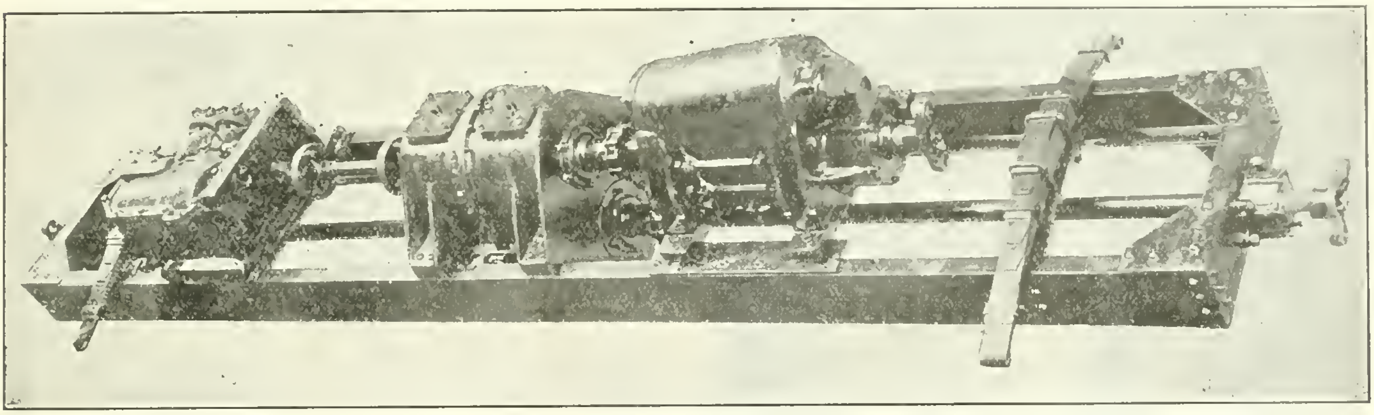
The Trailer Coach Seats 44 Passengers

THE heavy-duty gasoline motor driven coach, capable of hauling one or more trailers, presents a problem far more difficult of solution than that which the smaller equipment has had to meet. In the field which could be covered by relatively light weight and light powered equipment a number of designs are available at the present time, several of which have demonstrated their ability to do the work required in regular service. There exists, however, in the minds of many railroad men a feeling that there is a need and a real field for larger and more powerful motor car units. In response to this expressed desire several designs have already been offered but owing to a lack of driving power, some weakness in transmission or gearing, cars too weak for the hard duties of railroad service, high operating and maintenance costs, or to some feature not yet perfected the evolution of such equipment has been a slow one. For these reasons the new equipment which has been built by The Sykes Company, Winthrop Harbor, Ill., is of special interest.

The first train, which has been delivered to the Chicago Great Western, consists of a motor coach having a baggage compartment 16 ft. long and a passenger compartment 21 ft. long provided with seats for 30 passengers, together with a trailer coach 33 ft. long inside provided with seats for 44 passengers. Both cars have toilet compartments. The motor coach is 51 ft. 7 in. long over-all, with a body 44 ft. 7 in. long outside, and 8 ft. 3¼ in. wide at the eaves. The height over-all is 12 ft. 2½ in. The trailer coach is 39 ft. 4 in. long over-all and 31 ft. 2 in., long inside the passenger compartment. The inside width of both cars is 7 ft. 9½ in., the height from floor to ceiling is 8 ft. and the elevation of the floor above the top of the rails is 3 ft. 7 in. The distance between truck centers is 33 ft. 7½ in. on the motor car and 23 ft. on the trailer. The wheelbase of the trucks is 5 ft. 2 in. and the cars are adapted to pass around curves of 100 ft. radius.

The light weight of the motor coach is approximately 38,000 lb. and of the trailer coach 26,000 lb. As the train provides seats for 74 passengers this is at the rate of 865 lb. dead weight per passenger seat. In addition, the 16-ft. baggage compartment has a normal capacity for 3,000 lb. of baggage.

The cars are driven by a Sterling six-cylinder gasoline



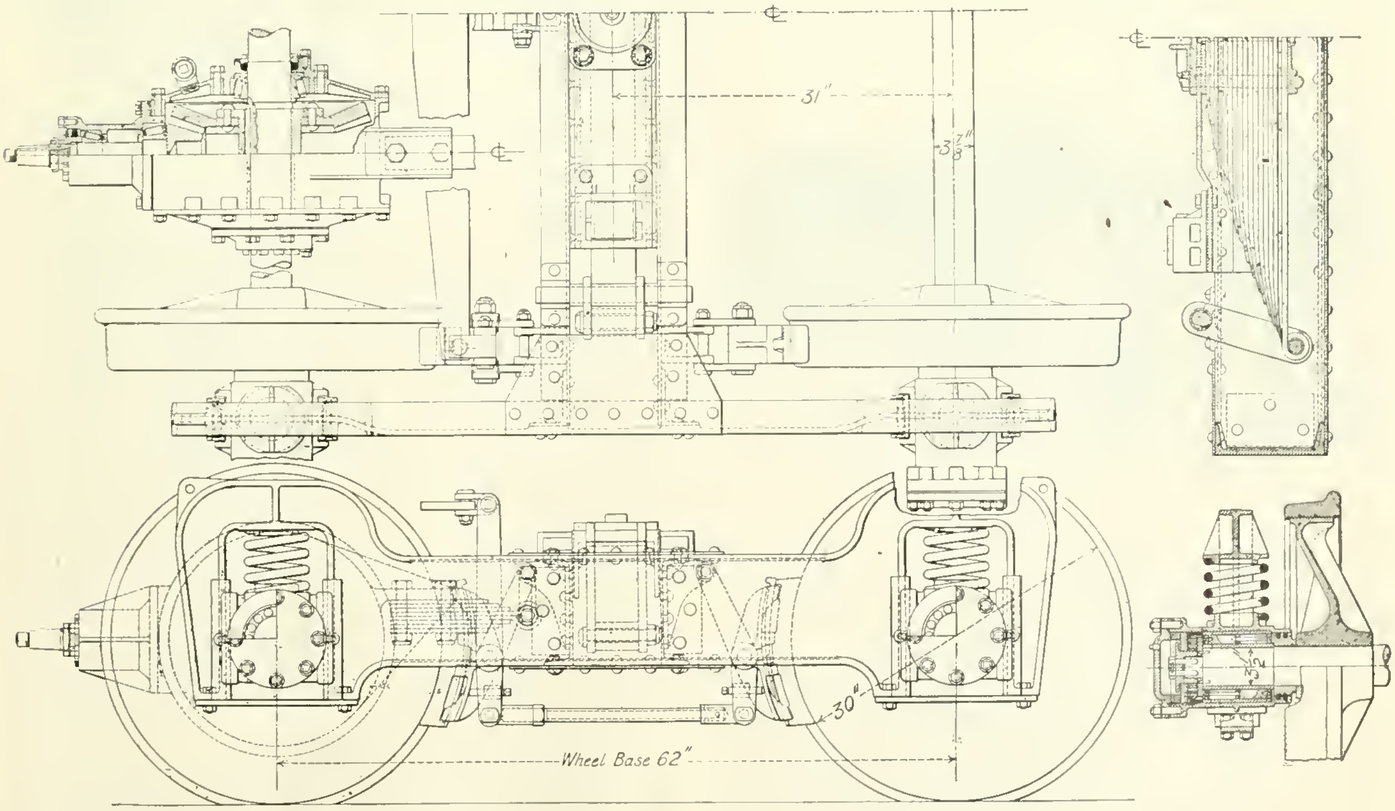
Transmission, Transfer Gear Box and Air Compressor are Mounted on a Sub-frame Which is Spring Suspended from the Main Frame of the Coach

motor with cylinders, 5¾ in. bore by 6¾ in. stroke, developing 180 hp. at 1,250 r.p.m. and 245 hp. at 1,750 r.p.m. Electric starting and lighting systems are provided, the motor being direct driven from the engine and of a capacity sufficient to carry all the lights of a two-car train, including the headlight, and to keep the lighting batteries charged to capacity at all times.

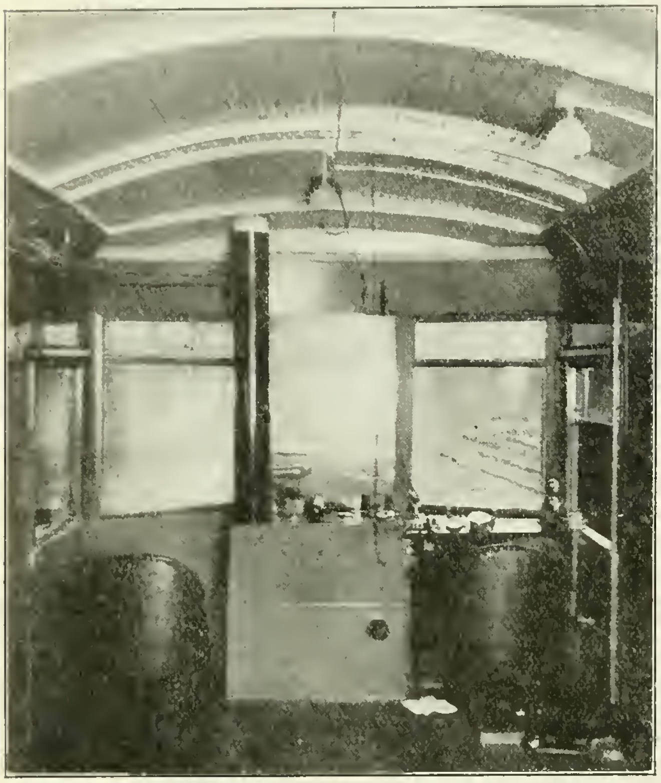
The clutch is of the Hale-Shaw type, of high capacity and runs in oil. It was developed for ordnance work by the U. S. army and also was used for submarine chasers. The transmission is of a special jaw-clutch type built by the Cotta Transmission Corporation and direct connected to a transfer gear case. The speeds provided for are 8.9, 15.1, 28.7 and 43 m.p.h. ahead and 6 and 15 m.p.h. in reverse. The drive is connected by bevel gears to the inside axle of each truck.

An interesting and important feature of the design of this car is the use of a sub-frame suspended by springs from the main channels of the motor coach. The transmission, transfer gear box and air compressor are mounted on this sub-frame. This method of suspension eliminates gear noises and vibrations. Moreover the entire driving mechanism may be dismounted and another set mounted to replace it in two hours' time. The motor and entire power plant are so fitted that they can be detached, removed and replaced in the space of an hour. By carrying spare units and replacing when repairs are required, the work can be performed economically and the car kept in service while the driving mechanism is being overhauled. These points are typical of the attention that has been given to the details of design which should tend to keep the costs of maintenance at a minimum.

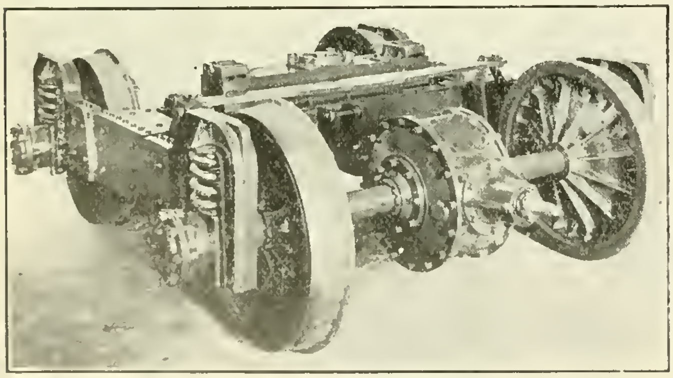
The front and rear trucks are of standard bolster construction with semi-elliptic springs under the bolster and



Plan and Elevation of Truck Used on Sykes Motor Car with swinging suspension cradles. The wheelbase is 5 ft 2 in. and the wheels 30 in. in diameter with cast steel centers and rolled steel tires. The axles are of chrome-nickel steel, heat treated, 3⅞ in. in diameter and have 3½ in. journals with Stafford roller bearings.


Driving Compartment of the Motor Car

In addition to hand brakes the cars are equipped with Westinghouse semi-automatic air brakes. The air compressor has two cylinders and a capacity of 10 cu. ft. per min. There are two main reservoirs, 18 in. by 72 in. The foundation brake rigging includes brake shoes of the type commonly used in railroad service. The cars are equipped with M.C.B. automatic couplers, cored out to save weight, and located at the standard height above the rails.


Motor Car Truck with Axle Drive

In the preliminary runs on the Chicago Great Western the train, about two-thirds loaded, attained a speed of 63 m.p.h. on the level and was driven over a one per cent grade, seven miles long, the summit being passed at a speed of 47.4 m.p.h. with the throttle three-quarters open. The throttle was never fully opened during the run yet there was at all times an apparent surplus of power.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Another Case of Failure to Stencil Cleaning Date

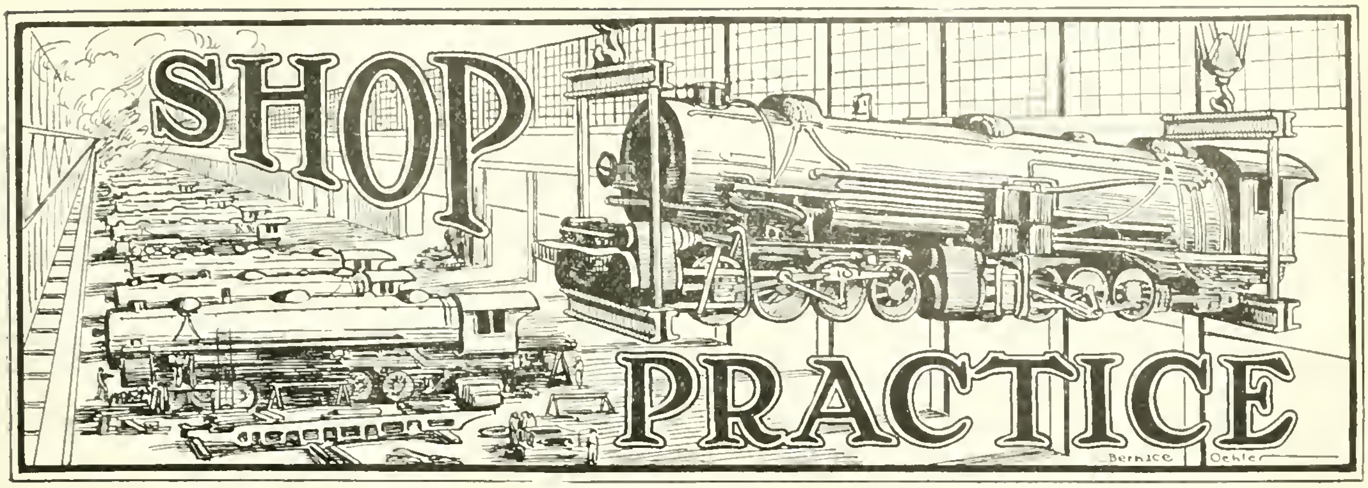
The Michigan Central made a charge against the Bessemer & Lake Erie of $4.92 for cleaning, oiling, testing and stenciling the air brakes on Bessemer & Lake Erie car No. 8534, on December 13, 1920. On February 23, 1921, the Buffalo, Rochester & Pittsburgh reported the same work on the same car, the repair card showing the car to be stenciled for last cleaning, March 6, 1920. The B. & L. E. called this to the attention of the Michigan Central asking for offset authority or correction of car number. The Michigan Central claimed the initial and number to be correctly reported and refused offset authority on the ground that the car was on the Michigan Central line on March 6, 1920, and that it did not have the air brakes cleaned at that time. The Michigan Central stated that: "Had Buffalo, Rochester & Pittsburgh shown last date of brake cleaning the same as reported by our man, we would gladly concede the point that it was negligence on the part of our repair man." The car owner maintained that when received home January 17, 1921, no interchange inspector could know that the Michigan Central would later make a bill for stenciling the car, because the charge had not yet been made.

The Arbitration Committee's decision states that: "It is evident that the Michigan Central failed to apply proper stenciling or obliterate old stenciling at the time the work was done. Its charge, therefore, should be withdrawn. Rule 90 applies, and car owner could not be expected to obtain joint evidence upon arrival of car home."—*Case No.* 1252, *Michigan Central vs. Bessemer & Lake Erie.*

Handling Line Is Responsible for Damage in Derailment

On November 3, 1920, St. L. B. & M. flat car No. 8668 was broken in two while in the possession of the Macon & Birmingham. Under date of November 4 the car accountant of the handling line advised the car accountant of the owning line (the Gulf Coast Line), that the car was destroyed in a derailment. On November 4, December 13, December 27, 1920, and January 5, 1921, the superintendent of the Macon & Birmingham reported to the mechanical superintendent of the owning line that the car had been in an accident and asked for depreciated value in order that he might determine whether it would be cheaper to destroy or rebuild the car. Later, however, after an inspection of the car, the mechanical department of the Macon & Birmingham decided that the car was broken in two in ordinary switching and on April 18, 1921, the owner was so advised, a sworn statement to the effect that the car was "derailed and damaged in ordinary switching," from the conductor in charge at the time the car was damaged being attached as evidence. On this basis the handling line claimed owner's responsibility.

The Arbitration Committee decided that: "In view of the statement of the conductor handling the train that the car was derailed, as noted in the agreed statement of facts, the handling line is responsible."—*Case No.* 1255, *Gulf Coast Line vs. Macon & Birmingham.*



Locomotive Scheduling at the Silvis Shops

Part 3—Analysis of Cost Accounting Division

New Schedule System to Provide Centralized Control of Production and Accurate Cost Data

By L. C. Bowes,* G. F. Sandstrom,† and H. K. Robinson ‡

THE previous articles have dealt primarily with the procedure of controlling production activities, making for efficient and economical output. However, in order to reflect such economical output, it is very essential that there be a supporting division of cost accounting. But, such accounting procedure should not be based on accounting requirements alone as heretofore, which is all very well in itself, but should be designed absolutely on engineering procedure and data, which can only be secured by the aforementioned well defined and established centralized control of all production activities. In other words, the accounting division should reflect and be governed by the production activities rather than the production activities be governed by the procedure laid down by the accounting division. There would then be an organized endeavor which would make available real analysis and subsequent control, creating an opening whereby the potentialities of production can be clearly established, rather than having a mass of statistical and post mortem data. It is very evident, therefore, that because of the fact that production functions and routine are based on unit operations and analysis, the desired accounting procedure must also be based on unit classification, which means nothing more nor less than to satisfy the great cry of the present age for

Unit Costs

A true system of unit cost accounting makes possible the establishment of predetermined performance, which in comparison with actual performance makes obvious the potentialities of such a system.

Functions of Cost Accounting Division

The proposed system provides for the following functions, which will be supported by necessary routine.

1—General Accounting
a—Shop ledger
b—Expense ledger
c—Reports
d—Invoices and vouchers

2—Cost Accounting
a—Detail costs
b—Comparative costs
c—Expense analysis
d—Labor and material distributions
e—Expense distribution

3—Payroll
a—Timekeeping
b—Payroll summaries

4—Statistics

Following is a detailed explanation of the foregoing listed functions:

1—General Accounting

a—Shop Ledger: The system provides for using a shop ledger for controlling all the charges and disbursements that the particular shop is responsible for. This shop ledger is also used for controlling the expense accounts that appear in the expense ledger, the expense ledger being divided departmentally and the expense analysis being maintained according to as few accounts, or as many accounts as may be found desirable. The chart of accounts is so designed that it permits of the maximum amount of elasticity, in the arrangement and grouping of accounts.

b—Expense Ledger: This is used for providing departmental analysis of all expenses. This ledger is so arranged that a budgetary control may be used in connection therewith for each and every account.

At the close of each month, detailed comparative expense analyses are compiled from this expense ledger for the departmental heads so that they may be informed as to the expense of operating their respective departments and do all in their power to control these expenses. A few of the important expense accounts that heretofore have been buried in the cost of shop operation, which are brought out in this proposed system of cost accounting, are as follows:

1—Losses, due to lack of material.
2—Losses, due to insufficient appropriation of working capital.
3—Losses, due to idle equipment.
4—Work on defective purchased material.
5—Defective purchased material, not replaced by vendor.
6—Defective workmanship (errors in processing).
7—Defective design.
8—Transferring parts from one locomotive to another due to lack of material.

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*Production engineer, C. R. I. & P.
†Industrial engineer, Roberts-Pettijohn-Wood Corporation.
‡Special accountant, C. R. I. & P.

This system also provides for the inclusion in the cost of all elements of expense that have not heretofore been considered as part of the cost of locomotive repair shop production, such as:

1—Executive and superintendent's salaries.
2—Stationery and office supplies.
3—Repairs and maintenance to shop buildings and building equipment.
4—Repairs and maintenance to shop machinery and equipment.
5—Repairs and maintenance to power plant buildings, machinery and equipment.
6—Repairs and maintenance to shop yards and equipment.
7—Service charges from outside departments.
8—Insurance.
9—Taxes.
10—Depreciation on all property, including shop buildings and equipment, shop machinery and equipment, power plant buildings, machinery and equipment, and shop yard structures and equipment.

c—Reports: These are rendered monthly covering all information required by department heads and managements.

d—Invoices and Vouchers: This function provides for the necessary routine for handling invoices and vouchers.

2—Cost Accounting

a—Detail Costs: The departmental cost method is the one proposed, which reflects the detailed costs as of the departmental grouping in the shop. In addition to departmental analysis and consequent cost, the system is capable of obtaining unit operation costs departmentally. The cost of locomotive repairs will be recorded in regular accounting procedure according to the specific divisions of classes of repairs on each locomotive. It is the intention to separate definitely the costs of actual repairs to locomotive parts as against the cost of manufacturing new.

b—Comparative Costs: The comparative cost record is used for making final analysis of costs. The costs will be recorded according to individual parts, and classes and divisions of locomotive power. All comparisons of costs will be reduced to a per unit basis.

c—Expense Analysis: Detailed departmental comparative expense analysis, will be provided that will reflect a comparison of actual expenses for each and every account by departments, with the average actual "to date" and the average or budget amount for any preceding period. In addition, a further comparison will be made of the total actual expenses "to date" with the total predetermined or budget "to date."

d—Labor and Material Distributions: Labor distribution will be made according to direct and indirect labor; direct labor being that which can be charged to a specific order for locomotive repairs or stock orders for manufacture of repair parts. Indirect labor being all other than that not mentioned above.

Material distributions will be maintained according to direct and indirect materials, the same as labor distribution.

e—Expense Distribution will be maintained so that detailed analysis may be had of any statistics that may be required, such as the repair and maintenance to individual machines or groups of equipment.

3—Payrolls

a—Timekeeping: The timekeeping system provides for the use of an individual job ticket, which means one ticket per man, per operation, per day, and covers all information necessary for the detail unit labor costs.

b—Payroll Summaries: This provides for the necessary gathering of payroll and labor statistical data.

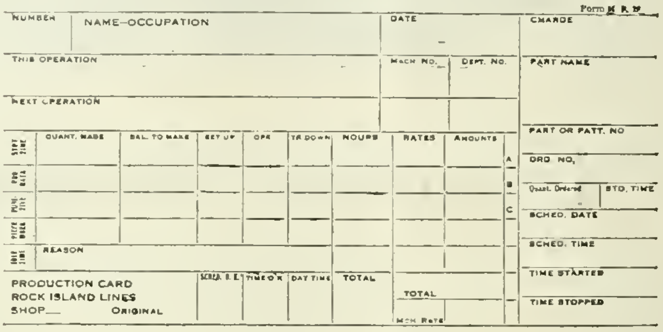
4—Statistics

This provides for the necessary compilation of any statistics required by shop, management or other governing bodies.

Routine of Accounting Division

At this time only the routine of such established functions as are actually in operation will be explained in the following:

The booths illustrated in the July issue of the *Railway Mechanical Engineer*, Fig. 3, were placed and each booth provided with a production clerk who handles the production tickets (see Fig. 5) for the workmen. These tickets are in triplicate form and are made out in advance by these clerks from data furnished by inspection reports and schedule boards. These tickets show the work to be done and are then placed in the racks (Fig. 4, July issue) which are numbered to show the machine or production center which is to do the work. The workman goes to his booth, calls his number, name and machine or production center number and the clerk takes the card from the rack, shows his number, name and starting time and gives him the ticket. The ticket shows just what is to be done and makes it unnecessary for the workmen to hunt the foreman for instructions. If a print or drawing is necessary, it is given to the workman with the production ticket. After the job is finished the workman returns the ticket to the booth, the production clerk shows time finished and gives him the ticket for his next job. At the end of the day the total time shown on the production tickets for the day is checked against the total time shown on the "in and out clock card." This card shows only the man's number, name, occupation and the clock stampings. The production tickets for the day then go to the office of the Production Department, the triplicate is detached for use of the production supervisor and the time study men, the original and duplicate being forwarded to the Accounting Department. Comptometer operators then multiply the hours on each ticket by the man's rate and show the amount to be paid for that particular job, after which the duplicate is detached and turned over to the cost department, the original going to the payroll department from which payrolls are made after the comptometer operators have made a consolidation of each man's time and money for the day period.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Quant. Ordered
STD. TIME
C
SCHED. DATE
SCHED. TIME
REASON
TIME STARTED
SCHED. E. L.
TIME O'R
DAY TIME
TOTAL
TOTAL
TIME STOPPED
MCH RATE
PRODUCTION CARD
ROCK ISLAND LINES
SHOP__ ORIGINAL

Fig. 5—Production Card

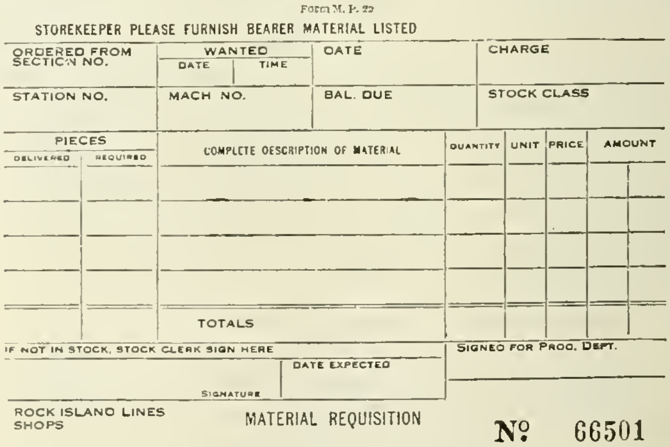
Form M. P. 22
STOREKEEPER PLEASE FURNISH BEARER MATERIAL LISTED
ORDERED FROM SECTION NO.
WANTED
DATE
TIME
DATE
CHARGE
STATION NO.
MACH NO.
BAL. DUE
STOCK CLASS
PIECES
DELIVERED
REQUIRED
COMPLETE DESCRIPTION OF MATERIAL
QUANTITY
UNIT
PRICE
AMOUNT
TOTALS
IF NOT IN STOCK, STOCK CLERK SIGN HERE
DATE EXPECTED
SIGNATURE
SIGNED FOR PROD. DEPT.
ROCK ISLAND LINES SHOPS
MATERIAL REQUISITION
№ 66501

Fig. 6—Material Requisition

All statistics heretofore required can be compiled from these tickets, which in no way interferes with reports and statements required by federal regulations or operating and accounting officers of the railroad.

The cost department is furnished the duplicate copies of the production tickets as soon as the earnings are shown and assorts these tickets by accounts, locomotive numbers, jobs, etc., after which it is just a matter of consolidation.

Material tickets (see Fig. 6) for material used in the shops are prepared in triplicate and when the material is drawn the triplicate is returned to the Production Department, the original and duplicate going to the store accounting office where they are priced and extended into money, the originals supporting the store bill versus the shop and the duplicate remaining in the store office for record. The cost department then assorts the original and handles them in the same manner as the production tickets for the labor.

It is important to note that a great advantage of this new system lies in the fact that the shop is using no more than the two already existing forms, namely, the production ticket and the material ticket, which however, have been merely revised.

[The next and last article will take up the matter of Performance. This will be strictly an engineering dissertation, setting forth certain well defined principles and attempt to show the potentialities of a possible output of 180 locomotives per month, by exploiting the practicability of the theory of breaking up locomotive repair work into three major divisions, namely, Stripping, Assembling and Manufacturing.—EDITOR.]

Standardization of Locomotive Repair Parts*

Part 3

Methods of Manufacturing and Fitting Standard Taper Frame Bolts; Reaming Holes to Step Gages

By M. H. Williams

It is not difficult to set sizes suitable for taper frame bolts, and where once properly established it will be found that a reduction in cost and time of turning will follow.

For tapers of 1/16 in. per ft.—mostly used for frame bolts—the diameters or step sizes can, to good advantage, advance by either 1/64-in. steps which is equal to the increase in diameter of 3 in. length of bolt, or, should this make it necessary to maintain too large a stock, the steps can be advanced by 1/32 in. equalling 6 in. length of bolt. The former reduces amount of reaming necessary and doubles number of step sizes. The latter increases the amount of reaming and reduces number of sizes.

The master gage Fig. 12 will serve to illustrate step sizes. This gage has a taper of 1/16 in. per ft. Graduating lines are spaced 3 in. apart, which for this taper increases the diameter 1/64 in. at each succeeding graduation. The gage shown is 1 in. diameter at the small end and has 15 in. of tapered surface which is a convenient length. Similar gages may be made for any desired diameter. If step sizes advancing by 1/64 in. call for too great a variety of sizes, the intermediate graduations may be omitted. Such master step gages are valuable for maintaining standards of taper for bolts, grinding reamers and checking reamed holes. The graduating lines shown are used as step sizes, *i.e.*, the diameter of bolts directly under the head.

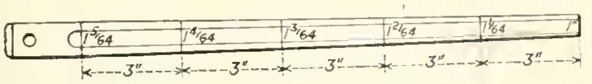

Fig. 12—Plug Gage for Step Sizes of Taper Bolts

Internal Gages for Taper Bolts

In order to properly carry out a system of step sizes it is essential that suitable internal gages be provided. For measuring the diameter and the taper of bolts, internal work gages as shown in Fig. 13 are used to advantage by the bolt turner. These gages may be of soft steel or cast iron. The taper holes are carefully reamed to a size so that the desired graduation of the external gage, Fig. 12 comes flush with the face of this internal gage the diameter being stamped at each hole. The dimensions given in Fig. 13 meet the requirements for the average run of bolts. While frame bolts longer than 8 in. are common, it will be found that by turning to a gage of this length all necessary accuracy is readily obtained.

Each of the seven holes advances in diameter by 2/64 in. steps, which is entirely satisfactory. The complement of these gages should cover all diameters of frame bolts commonly used, which makes it necessary to provide several. However, when made of cast iron their cost is low in comparison to the economies that follow. These are generally made locally. In addition to bolt manufacture they are also used in the tool room when grinding reamers.

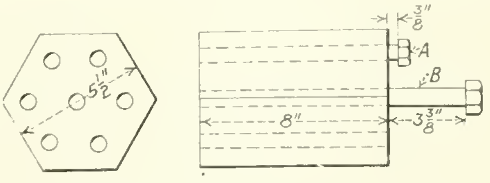

Fig. 13—Internal Gage for Fitting Taper Bolts

When finishing taper bolts, either on bolt skimming machines, turning, or other methods, the even 64th sizes such as 1-2/64, 1-4/64 in., etc., are machined to enter the gage so that the head projects approximately ⅜ in. from the face as shown at *A*. The intermediate sizes, such as 1-3/64, 1-5/64, etc., are machined to stand away 3-⅜ in. as shown at *B*. The ⅜-in. projection is the amount allowed for driving or drawing home. This reduces the number of holes in the gage by half and admits of accurately gaging all sizes coming within their range.

Machining and Fitting Taper Bolts

Machining and fitting taper frame bolts is now done in a number of ways, therefore no attempt will be made to describe all processes. The following explanations will dwell mainly on what may be called ideal methods and are described with the hope that some of the practices mentioned may be made use of and thereby result in an improvement over the practices commonly employed.

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* This is the third of a series of articles, the first of which appeared in the June issue of the *Railway Mechanical Engineer*, describing the methods that have successfully been adopted on one of the large railroad systems and which have expedited locomotive maintenance work and reduced the cost.

It is [illegible] to manufacture taper frame bolts in large quantities [illegible] production [illegible] in order to take advantage of the resulting economies. However, the great variety [illegible] required to meet conditions when repairing locomotives [illegible] certain limitations on quantity production. An [illegible] is given of special machines for finishing taper bolts.

Bolt Skimming Machines

In the larger shops, under favorable conditions, taper frame bolts are economically finished in quantity production on bolt skimming machines. Where these machines are employed the rough forgings are first finished to one diameter for their entire length and also faced under the head by revolving the bolt in a hollow mill or skimmer. The bolt is then transferred to and finish turned on a second tapered hollow mill on the same machine which has two cutters or knives and two backers all of which are the full length of the bolt, these cutters being carefully set to a gage of the same taper as the bolt. Bolts finished in this manner are sufficiently accurate to meet general requirements. After finishing in this machine, the ends are threaded on regular bolt threaders. When required for use they are drawn from stock and driven into place without additional machining, the holes having been reamed to suitable step sizes. As previously mentioned, this is an economical method for machining taper frame bolts and is now employed to good advantage in the larger shops, which are warranted in carrying a large stock of these articles. However, owing to the almost endless variety of diameters and lengths required to meet the condition of re-reamed holes which should from necessity cover a range from the original or standard sizes gradually upwards through the many stages of enlargement, it would be necessary to keep a large variety in stock. This places certain limitations on this method of manufacture that should be carefully considered.

Roughing Out to Sizes Varying by 1/8 Inch

Another method is to forge, center both ends, rough turn, thread and place in stock. When required for use they are drawn from stock, turned to required diameter and applied. It is advisable where this practice is followed to rough turn to sizes governed by thread sizes, *i.e.*, a 1-1/8 in. bolt, 12 in. long and 1/16 taper per foot is rough turned 1-3/16 in. diameter next the threaded end, the diameter 1-5/16 coming close to the minimum size for a bolt threaded 1-1/8 in. Or, to state another way, bolts threaded 1 in. are used for all sizes above the minimum to a point where the 1-1/8 in. bolt begins; after this the next or 1-1/4 in. size is used, this plan being followed for all diameters and lengths. This practice will reduce the varieties of bolts carried in stock to a minimum. Having the bolts rough turned, faced under the head and threaded reduces the time in repair shops when finishing to the various sizes for repair work. Considering the fact that bolts can be blanked out in the manufacturing shop in quantities at a correspondingly low cost makes this practice advantageous.

In the majority of the smaller shops bolts are turned directly from rough forgings to sizes required for fitting frames. This is a simple practice but much more expensive than semi-finishing in the manufacturing department.

Ideal Bolt Finishing Machine

There is a pressing need in the medium sized shop for a machine that may be in the form of the upright bolt skimming machine or the conventional form of horizontal bolt threading machine and equipped with a cutter head or similar device which will automatically enlarge when turning bolts from the small or point end to the large or head end and machine to the correct taper and diameter. These cutter heads, in addition to opening up to give the correct taper, should be readily adjustable from one size to another similar to changing the diameter of threading dies on a bolt cutter, the actual diameter being shown by an indicating dial which will admit of the operator changing from one diameter to another in a minimum time. The latter feature is necessary in order to meet the requirements of every day repair work and the many sizes demanded. A machine of this nature should have two or more heads in order to keep the operator fully employed when turning the longer bolts. Moreover each head should be driven by a separate clutch or motor in order to avoid stopping the entire machine when adjusting a single head. In addition it should be provided with cutter heads suitable for turning the straight part of the bolt to a suitable diameter for threading.

With a machine of this nature, taper bolts could be turned to the many sizes required and if provided with quick and accurate adjustment for cutters, the time of changing from one size to another should not be a serious consideration. With this ideal machine it would be necessary to carry only a stock of bolt forgings, every day's requirements being met by adjusting the cutter heads.

Too Much Time Lost Between Turnings

Under every day shop conditions it will generally be found that the time taken to turn bolts by any process is but a secondary consideration when compared to the time required to measure diameters of taper bolt holes in frames and cylinders, and in addition measure diameters of bolts during the process of turning, or possibly making several trials of bolts in holes. A greater amount of time is often consumed in going to and from the locomotive, trying bolts, etc., than in turning. It therefore follows that economies should be effected by reducing the time lost between bolt turnings, or adopting a practice whereby the operator when turning bolts does not leave his machine for the purpose of taking sizes.

Reaming Taper Holes

Two general plans may be followed when bolts have been previously finished to step sizes. One practice is to make use of a gage similar in general design to that shown in Fig. 12. When reaming, the hole is enlarged sufficiently to true up and also so that one of the graduations comes flush with the frame. That is, if when reaming, the hole can not be trued for the 1-4/64 in. graduation, the reaming is continued until the 1-5/64 in. line comes flush, or continued until a full reamed hole is obtained. This results in a reamed hole to step sizes that may differ a minimum of 1/64 in. or 1/32 in. according to step sizes adopted. With taper holes reamed to the gage the finished bolts are drawn from stock and applied without further machine work. This in many respects is an ideal method, however, there are certain limitations such as the inconvenience of toting around the numerous taper gages required to meet all sizes, possibility of errors in measuring holes or bolts and the difficulty of keeping up the large stock of sizes.

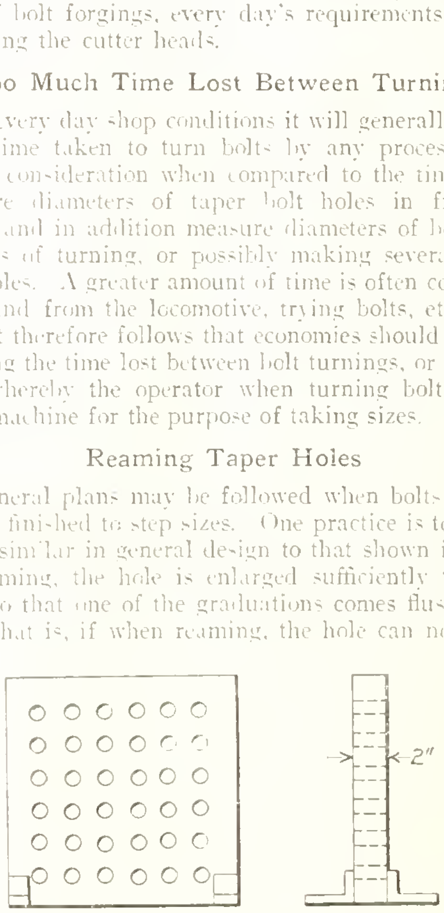


Fig. 14—Reference Block Gage for Step Diameters of Taper Bolts

Another plan is to gage the size of holes previous to reaming, draw finished bolts from stock of size a trifle larger than the holes and ream the holes to suit the bolts. This eliminates the errors that may creep in from defective reaming or bolt turning. This plan has a number of good points.

Another plan is to provide the erecting shops with internal gages as shown in Fig. 14 having a large number of accurately reamed and marked holes agreeing with step sizes. These are used either for measuring diameter of bolts or reamers. As they are only used for measuring diameters they need not be more than 2 in. thick. When in doubt as to sizes of bolts they are tested in the gage which provides a handy check for bolt sizes. They are also used for the purpose of gaging holes in the following manner. A reamer that appears satisfactory for the hole to be reamed is selected and placed in the frame hole. The distance it enters the hole being noted, the reamer is then placed in a suitably sized hole in the gage and chalk marked to agree with the face of gage or 3 in. distant. The hole is then reamed until the chalk mark comes flush with the frame. A rough and ready way of testing diameters of holes is to place the reamer in the hole and when held in the hand, the thumb nail is placed flush with the frame, the reamer withdrawn and placed in the gage and the position noted. While this is a crude way a man accustomed to the work can thus gage very accurately.

By this plan of gaging, the holes may be reamed to step sizes, finished bolts drawn from stock and applied, or the taper holes may be measured previous to reaming, bolts of anticipated sizes drawn from stock, holes reamed to suit bolts after which the bolts are driven into place.

In the event of the ideal bolt finishing machine being developed, or even when turning on center lathes by the use of these gages a memorandum of step sizes of bolts required can be made out at the locomotive and handed to the bolt finisher who would make up what is required from this list, the bolts being fitted to gages shown in Fig. 14. These may be of a size suitable to drive into the previously reamed holes, or to the anticipated sizes to admit of reaming holes to suit the bolts. By this plan the bolt turner would fit all bolts to gages and as a result would not leave his station for the purpose of taking sizes. This should increase the output with a corresponding reduction in costs. Moreover, fitting bolts to gages eventually results in an improvement in the grade of work.

(*To be continued*)

Railroad Master Blacksmiths Meet at Chicago

Good Attendance and Discussion of Technical Papers Mark the Twenty-Seventh Annual Convention

The twenty-seventh annual convention of the International Railroad Master Blacksmiths' Association was held at the Hotel Sherman, Chicago, on August 21, 22 and 23. The last convention was held in 1920 and since long periods of inactivity in association work are usually followed by more or less of a lapse of interest, the officers were pleasantly surprised both at the attendance and the spirit shown. Seventy-eight members of the association, 46 supply men and 64 members of the Ladies' Auxiliary registered at the convention and were for the most part present at the opening session. The keynote of the convention was undoubtedly the desire of the members to build up the association and spread knowledge regarding the best railroad blacksmith shop practice to the mutual advantage of the members and the railroads which sent them.

The invocation was offered by C. B. Rowe, secretary of Y. M. C. A., and D. G. Gallagher, assistant corporation counsel of Chicago, welcomed the convention in the name of Mayor Dever. Joseph Grine (N. Y. C.), president of the association, delivered a short but forceful address outlining the object of the association and particularly its main object of enabling members to help solve each other's problems. He pointed out that while the blacksmith shop supervisory forces were pressed to the limit during the war their work is hardly less arduous now in building up depleted shop forces and meeting new problems.

At this point in the program the members were agreeably surprised to listen to an address by M. D. Franey, formerly master mechanic of the Lake Shore & Michigan Southern at Elkart, Ind. Mr. Franey paid a glowing tribute to the master craftsmen, not only in the blacksmith's but in other allied trades, who have served their apprenticeship and risen from the ranks to positions of authority. He testified to the practical value of association work and praised as broad gage the higher railroad officers who authorize their representatives to attend conventions.

One of the features of the convention was a moving picture showing the manufacture and use of oxygen and acetylene gas, this film being explained by Professor A. G. Kinsey (Air Reduction Sales Company) as it was shown. A varied

Joseph Grine (N. Y. C.)
President

George Hutton (N. Y. C.)
1st Vice-President

Samuel Lewis (Can. Nat.)
2nd Vice-President

W. J. Mayer (Mich. Central)
Secretary-Treasurer

entertainment program was provided for the ladies and both members and guests thoroughly enjoyed the annual banquet furnished through the courtesy of the Supply Men's Association.

The five technical sessions were well attended, the committee reports being listened to with good attention and followed by valuable discussions. Abstracts of some of the papers are given below and others will appear in subsequent issues.

Drop Forging

By P. T. Lavender

Norfolk & Western, Roanoke, Va.

For many hundred years metals were worked by hand forging, but with progress in the manufacture of various commodities it became necessary to replace this old method by a machine capable of turning out quantities of a given product, uniform in size and with a minimum waste of material. To accomplish this great saving, a drop hammer was built and proved to be a machine of great merits. It has been so developed in recent years that its products are too numerous to mention.

It eliminates the great waste of hand forging, by leaving on the finished piece a minimum allowance to be removed by machining operations. Hand forging left the piece of work with entirely too much stock to be removed by machining.

The drop hammer saves labor as compared with hand forging and also increases production from 10 to 20 times, and in many cases more. Many pieces made by a drop hammer would require several heats in hand forging, which of course means a saving of fuel.

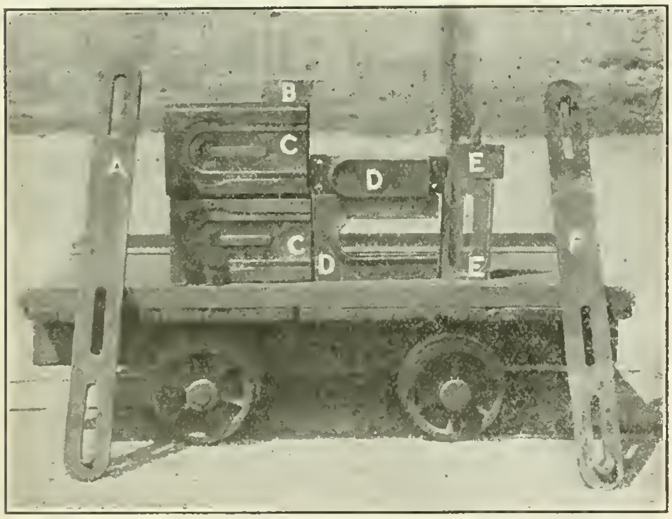


Fig. 1—Drop Forging Dies for Reclaiming Draft Gear Side Links

One of the distinct advantages of a drop hammer over other methods of forging is the compactness of the metal after the operation is completed. The work after being heated evenly to a yellow heat is placed under the hammer with the fiber in the same horizontal plane for each operation, thus each stroke of the hammer drives the fibers closer together. In no case is the work placed under the hammer such that it will be upset, for upsetting tends to drive the fibers away from each other, and thereby causes a spongy or porous effect in the grain of the finished work. Naturally a product with the grain driven close together will stand a greater tension or compression than one with the grain not so close together.

In order to secure a drop forging with minimum scale and minimum waste of metal and with a maximum production, it is necessary to have properly designed dies. These dies should be accurately machined and all vertical surfaces relieved five degrees. This relief enables the operator to free the work and seldom will it stick to a die. In most cases where the work sticks or hangs to the dies it is a faulty design and principally in relief.

Any material of 45 to 70-point carbon will make good dies. Old scrap driving wheel axles are very good, for this purpose. We do not heat treat dies but take them from the die room and put them into service. Wherever there is a sufficient amount of forgings to make, a drop hammer should be installed.

Dies used at the Roanoke shops for reclaiming the side links of Farlow draft gears are shown in Fig. 1, in which *A* is a scrap link and *B* a piece of material sufficient to reinforce the bearing at the end where the key works. This is placed on the scrap link *A* and both put into a furnace and brought to the proper heat. They are placed on die *C C* and stamped and then removed to the trimming press and the outside flash or excess material trimmed off by dies *D D*. Dies *E E* punch the slot as shown in the finished link *F*. You will note that the bearing at key seat has twice the wearing surface as the old one. These dies were a great help to us at Roanoke shops during the world war when we could not secure new material.

Frame Making and Repairing

Papers on the practices followed in frame making and repairing on various roads were submitted by C. H. Nutter, Boston & Maine, North Billerica, Mass.; G. W. Kelly, Central Railroad of New Jersey, Elizabeth, N. J., and T. F. Buckley, Delaware, Lackawanna & Western, Scranton, Pa.

Paper by C. H. Nutter

With the added facilities for autogenous welding at the present time, the repairing of frames has been reduced to a question of which method to use to get the best results at the least cost.

The introduction of the mechanical cutting torch enables new frame sections to be made from hammered steel billets, the most intricate shapes being cut and ready for use in a very few hours. New sections may be cut in such a way as to practically eliminate machine work except for shoe and wedge fits of jaws, cylinder fits and thickness of sections. Other parts can be cut to size, annealed and sent to the machine department in a very short time as compared to the old method of forging.

We are using the following kinds of welds: Oxy-acetylene, Thermit and electric and have no difficulty handling any one of them in a satisfactory manner.

It is useless for any of us to say that we do not have any failures. No matter what method is used, there is sure to be a certain percentage of failures, but it behooves the foreman blacksmith to so train his men who handle this class of repairs as to make this percentage as low as possible. The accompanying table shows welds made and how made in the year 1921 at the Billerica shop.

Kind of weld	Total number made	Number failures	Per cent
Oxy-acetylene	161	11	6.83
Thermit	37	6	16.2
Electric	7	1	14.3
	205	18	8.77

When I speak of a failure, it does not mean that the weld proper breaks but should the frame break near the weld or in such a manner that the weld was responsible for the break, such as improper expansion, improper methods, etc., it is called a failure. It is customary to run an engine into the shop to have a frame welded and there is not always time enough given to strip it in such a way that the proper expansion can be obtained. It, therefore, is not unreasonable to expect that the frame will break soon after its return to service. The total actual failures as shown in the table would have been only seven had the welds broken, for in 11 of the cases they broke at a point away from the weld which could not, therefore, be classed as failures in the strict sense of the word.

We keep a complete record of every weld made, who made it, and the date; also a sketch of the weld with a record of whether the expansion was perfect or not. We also stamp the welds made at the different points, with the shop mark carried at that point where weld is made and the date of making.

There are so many factors that enter into the breaking of frames, such as poor design, loose and improperly fitted shoes and wedges, loose binders, worn pins, loose rod wedges, loose bolts in frame braces, and last but not least, poor road bed, that we should have the co-operation of everyone from the lowest to the highest official, to bring the percentage of breakage as low as possible, and to keep locomotives in service.

We are applying new sections of a heavier design to such classes of engines on the Boston & Maine as were giving trouble, also adding frame tie castings where needed with very satisfactory results.

As proper expansion is essential to a good job, every effort should be made by the man in charge to see that the proper amount is given. In the case of acetylene welding, there are no two operators who use the same amount of expansion, as some weld faster than others, and great care should be taken in mating up the men to get the best results. Also, special training should be given to the men selected to weld frames, and a close check kept on their welding, to see that they are actually welding and not just filling in the vees. They should weld test pieces often and be shown the results of the tests. If the tests prove unsatisfactory they should be told why it is unsatisfactory, and should prove it for themselves by welding another piece for test purposes. No matter what process is used, only the most experienced men should be used at all times.

Paper by G. W. Kelly

The fact that the manufacture of locomotive frames has passed altogether into hands of the steel foundries which co-operate with the railroads in making frames of correct design and proper analyses does not relieve us of that most important duty of keeping frames in service. Steel frames have weaknesses as well as the wrought iron frames which they superseded and it requires quick decision as to the best method to effect repairs to return the locomotive to service with the least possible delay. We now have the use of Thermit, oxy-acetylene and electric welding processes and it has been proven unnecessary to remove the frames. Since 1905 the Central Railroad of New Jersey has used principally the Thermit process and has made several hundred welds which made a permanent repair. Included with this paper are illustrated a few types of steel frame sections that were welded on locomotives going through the shops for Class 2, 3 or 5 repairs. Frame sections such as shown in Fig. 2 were applied to about 45 locomotives; Fig. 3, 24 locomotives, and 25 locomotives had new frame sections similar to Fig. 3 except with two pedestals. The above sections were welded to wrought iron frames which were in first class condition.

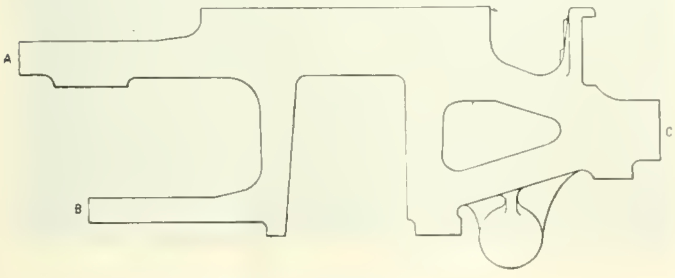


Fig. 2—Perferred Location of Welds

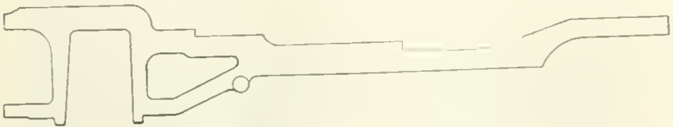


Fig. 3—Cast Steel Section Welded to Forged Frame

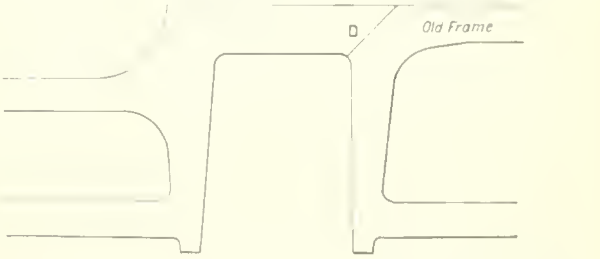


Fig. 4—With This Weld Allowance Must Be Made for Shrinkage

We prefer, when possible, to make the welds at *A*, *B* and *C*, (Fig. 2). When making repairs to the older type locomotives, where the frame is broken at two or more places in one pedestal, a wrought section is made and welded in as shown by Figs. 4 or 5. The weld at *D* (Fig. 4) also makes a permanent repair if allowance for the contraction of the weld is correct.

There were many long discussions when the Thermit process was first introduced. At that time there were many failures and there are still some today, and there will continue to be failures where the operator does not exercise the proper care on the several points, which govern the making of a successful weld. We cannot emphasize too strongly the importance of proper allowance for contraction, particularly on the heavy sections where it is most difficult to obtain it.

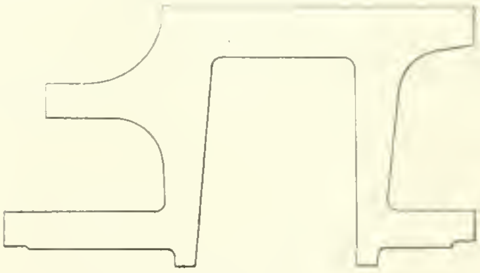


Fig. 5—Section Welded into Broken Frame

By using long heats of charcoal on opposite rails or pedestals, we have practically eliminated the use of a spreading bar or jack. The latter must be used with the greatest care, whereas the uniform heating of all the rails with charcoal allows a natural contraction which may be timed with the contraction of the weld without tension or buckling in the welded rail or other members of the frame.

The perfect drying out of the mold, sufficient pre-heating and the proper timing of the reaction will insure a perfect weld.

Paper by T. F. Buckley

A discussion on frames at this time should treat largely on the changes that have come through the substitution of cast steel for wrought iron. In cast steel a frame can be made much stronger than one of wrought iron as there are many brackets and braces cast integral on the frames which eliminate the bolting that is necessary when these parts must be fastened separately to wrought iron frames. It is now the aim of the mechanical departments to combine such braces as guide yoke knees, brake fulcrum brackets, reverse lever brackets, crossbrace knees, etc., solid with the frames. This practice can readily be followed with cast steel frames and the necessity for drilling for these braces is thereby eliminated. This plan with the cast steel frame strengthens the frame and reduces the liability of breaking.

In reference to the repairs required on main locomotive frames, we find we have more repairs to be done on wrought iron than on cast steel frames. The cast steel frames used on our heavier power engines have given us very little trouble. Our percentage of breakage on these frames is very small, the most frequent being the cracking away of the pedestal binder toes below the driving boxes.

We have been making repairs to locomotive frames for the past several years by electric and oxy-acetylene welding, the majority of repairs being made by the latter method, and have been getting good results from such repairs. We find the best method in repairing frames by acetylene gas is by using two torches, one on each side of the weld, until the work is finished. We cut all the welds in V-shape, to an angle of about 45 deg. and make sure that the scarf is clean where the weld is to be made. It is very important in making the weld to provide for proper expansion, this being difficult to describe as it is governed by the design of the frames and location of the weld. It is also necessary to have capable, experienced welders on this class of work. As previously stated, we are getting satisfactory results from the oxy-acetylene welding, but have also been well satisfied with results obtained by the other welding processes, notably the electric.

The largest percentage of frame repairs is on our older engines, built 12 or 15 years ago and having light section wrought iron frames. We have not generally removed any frames from these engines for welding during the past several years, but have made all repairs while the frames are under the engine. We find that in making welds under the engines, that at times it is difficult or impossible to provide for the proper expansion and contraction. We may think we have the correct length, yet when the weld is completed find we have thrown strains elsewhere which may later cause other failure of the frames. It is the writer's opinion that when several welds have been made under an engine in one frame section that when this particular engine is in the shop for general repairs, the frame should be removed, sent to the blacksmith shop for annealing and have the old welds examined. If necessary they can be worked over and all strains removed and the frames made to the proper dimensions in all particulars. Unless this is done good permanent results will not be obtained.

Discussion on Frame Welding

The papers on frame making and repairing were followed by an animated discussion of the various points brought out. H. W. Loughridge (P. & L. E.), McKees Rocks, Pa., emphasized what had already been said about the necessity of relieving strains after welding and stated that cast steel frames on the Pittsburgh & Lake Erie are giving satisfactory service with the exception of occasional broken pedestal toes, which may usually be traced to poorly fitted binders, loose shoes and wedges or rods pounding. M. C. Whelan (St. L.-S. F.), Kansas City, Mo., commented strongly on the so-called expert oxy-acetylene operators who claim to know more about expansion than the master blacksmith. Mr. Whelan described in detail by means of a blackboard some of the methods employed in making various frame welds on the St. Louis-San Francisco. G. W. Kelley stated that the next step in locomotive design would be the provision of rolled slab frames, cut out with the acetylene torch to the required shape. Joseph Grine (N. Y. C.), Depew, N. Y., said that in electric welding it was essential not to cut out more metal than necessary but that enough must be removed so that the operator can get at the weld. The type of electrode and the work of the operators must be subject to constant surveillance. Mr. Grine said that the New York Central has electric welded frames running since 1912 without giving any trouble. The welds are cut out to 45 deg. and reinforced where possible, using only the electrode. All frame welds are made without pre-heating, usually getting the expansion by means of a wedge. When necessary with this method the operator can be taken off the job and the weld completed at some later time, there being so little difficulty with expansion.

Shop Tools and Formers

Papers were submitted by G. H. Corcoran, Grand Trunk, Battle Creek, Mich., and H. W. Loughridge, Pittsburgh & Lake Erie, McKees Rocks, Pa.

Paper by G. H. Corcoran

If a foreman cannot get modern machines and tools, he must either make substitutes or get along without. It has not been so difficult of late years to get modern tools. If one can show the management in figures how a saving can be made, they are quick to take advantage of the situation and supply the tools.

A shop equipped with plenty of steam hammers is indeed fortunate and for all around purposes, the power hammer, either electric or steam driven, takes the lead in the smith shop. Those shops equipped with forging machines, drop hammers, shears and punch, bolt bulldozers, etc., with plenty of power behind them, are in the number one class, that is, if they are provided with machinists and tool makers to take care of their machines and make new tools.

In some cases, the job is done in the old fashioned way simply because a foreman uses good judgment in not making a tool for the job when there would not be enough of that particular work to pay for making the tool. Many foremen make new tools that do not pay, but make them to show off what they can do, and hang up another sample on the exhibition board. This is a poor proposition for the company. There are cases where it pays to make a tool for a single job, of course, but this would apply only to extreme cases, such as a pair of hammer dies for welding a heavy link under a steam hammer as it is easier to handle, makes a safer weld and a better looking job.

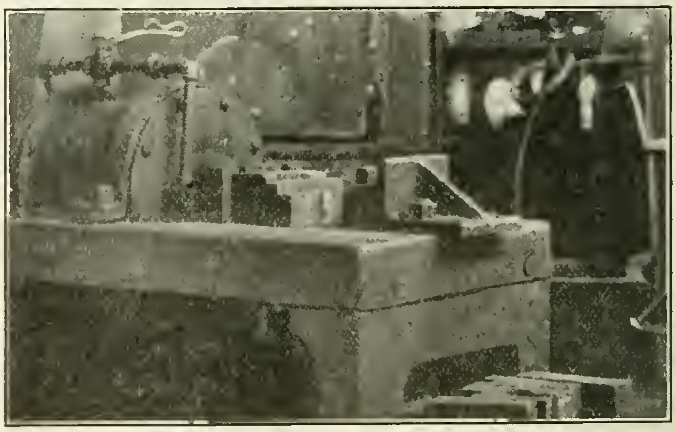


Fig. 6—Twelve-inch Air Brake Cylinder Set Up for Making Pipe Clips

One of the biggest and best helps for lathe work is to have stock cut just to the exact length so as to avoid facing ends of the job. A cold metal rapid cutting saw is a fine tool for this class of work and every smith shop should have one for it will soon pay for itself in the saving of machining. Often it costs more to face off a job that is too long than the job itself would cost when it is the right length. Another big saving of machine shop work is the forging to correct diameter of spring hanger pins and bushings. All pins and bushings are made on forging machines and are made very closely to size. In connection with forging of bushings to correct inside diameter, it has been found that the scaled surface wears much longer than those which are machined before case hardening.

A 12-in. air brake cylinder that has been discarded can be made into a small bulldozer and with a small face plate makes a very useful tool for all kinds of bending. One of these devices used for making pipe clips is shown in Fig. 6. It is located at a forge and has dies for all different sizes of pipe. It has a back stop fastened to the face plate and none of the dies are bolted to face plate. On the crosshead, dies may or may not be fastened. Owing to the many sizes of pipe clips wanted, a quick exchange of dies can be made. This air machine is a shop-made tool and can be used for many purposes besides making clips.

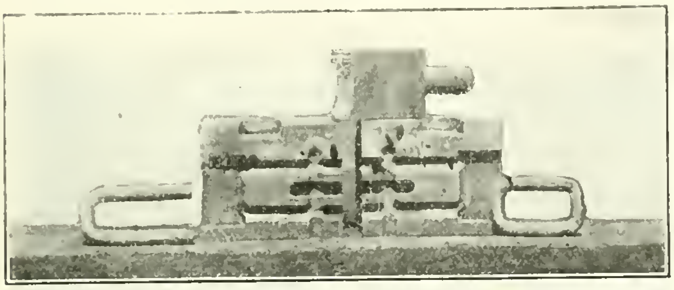


Fig. 7—Dies for Welding ¾-In. End Gate Hinge Link

Tools for bending metal cold have always been in practice more or less in the smith shop, but of recent years it is becoming more common as heavier parts are used to employ presses and bulldozers. Also the punch machine is used for bending iron in many shapes, squaring up staybolts and for other purposes too numerous to mention.

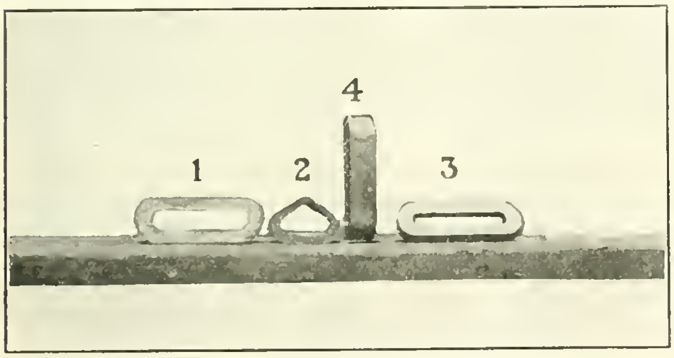


Fig. 8—Links Punched Under a Steam Hammer

Paper by H. W. Loughridge

The tools and formers needed today are those that are in use for each month's requisition, those that give you an increased production at a decreased cost.

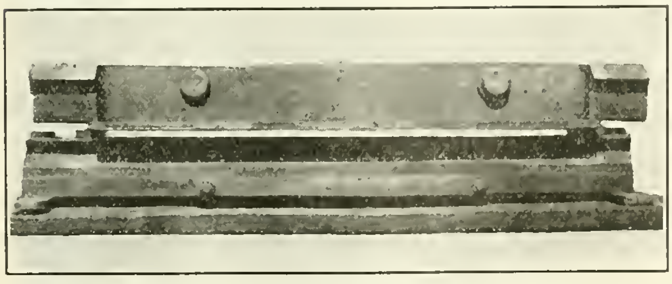


Fig. 9—Device for Bending Freight Car Sill Steps

Fig. 7 shows a set of dies for welding ¾-in. end gate hinge links. The link is first bent in a bulldozer. The other end is then welded by one pass of the forging machine. The recess in rear of dies is for the tong hold.

Links punched under a steam hammer are shown in Fig. 8, *1*, *3* and *4* being chain links for a flue cleaner, while *2* is drop door link used in connection with drop door hinges. If links and hinges are made from soft steel bar, five or six can be made in one heat. The practice at the P. & L. E. shops is to use scrap ends of material sheared to fit in die. By this method 25 or 30 can be kept in furnace, giving a continuous production.

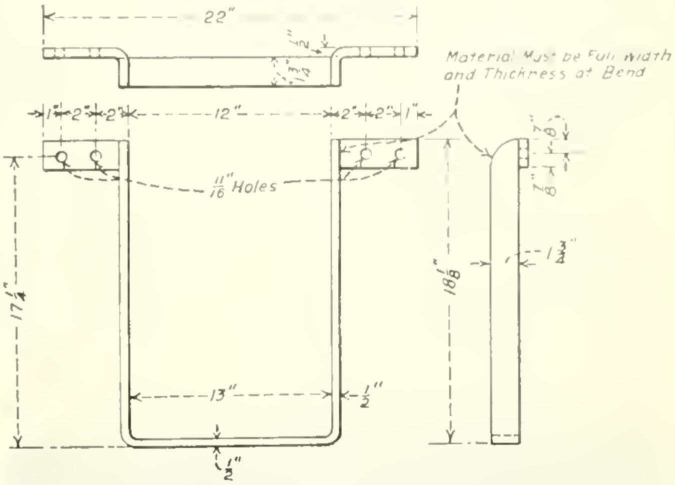


Fig. 10—Details of Freight Car Sill Step Made in Former (Fig. 9)

Fig. 9 shows a device for bending freight car sill steps, made as shown in the drawing, Fig. 10. The material is inserted in the bottom step of the former where the ends are bent on the edge to a 90 deg. right and left angle. Then the material is placed in the upper step where the vee part of the die forms the angle on the ends or pads. They are then bent on a regular sill step formerly used as third step.

Autogenous Welding

Papers on the subject of welding were submitted by W. F. Keller, Michigan Central, Jackson, Mich., and A. W. Young, New York, New Haven & Hartford, Readville, Mass.

Paper by W. F. Keller

Autogenous welding has become one of the greatest mechanical processes that has ever been taken up in railroad work and to get the full benefit of welding there are three things that must be considered. First, is the proper application of the method to be used, Thermit, oxy-acetylene or electric. To be in a position to get desired results in this respect shops should be equipped with the different welding appliances so that when the various jobs that are to be welded come up for consideration the one in charge will not have to do the work with one process where another should be used. One cannot use any one of the three welding methods exclusively and get by with it successfully.

Another practice in the application of welding processes that needs consideration is the use of the cutting method. In a good many shops a mechanic and helper will be assigned to do some work of a stripping or assembling nature and on account of the dependence on gas cutting there is a great amount of time lost in waiting for a burner where the job could and should be done by other methods. It has been found that the use of the process in this particular respect has caused much extravagance.

The next prime essential to successful welding is the preparation of the broken part to be welded. The big consideration in this respect is the matter of expansion and contraction and as each job presents a different condition in this regard one must realize first what should be done to prevent the weld in question developing undue strain. This condition will be found mostly in welding of frames and fire boxes or any job where both ends are tied and will not give freely to the contraction required from the welded part.

The third and most essential requirement in the welding business is a competent operator—one who will see that the two above necessities are properly taken care of before and after the weld is made along with the proper fusion of the metals to be applied.

Paper by A. W. Young

We use both the electric arc and oxy-acetylene methods at Readville and have had very good success. Practically all our welding on boilers, frames, cylinders, brake rigging, etc., is done by the oxy-acetylene process and the electric process is used principally for building chafes on frames, worn parts of link motion work, welding cracks in boiler sheets, welding in flues and other work where there is liability of distortion if done by a high heat process. We find that each process has its particular field, although the great advantage of cutting is wholly confined to be oxy-acetylene process.

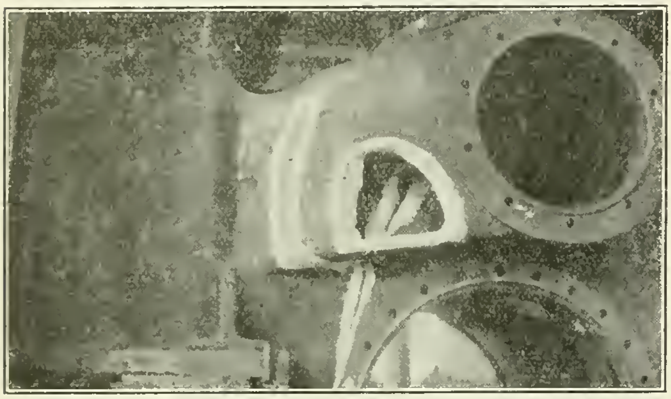


Fig. 11—Cylinder with Cracked Internal and External Port Walls Ready for Welding with Bronze

Our method of procedure with welding in general is as follows:

All work of any description is first cleaned, then scarfed with cutting torch to an angle of about 45 deg. Surfaces to be welded are then chipped or ground, care being taken that all oxidized metal is removed. Work is then assembled with proper allowance made for contraction, after which the article is welded, using the metal suitable to the particular work being done; that is, iron welding rod where broken parts are iron, steel welding rod where parts are steel, and invariably Tobin bronze for cast iron. All broken cylinders and other cast iron parts are repaired with bronze. We have adopted this method of repairing the cylinders after long experience and have had no failures when the bronze is properly applied. We find there is less brittleness and more elasticity with the bronze than with the cast iron rod. The preheating in the use of this metal is simplified for the reason that it does not require the building of a brick furnace around the cylinder and as before mentioned, the bronze has eliminated failures. We also use bronze for building up piston heads, valve stem cross-heads and innumerable other pieces and find it easily applied and very serviceable.

In repairing cylinders (Fig. 11), we proceed as follows: Scarf the broken or cracked section, allowing at least one-eighth inch opening at the bottom of the scarf. A charcoal fire is then built inside the cylinder or valve chamber or both as occasion requires. This fire is kept burning in the cylinder until the welding operation is completed and then left to cool off naturally. No drilling or pinning is required; neither do the welds require caulking as when done by the electric arc method. It is seldom that any part of a seam repaired by this method requires caulking. We have repaired and replaced broken parts of a large number of cylinders, using as high as 190 pounds of bronze per cylinder and have not had a failure.

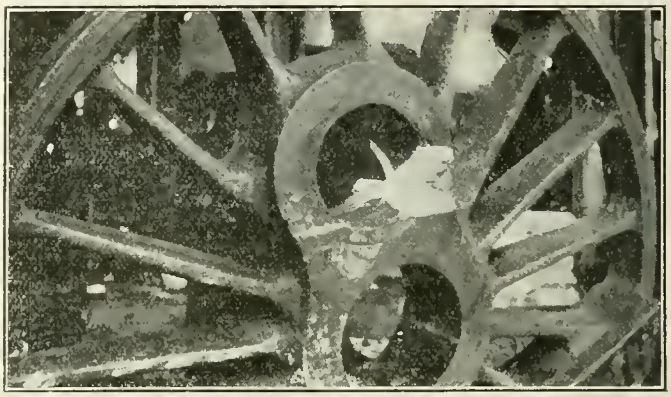


Fig. 12—Wheel Center Cracked Through Crank Pin Hole Ready for Welding

When repairing broken spokes in driving wheels we first remove the tire, cut the rim if it is not split, then jack the rim out thus allowing for contraction. After the spokes are welded and cooled off the rim is again welded which removes all strain from the welded spokes. The same practice is followed when repairing frames, etc. An unusual wheel center welding job is shown in Fig. 12.

This report would be incomplete were I to neglect to make mention of the Oxygraph machine placed in the shops by the Railway Oxweld Service Company. This is

Many Prominent Railroad Master Blacksmiths and Supply Men Wer Present with Their Families at the 27th Annual Banquet without a doubt the greatest labor-saving and largest producing machine on flat material that has been brought out in recent years and covers a great variety of work without any special appliances. This machine is used for making any shaped part from flat stock as follows: Spring equalizers, truck equalizers, eccentric crank arms, eccentric rod forks, eccentric rod heads, sections of locomotive frames, side and main rod heads, main rod straps, union links, hooks—all shapes, brake forks, brake hangers, spring hangers.

In addition to the above it is used for hundreds of other pieces too numerous to mention. All work is annealed after cutting on this machine.

As we get deeper into the autogenous welding subject the more interesting it becomes. There is no end to the economies both in time and material which can be accomplished by these various processes.

Other Association Business

A committee appointed two years ago to consider affiliation with the American Railway Association reported that it had a letter from Secretary Hawthorne saying that the American Railway Association was not expanding its activities at the present time and that he would keep the Master Blacksmiths' Association in touch with developments. The report of the committee was accepted and the committee discharged.

The secretary requested that every member consider himself a committee of one to send the secretary a list of master blacksmiths in his vicinity in order that they may be duly notified and induced to attend the convention next year. Mr. Hutton pointed out that where written requests for permission to attend the convention are made out in proper form one or two months in advance, there is seldom any difficulty in master blacksmiths getting permission to attend the convention and receive legitimate traveling expenses. A resolution of thanks was extended to the railroad managements through whose courtesy the members were enabled to attend the present convention.

The following officers were elected for the ensuing year: President, George Hutton (N. Y. C.), West Albany, N. Y.; first vice-president, J. J. Eagan (N. Y., N. H. & H.), New Haven, Conn.; second vice-president, H. W. Loughridge (P. & L. E.), McKee's Rocks, Pa.; W. J. Mayer (M. C.), Detroit, Mich., was re-elected to the office of secretary-treasurer and C. H. Nutter (B. & M.), North Billerica, Mass., was appointed chairman of the executive committee. In view of its central location and facilities for taking care of conventions, Chicago was selected as the place for the 1924 Master Blacksmiths' Convention.

Exhibitors

Forty-six representatives of railway supply companies registered at the convention, the following companies having exhibits:

Air Reduction Sales Company, New York.—Oxygen and acetylene tanks, hand and automatic welding and cutting equipment. Represented by G. Van Alstyne, G. E. Phelps, R. F. Helmkamp, E. M. Sexton, B. N. Law, R. O. Mueller and R. Peabody.

Ajax Manufacturing Company, Cleveland, Ohio.—Model of four-inch new model twin gear upsetting forging machine; upset railway forgings. Represented by J. R. Blakeslee, J. A. Murray, A. L. Guilford, R. W. Bannerman, W. W. Criley and C. W. Wicks.

Anti Borax Compound Co., Ft. Wayne, Ind.—Welding flux for cast iron and brazing flux. Represented by Charles O. Klane.

Bell & Gossett Company.—Case hardening compound. Represented by E. J. Gossett.

Buffalo Forge Company, Buffalo, N. Y.—Steel plate pressure blower with direct-connected motor drive. Represented by W. J. McDowell.

Garlock Packing Company, Palmyra, N. Y.—Garlock packings, gasket material and pump valves. Represented by John L. Fisher and C. W. Sullivan.

Jackman & Co., E. S., Chicago.—Literature on Firth-Sterling tool and die steels. Represented by E. T. Jackman.

Metal & Thermit Company, New York—Represented by H. S. Mann and W. H. Moore.

National Machinery Company, Tiffin, Ohio.—Forging machine and bolt machine products. Represented by E. R. Frost, F. W. Klenk, C. D. Harmon, F. J. Mawby and K. L. Ernst.

Railway Journal, Chicago.—Represented by E. C. Cook.

Railway Mechanical Engineer, New York.—Represented by C. B. Peck and E. L. Woodward.

Tool Foremen's Convention

The American Railway Tool Foremen's Association held its eleventh annual convention at the Hotel Sherman, Chicago, on August 29, 30 and 31. About 80 members and guests were present at the opening session. After the usual opening exercises J. B. Hasty (A. T. & S. F.), president of the association, delivered a brief address, expressing regret at the absence of old faces caused by death or members leaving railroad service and pointing out that the only way for the association to grow in size and accomplishments is for the 21 new members this year to frankly accept their share of the responsibility. He pointed out the value of improved methods of handling tool room work and stated that the only way this work can be raised to the desired standard will be by the mutual exchange of experience of the members of the association. The possible economy from standardizing tools used in railroad shops is well known and this work can be best carried out through the Tool Foremen's Association. A great deal has already been accomplished along this line but standardization of shop tools should be carried much further. Tool foremen can also be of great value to the railroads employing them by studying and developing tools which will increase the efficiency of machine operations. In view of the high cost of labor at the present time, more production per man is needed in order to keep costs within reason in all industries including the railroad industry. The production of machine operators is so largely dependent upon the kind and condition of the cutting tools, jigs and fixtures that these accessories deserve the closest study of expert tool makers. The value of the competent tool foreman in speeding up production by this means can hardly be overestimated.

Following Mr. Hasty, Past President J. J. Sheehan (N. & W.), was called on for some remarks, which he made as follows: "One man can not see all the angles to a problem and it is, therefore, a good idea for tool foremen to come together and exchange experiences to their mutual advantage and for the benefit of the railroads which they represent. Tool foremen have had strenuous times during the last few years on account of the war and unsettled labor conditions, the effects of these conditions being felt almost as much by the tool foremen as by other shop supervisors. . . ."

One of the important features of the convention was the address by H. T. Bentley, general superintendent of motive power and machinery of the Chicago & North Western.

Committee reports were presented on the following subjects which were quite generally discussed:

Forming and Combination Punches and Dies.
General Tool Grinding and Use of Jigs on Grinders.
Forging Machine Dies.
Jigs and Devices for Locomotive and Car Shops.
Reclamation of Shop Tools and Shop Equipment.

The officers elected for the coming year were as follows: G. W. Smith (A. T. & S. F.), president; Charles Helm (C. M. & St. P.), first vice-president; George Tothill (B. R. & P.), second vice-president; E. A. Hildebrandt (C. C. C. & St. L.), third vice-president; W. C. Stephenson (A. C. L.), secretary-treasurer and J. S. Duca (C. R. I. & P.), assistant secretary-treasurer. R. D. Fletcher, retiring secretary-treasurer was presented with a pin and cuff links and also made an honorary member of the association in recognition of his meritorious services.

Abstracts of the papers and further details of the convention will be published in the next issue.

The Missouri Court of Appeals (St. Louis) holds that an engine being prepared to take out a train of cars, some of which were loaded with interstate freight was engaged in interstate commerce, and one employed in so preparing it was within the act.

Erecting Shop Practice on the Southern Pacific

Efficient Devices and Methods for Expediting Erecting Shop Work at the Sacramento Shops Are Described

By H. C. Venter
General Foreman, Southern Pacific, Sacramento, Cal.

THE growing demands for transportation throughout the country have burdened the mechanical department of the railroads so that it has become a problem to provide sufficient motive power. New locomotives must be purchased and old ones kept in good repair, and in this maintenance work there is no shop department more important than the erecting shop. The erecting shop is one of the essential links upon which the transportation department must depend for its locomotives.

Much has been said in the past about scheduling locomotives through the shop in as short a time as possible, but scheduling on one road may not be practical on a road a few hundred miles away. It can, however, be impressed on all those in charge that first class workmanship is required in repair work, particularly in the erecting shop, in order to produce locomotives which can give the service expected of them today. It is well to have a record showing a large output, but good workmanship must not be sacrificed.

Locomotives undergoing general repairs in the erecting shops should be thoroughly inspected and the inspector's reports, in conjunction with the work reports, will form a basis for a decision as to what parts must be taken down for renewal or repair. Particular attention should be paid to cylinder bolting, lining and bracing frames, laying out shoes and wedges, counterbalancing, connecting up the motion work and valve setting, as upon careful performance of this work depends the locomotive mileage between shoppings. If this work is properly taken care of at the general shops, it will prevent a great deal of running repair work at roundhouses.

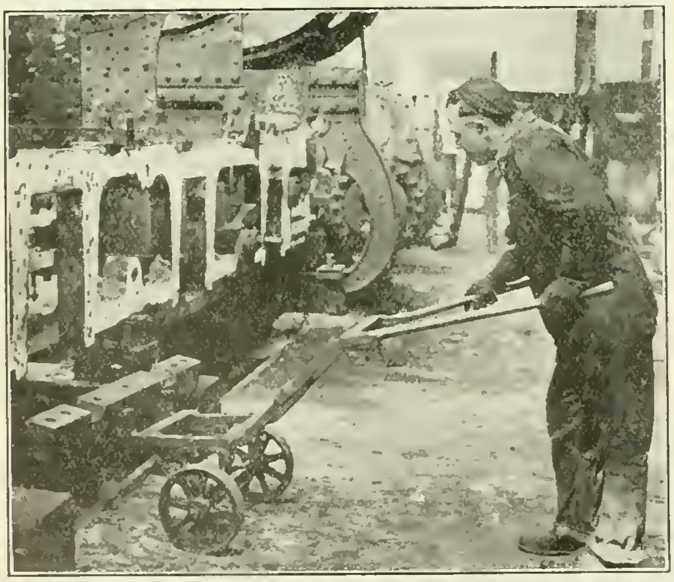


Fig. 1—Method of Using Locomotive Binder Truck

The difficulty of erecting shop work and work in some of the other shop departments has been greatly increased in recent years by the auxiliaries for fuel and power conservation with which modern power is equipped. The maintenance of superheaters, feedwater heaters, automatic stokers, boosters, etc., places an additional responsibility on the mechanical department. The amount of capital invested for these auxiliaries is an imperative reason why erecting shops must turn out locomotives able to meet the demands and expectations of the managements. To do all that is expected in the erecting shop with the present shortage of competent mechanics and in view of the increasingly large and heavy locomotive parts, it becomes necessary to utilize time-saving devices wherever possible and those described in this article have proved valuable at the general shops of the Southern Pacific, Sacramento, Cal.

Labor-Saving Devices

The two-wheel truck, illustrated in Fig. 1, is used for applying frame binders, one man easily handling the heaviest binders while being fitted to the pedestal jaws. As shown in the illustration, the device consists of a pair of substantial truck wheels and axle to which is bolted a light but strong framework, reinforced by welded cross braces. Heavy binders can not only be moved about the shop on this truck, but can be applied to the pedestal jaws with much less physical effort than formerly required.

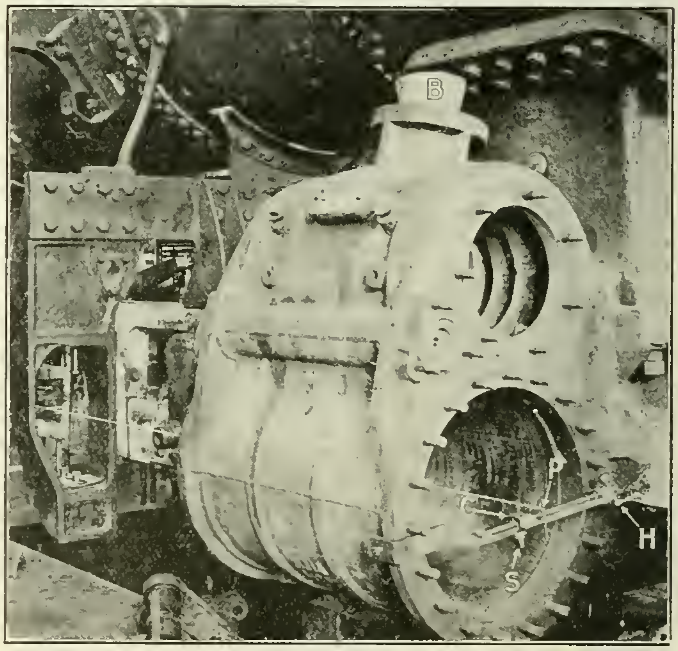


Fig. 2—Convenient Jig for Holding and Adjusting Cylinder Center Line

A convenient jig, providing easy adjustment of the cylinder center line used when squaring frames or laying out shoes and wedges, is illustrated in Fig. 2. This jig consists of a 2-in. by ⅝-in. metal bar shaped as shown and bolted to the front of the cylinder in an approximately horizontal position. Crosshead *C* is capable of adjustment along this bar by means of an adjusting screw and handle *H*, being held in any desired position by the large thumb screw *S*. The center line is attached to the upper end of a ¼-in. threaded pin *P*, which is adjustable up and down by means of two ¼-in. nuts not very clearly shown in the illustration. The other end of the center line is held by a similar arrangement bolted to one of the frame jaws. The center line thus has screw adjustment to the right and left and up and down, at each end. It can be quickly and accurately adjusted to the center of the cylinder, considerable time being saved over former methods of holding the center line.

Attention is called to the wooden block, *B* (Fig. 2) inserted in the steam pipe connection to the valve chamber. This block prevents nuts and dirt from falling into the valve chamber, or steam ports, and causing subsequent trouble after the piston and main valve have been reassembled and the cylinder heads applied.

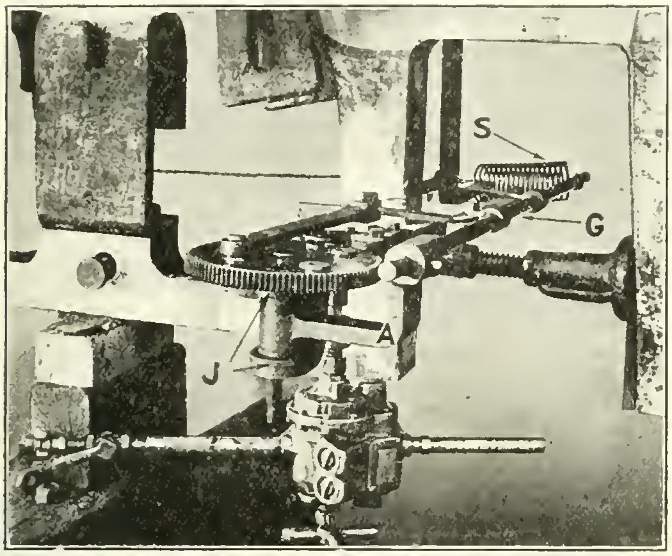


Fig. 3—Power Hack Saw Cutting Out Frame Section

The Sacramento shops have a standard practice in making oil frame welds which has worked successfully for the past five years with a small percentage of failures. In connection with these welds, the power hack saw illustrated in Fig. 3, is used to good advantage and is an important time-saver. The saw can be set up in either a vertical or horizontal position and used to cut out frame sections as desired.

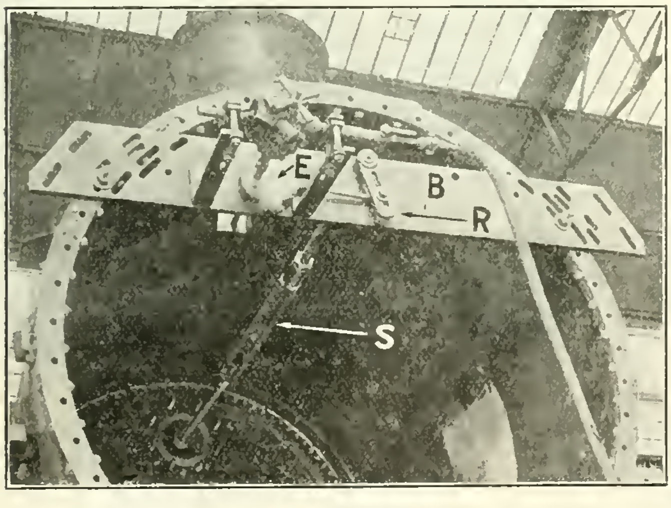
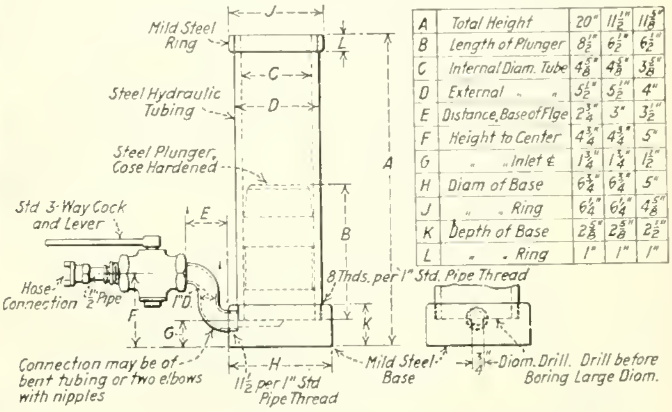


Fig. 4—Pneumatic Device for Grinding Dry Pipe Joint in Flue Sheet

Referring to Fig. 3, the construction and use of this power hack saw will be evident. It is driven through a pair of spur gears by a pneumatic motor, the main saw framework being held firmly against the frame section to be cut by means of a jack or other convenient method. The saw blade is given a reciprocating motion by means of a crank pin on the large spur gear shown. Substantial arm *A* pivots on a pin held between jaws *J* and carrying on its upper end the large spur gear. To arm *A* is attached the guiding bar *G* for the saw frame. The pressure of the saw blade on the frame can be adjusted to the proper amount for most efficient cutting by means of spring *S* which can be put in tension by means of the string shown at the left of the frame jaw.

The method of grinding dry pipes to the flue sheet is illustrated in Fig. 4. A large plate *B*, provided with suitable slots to accommodate the largest boilers is bolted to the smoke box ring as shown. To it is attached the brackets for supporting the driving motor and the eccentric *E* which gives a reciprocating motion to arm *R*. This causes the shaft *S* and dry pipe to make a partial revolution first in one direction and then in the other, the amount of motion being adjustable by means of the nut and slot in arm *R*. The pressure of the dry pipe against its joint in the flue sheet can be governed by means of adjusting nuts on shaft *S*. This pressure must be relieved occasionally and the dry pipe backed out for inspection of the joint and renewal of the abrasive and oil, if necessary. Experience with this device has shown that heavy dry pipes can be ground in quickly and with practically no physical effort as compared to former methods of hand grinding.


J
Mild Steel Ring
L
C
Steel Hydraulic Tubing
D
Steel Plunger, Case Hardened
A
Std 3-Way Cock and Lever
E
B
8 Thds. per 1" Std. Pipe Thread
Hose Connection
½" Pipe
1" D.
F
G
K
Connection may be of bent tubing or two elbows with nipples
H
11½ per 1" Std Pipe Thread
Mild Steel Base
¾" Diam. Drill. Drill before Boring Large Diam.

A	Total Height	20"	11½"	11⅝"
B	Length of Plunger	8½"	6½"	6½"
C	Internal Diam. Tube	4⅝"	4⅝"	3⅝"
D	External " "	5½"	5½"	4"
E	Distance, Base of Flge	2¾"	3"	3½"
F	Height to Center	4¾"	4¾"	5"
G	" " Inlet ℄	1¾"	1¾"	1½"
H	Diam of Base	6¾"	6¾"	5"
J	" " Ring	6¼"	6¼"	4⅝"
K	Depth of Base	2⅝"	2⅝"	2½"
L	" " Ring	1"	1"	1"

Fig. 5—An Effective Pneumatic Bolt Extractor

The device illustrated in Fig. 5 is used for extracting bolts and materially speeds up this time-consuming operation. The device consists of a base plate of mild steel counterbored to receive the steel tubing shown, the latter being reinforced at the upper end by a mild steel ring. A plunger is provided, being ground to a sliding fit in the tubing and tapered at the upper end to allow for some upsetting action without sticking in tubing. Air from the shop line is supplied to the base through a standard three-way cock as shown. In operation, this device is applied over the end of the bolt to be removed and operation of the lever admits air beneath the plunger, driving it against the end of the bolt. Returning the lever to its first position shuts off the air supply and releases air from the tubing, allowing the plunger to return. This operation is continued until the bolt is started. Particular care must be taken to support the bolt extractor rigidly and in line with the bolt. This bolt extractor is made in three sizes to accommodate different sized bolts. The dimensions and method of construction are clearly shown in the drawing.

An efficient device for pulling locomotive driver and trailer springs in applying spring hangers and pins is illustrated in Fig. 6. This spring puller consists, as is ordinarily the case, of a yoke and chain and adjusting screw. The particular feature in this case is the ball bearing race at the bottom of the screw with twelve ¼-in. steel balls, enabling springs to be pulled with as little loss of effort due to friction as possible. This design also has been worked out to provide maximum clearance for the engine frames.

A tread gage for measuring tire wear at both the flange and tread is illustrated in Fig. 7. This gage is made of a scrap, hand saw blade and conforms to the standard tire contour. Two fingers are provided, as shown, to indicate the flange and tread wear, these fingers being graduated in sixteenths of an inch at the ends. A particular advantage of this type of gage is the fact that it can be applied to worn tires in places where the light is not very good and then taken to a good light to read the graduations.

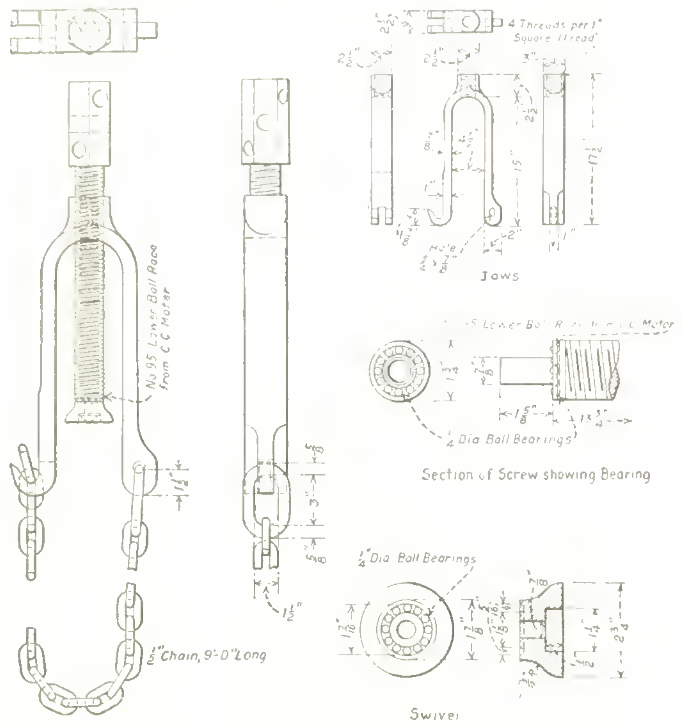

4 Threads per 1" Square Thread
Jaws
No. 95 Lower Ball Race from C.C. Motor
Section of Screw showing Bearing
¼" Dia. Ball Bearings
½" Chain, 9'-0" Long
Swivel

Fig. 6—Driver and Trailer Spring Puller with Ball Bearing Swivel

A portable tire-turning tool, which has proved successful in cutting down flanges over the I.C.C. limit, is illustrated in Fig. 8. By using this tool, it is not necessary to drop the wheels on locomotives in order to cut the flanges down to the proper height and keep the locomotives in service until ready for general repairs. The details of the portable tire turning tool are shown in Fig. 8, the method of using it being indicated in the upper left corner of the illustration. The tool holder is made in right and left types, being applied to the brake hanger pin on which it pivots. The cutting tool is secured by two set screws in one end of the holder and rests on the tire flange. A roller in the other end of the holder also rests on the tire flange, being adjusted readily with respect to the driving wheel by means of a steel feed nut. It is obvious that revolution of this feed nut in the proper direction will increase the pressure of the cutting tool on the flange, when running the locomotive along the track will cause a chip to be taken from the flange. Three different types of tools are used for the first, second and finish operations, as shown in the illustration. It will be noted that the feed nut is turned by means of a small ¾-in. hexagon bar inserted in suitable holes in the nut.

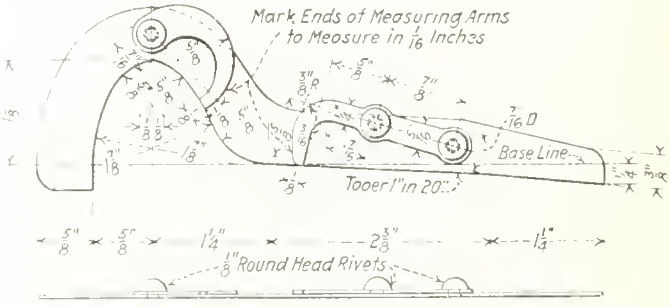


Fig. 7—Gage for Measuring Wear of Flange and Tread

A jig for plumbing crank pins in obtaining the position

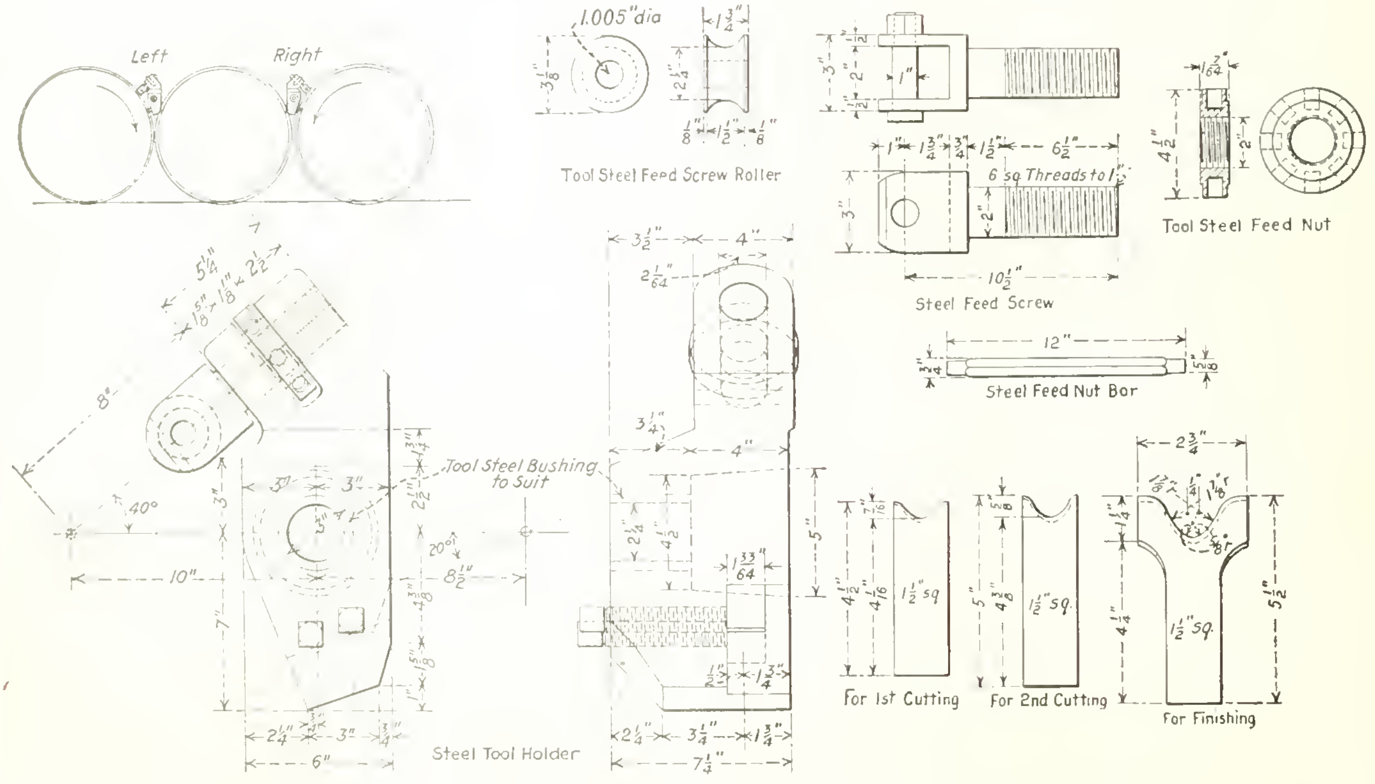


Fig. 8—Portable Tire-Turning Tool for Cutting Down Flanges to the Proper Height without Unwheeling Locomotives

of eccentric keyways before wheels are placed under the locomotive is illustrated in Fig. 9. The standard practice at the Sacramento shops is to apply eccentric keyways before the wheels are placed under the locomotive, thereby saving from eight to twelve hours of locomotive shop time. The device consists of a metal framework cut out as shown to be applied over the largest crank pin. A spirit level *L* is applied to the top of the frame, an adjustable pointer *D* being provided at the bottom. Two bearing pieces, *B* and *C*, are attached to the frame, being accurately machined to form an equal angle with the center line of the pointer and level. In using this jig the axle center is filled with babbitt or soft metal and the center accurately located in the usual manner and prick punched. The jig is applied over the crank pin and pointer *P* adjusted to the center point. The wheels are then rotated until the spirit level shows that the center of the crank pin and axle center are in the same vertical line.

A portable axle keyway milling machine is also used at Sacramento shops, being rigidly held in the correct position on the axle by two straps and a large adjusting screw at the bottom. Power is applied to a spindle and milling cutter by an air motor through a suitable worm and gear arrangement. Hand feed in two directions is provided, one parallel with the axle in accordance with the length of the eccentric keyway and the other at right angles to this motion to give the proper depth required. The device is rigid and produces an accurate job in considerably less time than could be accomplished by drilling, chipping and filing.

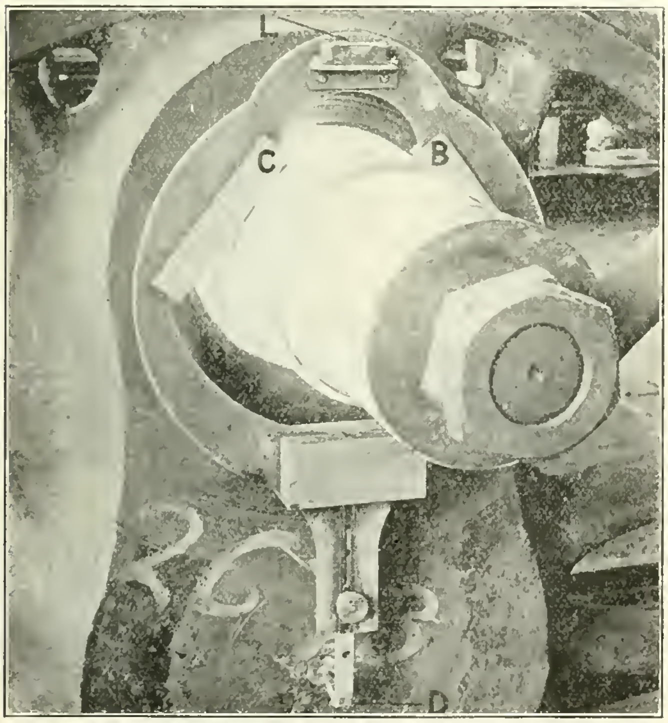


Fig. 9—Jig for Plumbing Crank Pins when Laying Out Eccentric Keyways

A shrinkage gage for locomotive driving wheel tires has also been made and greatly improved the work of fitting tires to wheel centers, practically eliminating trouble due to loose tires. This gage does not differ greatly from the usual types of shrinkage gages and consists of a 7/16-in. rod of the required length, with a taper hardened point on one end and a micrometer head provided with a taper hardened point on the other end. A solid lock nut holds the adjustment while making a reading. The shrinkage allowed for different sizes of tires, ranging in size from 45-in. to 84-in., is shown in the accompanying table.

Table Showing Allowance for Tire Shrinkage

Outside diameter of tire	Diameter to bore tires	Diameter of wheel centers	Shrinkage allowed
45 in.	37.9603 in.	38 in	.0397 in.
51 in.	43.9505 in.	44 in.	.0495 in.
55 in.	47.9439 in.	48 in.	.0561 in.
57 in.	49.9406 in.	50 in.	.0594 in.
63 in.	55.9309 in.	56 in.	.0692 in.
69 in.	61.9209 in.	62 in.	.0791 in.
73 in.	65.9144 in.	66 in.	.0856 in.
77 in.	69.9078 in.	70 in.	.0922 in.
79 in.	71.9045 in.	72 in.	.0955 in.
81 in.	73.9012 in.	74 in.	.0988 in.
84 in.	77.8947 in.	78 in.	.1053 in.

Considerable difficulty is experienced when exhaust nozzles are not an accurate fit on the cylinders and allow exhaust steam to blow through and possibly cut the steam pipes or other parts in the front end. If exhaust nozzles are scraped to a bearing on the cylinder, considerable time is required and the ordinary method of grinding joints would be so laborious with a heavy exhaust nozzle as to be practically out of the question. The operation of grinding exhaust nozzles can be greatly facilitated by means of a device, of which a general idea is given in Fig. 10. A framework, supporting a driving motor and two eccentrics, is attached to the smoke box ring as shown. Two arms, adjustable in length to suit different types of locomotives, are attached, one to each eccentric and to a bracket arranged to be clamped around the exhaust nozzle. The eccentrics are set 180 deg. apart and it is obvious that operation of the air motor and eccentric shafts will give the framework and exhaust base a semi-revolving motion. If oil and abrasive are applied between the exhaust nozzle and the cylinder, this motion will soon wear down the high points and bring the nozzle to a suitable bearing.

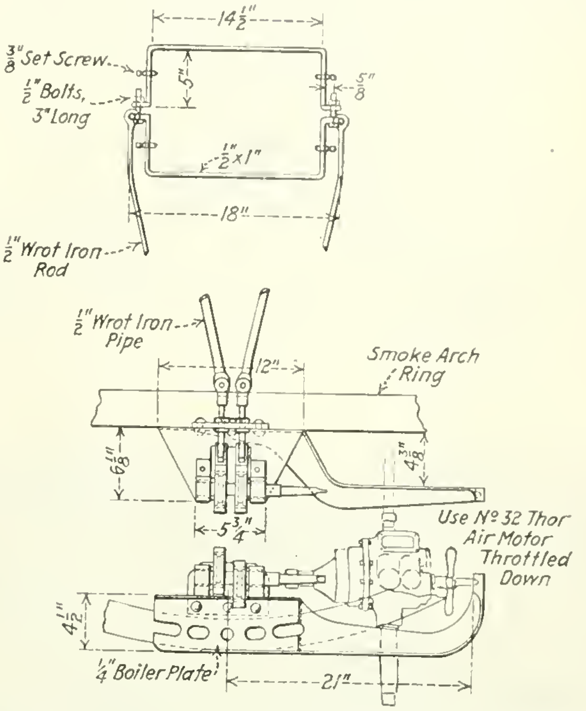


Fig. 10—Device for Grinding Locomotive Exhaust Nozzles

One of the things which hampers erecting shop work greatly is the absence of necessary air pressure when needed for heavy riveting operations, or when driving out frame bolts. There are many air operated devices in the average railroad shop and when these all work at the same time, it frequently happens that the air pressure on the shop line is reduced below the point at which pneumatic tools operate efficiently. To overcome this difficulty a portable air compressor has been developed, as shown in Fig. 11. This device consists of a Westinghouse 9½-in. air compressor, mounted on a strong, but easily portable four-wheel truck. The air

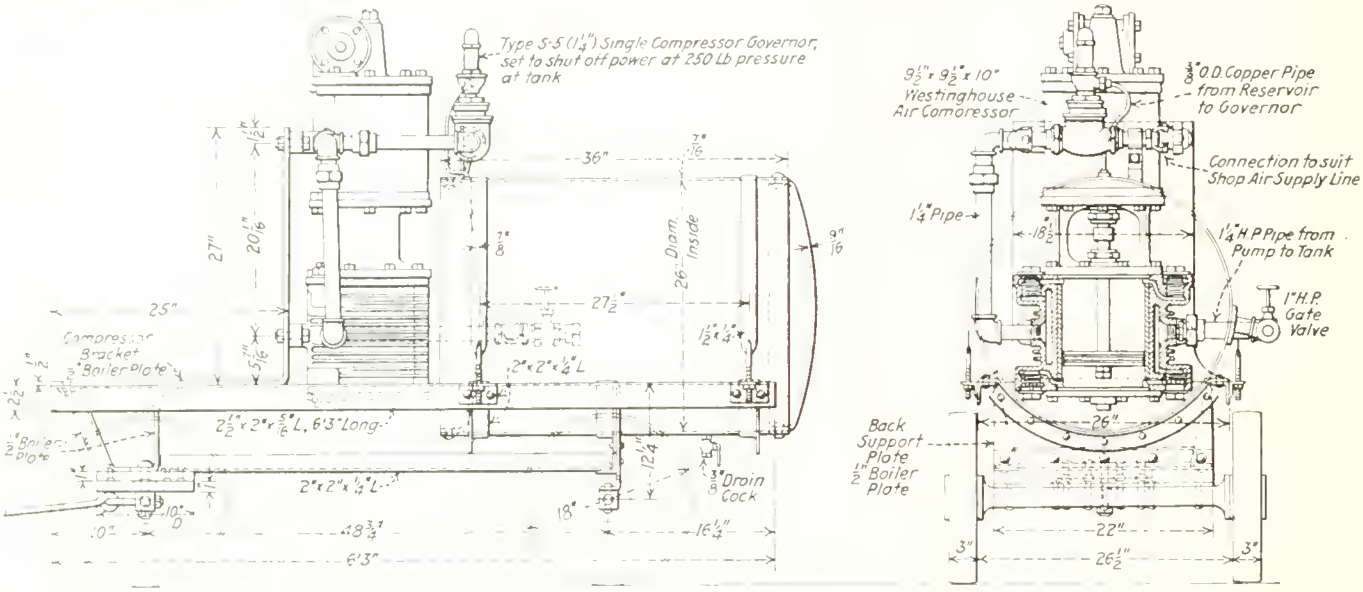

Type S-5 (1¼") Single Compressor Governor, set to shut off power at 250 Lb pressure at tank
36"
7/16"
27"
20 1/16"
1/2"
7/8"
26" Diam. Inside
9/16"
25"
27½"
Compressor Bracket 1/2" Boiler Plate
5 7/16"
1½"×¼"
2"×2"×¼"L
2½"
2½"×2"×5/16"L, 6'3" Long
1/2" Boiler Plate
12¼"
3/8" Drain Cock
2"×2"×¼"L
10" D
18"
10"
48¾"
16¼"
6'3"
9½"×9½"×10" Westinghouse Air Compressor
3/8" O.D. Copper Pipe from Reservoir to Governor
Connection to suit Shop Air Supply Line
1¼" Pipe
18½"
1¼" H.P. Pipe from Pump to Tank
1" H.P. Gate Valve
Back Support Plate 1/2" Boiler Plate
26"
22"
3"
26½"
3"

Fig. 11—Portable Air Compressor Gives the Added Pressure Needed in Driving Out Bolts and on Heavy Riveting Work

[illegible] of the compressor is bushed to 6½ in. in diameter [illegible] supplied from the shop line to both the steam and [illegible] air coming through a suitable connection to the [illegible] The amount of pressure obtained with this air compressor will depend on the pressure of the shop line, but [illegible] bushing the air cylinder and piping the air sup- [illegible] steam and air inlets will give a pressure sufficiently high to satisfy all needs. Normally, it is possible to get 250 lb. per sq. in. pressure and the governor is set to stop the compressor when that pressure is reached. A reservoir 26 in. in diameter by 36 in. long is clamped to the truck and receives the air as it comes from the compressor. The caution should be observed of carefully testing this reservoir before use to make sure that it will not fail. This portable compressor is comparatively inexpensive to make and being easily portable to any point in the shop, forms a ready means of supplying air wherever a pressure exceeding that of the shop lines is needed.

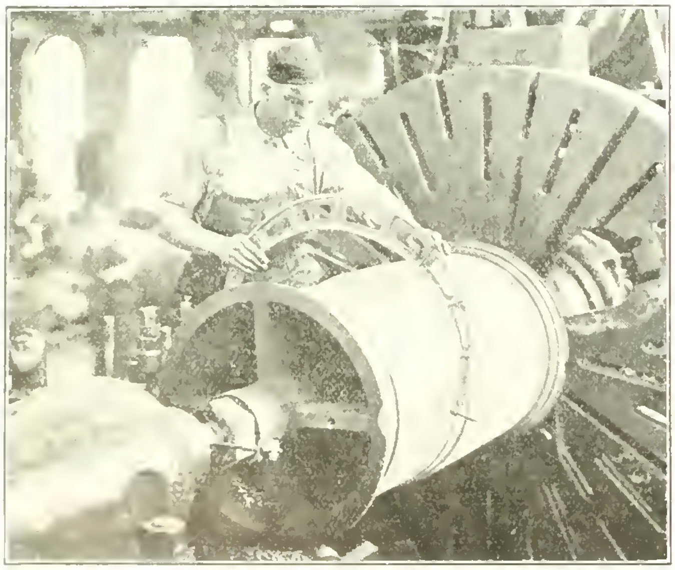


Fig. 12—Shop-Made Micrometer in Use Calipering Cylinder Bushing

An interesting shop-made micrometer for large work is illustrated in Fig. 12. The framework is of aluminum with a micrometer anvil attached to one side and micrometer head to the other. The particular job, shown in the illustration is turning a cylinder bushing to fit a cylinder and the operator is making the allowance for shrinkage, the cylinder size being accurately determined by means of the micrometer.

The ball joint reamers, illustrated in Fig. 13, are made with 5-in. and 7-in. radius, inserted, high-speed steel blades. A No. 5 Morse taper shank is provided in each case. The body of the tools are made of soft steel, the inserted blades being held by caulking. Thirteen blades are used in the 5-in. reamer and 17 blades in the 7-in. reamer, both reamers being used for steam pipe joints and general use. They enable steam pipe joints to be kept in good condition and thus largely reduce troubles from steam leaks at these important joints.

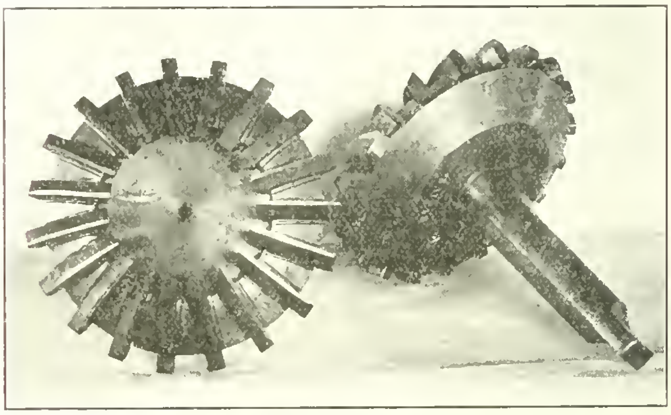
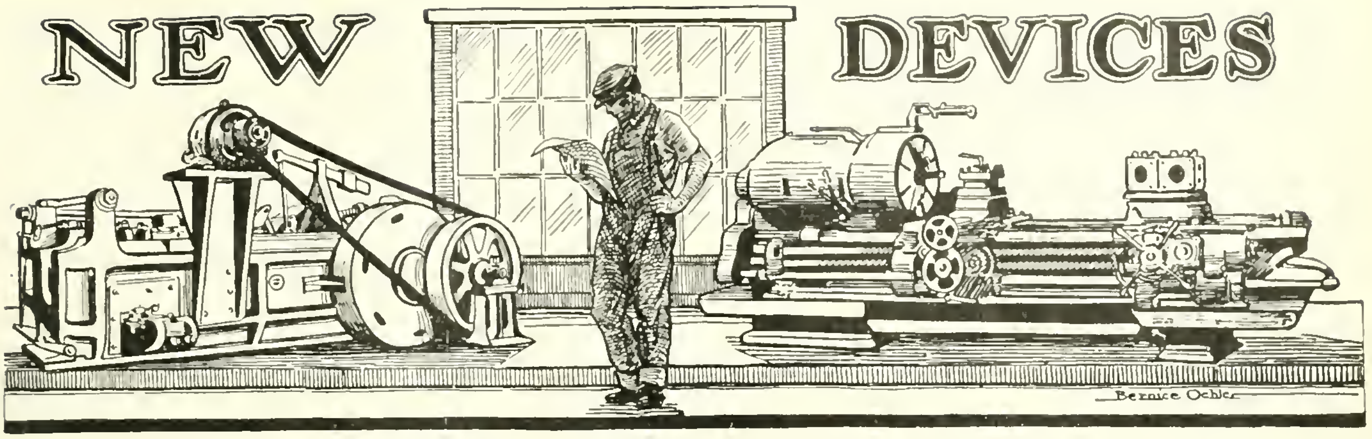


Fig. 13—Ball Joint Reamers with Inserted High Speed Steel Blades

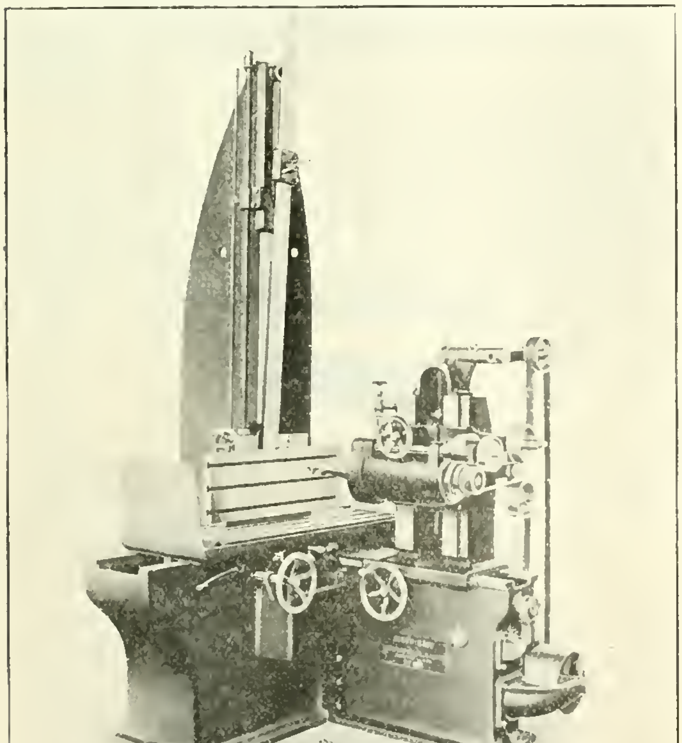
These various time-saving devices are in daily use in the Sacramento erecting shop and there must be further developments along this line both at Sacramento and other railroad shops if the large modern locomotives are to be properly maintained.

Pullman in the Movies.—A motion picture has been made by the Pullman Company comparing traveling in 1859 and in 1923. The film shows the first Pullman car with passengers wearing costumes of pre-Civil War times and illustrates in part the construction of sleeping cars. The picture is designed to inform people regarding the methods employed by the Pullman Company and to illustrate the safety and comfort of travel today.



Sundstrand Radius, Internal and Surface Grinder

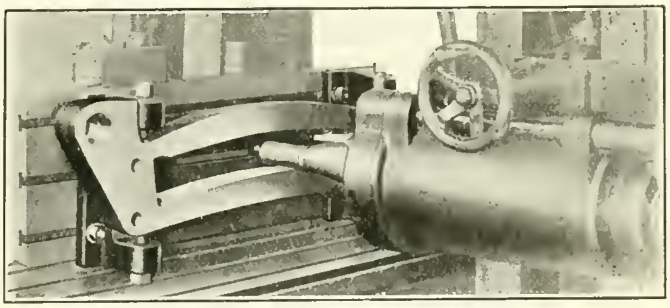
An entirely new design of grinding machine, called the Sundstrand, has been brought out by the Rockford Milling Machine Company, Rockford, Ill. It not only is a highly satisfactory radius link grinder, but because it is so easily converted to internal and surface grinding, its adaptability in the railroad shop is practically unlimited. By the use of a vertical radius bar a compact design was secured. Its advantages over the old horizontal type, which necessarily occupies so much valuable floor space, can readily be seen.



General View of Sundstrand Combination Radius, Internal and Surface Grinder

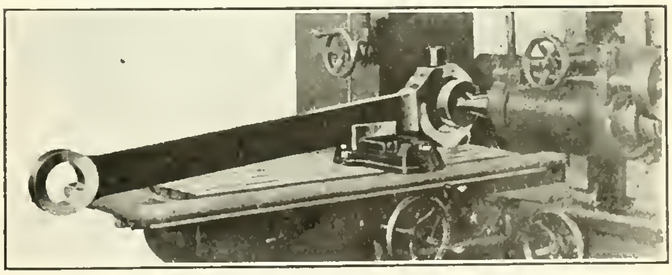
The Sundstrand grinder has a capacity for grinding radii from 18 in. to 100 in. The vertical pendulum motion is entirely independent from the rest of the machine and when not required, can be detached or the radius bar can be swung out of the way. The additional advantages of a horizontal surface or internal grinder, are thus always available.

It is provided with the standard spindle for radius link grinding and light surface grinding. For internal grinding of holes a planetary motion to the spindle is obtained through gearing, easily adjustable in the spindle head while in motion. The spindle head is also arranged for an oscillating motion. For heavy surface grinding, the standard spindle can be removed and another used in its place, designed for that purpose alone.



Radius Grinding Link Using Oscillating Movement to Heavy Surface Grinding Spindle

The base is made of two heavy castings, well ribbed and provided with wide bearing surfaces for the horizontal table and spindle column. The castings are firmly secured at right angles, insuring exact alinement at all times for the spindle and vertical table. To the back of the base is bolted the vertical column for the radius bar and this column also serves as the motor bracket when the machine is arranged for motor drive.



Grinding Hole in Side Rod Using Standard Spindle with Planetary Motion

When radius grinding, the work is held to the vertical table, which is secured to the radius bar. This table measures 12 in. by 36 in., and is controlled in its reciprocal motion by the horizontal table which measures 16 in. by 48 in. An automatic longitudinal feed of 50 in. is provided with either hand or power feed in either direction.

The spindle column is heavy with wide bearing surfaces on the base, the adjustable spindle head being supported on two dovetail bearings on the spindle column. Practically the entire drive mechanism is contained in the base below. The column has a maximum horizontal adjustment of 14 in. obtained by hand. The spindle head which runs on ball bearings has a vertical adjustment of 20 in. The spindle runs on ball bearings of an ample size to take care of large wheels and provision is made for taking up the wear by means of a single nut.

The driving sleeve is connected in the housing by an eccentric spindle, providing a planetary motion for internal grinding which can be increased from 0 in. to 1¾ in. larger than the diameter of wheel.

If the machine is to be motor driven, a motor is mounted at the back of the vertical column out of the way of the operator and off from the floor. The motor recommended is 7½ hp., 1,200 r.p.m. Should a motor drive not be desirable, a jack shaft can be furnished or the machine can be driven from the line shaft. An oil pump for cutting coolant is regularly furnished. This is located below the spindle column and draws coolant from a reservoir in the base.

A High Carbon Welding Metal

WELDING has proven its value in railroad applications not only in maintenance, construction and repairs but also as a reclamation medium particularly on low carbon steel parts. The reclaiming and maintenance of high carbon steel parts such as buffer castings, frog points, steel tires, etc., have somewhat suffered due to the fact that a suitable welding metal was not generally available.

The Page Steel & Wire Company, Bridgeport, Conn., has perfected a welding metal, the carbon analysis of which is practically 1.00 per cent, for welding high carbon parts by either the oxyacetylene or electric arc welding process.

The principal application of Page high carbon welding rods and electrodes is for the building up of worn surfaces where a high resistance to abrasive wear is desired. In electric arc welding this electrode maintains a stable and uniform arc. In gas welding the metal flows smoothly. With either process the finished weld may be ground but is not readily machinable.

Tests of Weld Deposits on .42 Carbon Steel

Original metal—		
Carbon		.42
Scleroscope		35.
Two layers of weld metal—		
Outer surface of deposit	.63	38
At a depth of 1/16 in. from top	.56	37
At a depth of ⅛ in. from top	.57	33
At a depth of 3/16 in. from top	.46	34

The table shows a typical result of weld deposits when made on a steel of .42 carbon content indicating wearing qualities that are more than equal to the original material.

Asco Torsion Spring Journal Box Lid

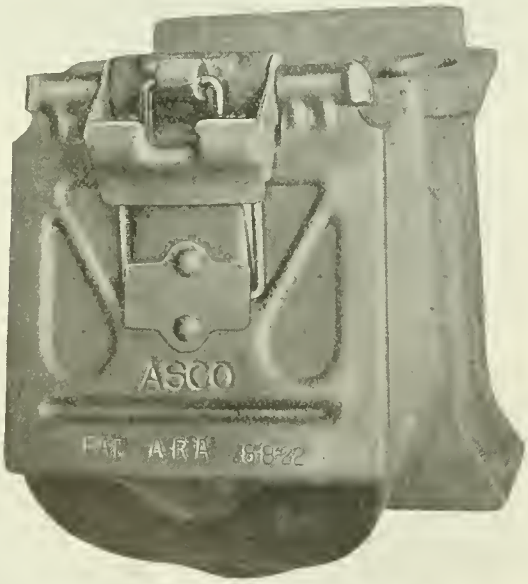


Fig. 1.—Journal Box with Asco Torsion Type Roller Bearing Spring Lid

A NEW type of journal box lid, known as the Asco hoodless torsion type roller bearing spring lid, has been introduced recently by the Allegheny Steel Company, Brackenridge, Pa. This lid, which is applicable to any journal box having the standard A.R.A. box face and lug, possesses the merit of forcing the lid against the box face at the top as well as at the bottom.

The lid body is pressed from ⅛ in. steel plate with side and bottom flanges and an integral turn-down scroll. It is stiffened by special embossing and as a result of the design is of light weight. The torsion spring with its roller is attached to the pressed steel lid as shown in the illustrations. A separate spring retainer and a pin completes the list of the additional parts that are required.

The application of the lid is a simple operation and may be performed by one man in a moment or two without any fitting, provided the box has an opening with a flat bearing surface and a box lug which approximates the A.R.A. di-

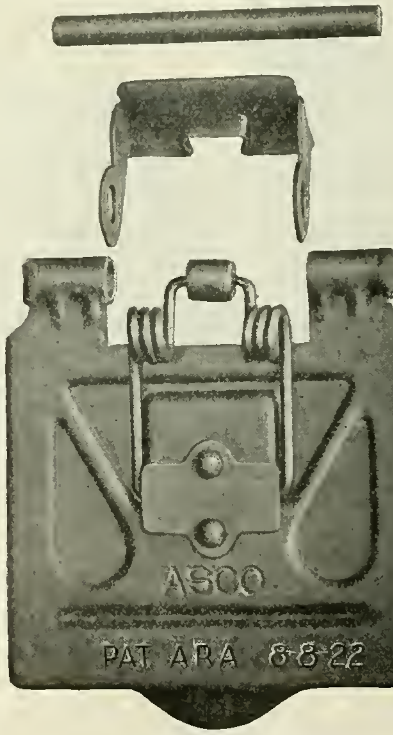
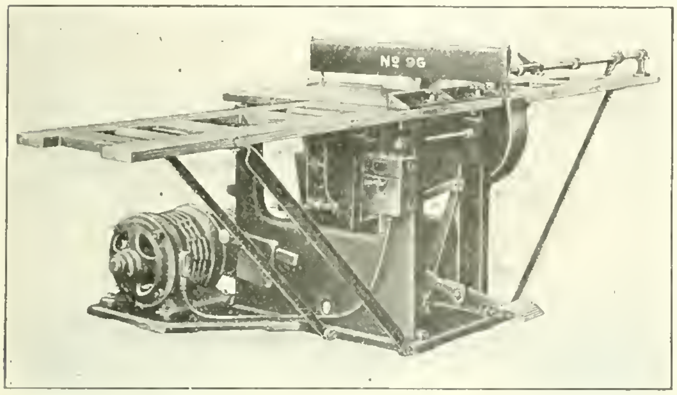


Fig. 2.—Asco Lid with Attached Roller Bearing Spring; also Separate Spring Retainer and Pin

mensions. All that is necessary is to lay the lid on the box face, hold the spring retainer in position, insert the headless pin and hammer down the right hand scroll which positively locks the lid body, spring retainer and pin. The spring retainer is then snapped into its locked position by a short pinch bar inserted between the spring roller and the retainer. The only tools required are a light hammer and a small pinch bar. This lid not only reduces the weight and insures a strong and even bearing pressure between the lid on the box on all four sides of the opening, but the spring action does away with all strain on the scrolls of the lid and also overcomes the wear on the box lug.

High Speed Under-Swing Cut-off Saw

As a rule swing cut-off saws are suspended either from the wall or ceiling and something new along this line is now offered in the No. 96 high speed under-swing cut-off saw illustrated. Made by the Oliver Machinery Company, Grand Rapids, Mich., this saw is designed for either belt or motor drive, being operated by means of the foot treadle at the front. By pressing on this foot treadle, the saw itself is brought forward to cut off 2-in. material up to 22 in. wide, or 4-in. material up to 16 in. wide. The instant the pressure is relieved from the foot treadle, the saw goes back, there being a spring in connection with the foot treadle arrangement to give the saw a quick return so that it is more rapid in operation than the usual overhead type.



Oliver No. 96 Under-Swing Cut-Off Saw

The saw arbor itself can be locked in a stationary position so that it can be used as a rip saw. Using the miter gage, it will serve like the ordinary stationary arbor cut-off saw. These are adaptations, however, as the machine itself is most efficient as an under-swing cut-off saw. For ripping and miter gage work, it is accurate enough for the ordinary contractor and builder but it is not recommended for ripping and miter work in a pattern shop. It does not take the place of the universal and variety saw bench in a practical way but it is useful and strongly recommended for cutting off lumber as it comes from lumber racks or piles.

The machine is guarded with an adjustable saw guard and has an enclosed saw and dust chute. Both of the operator's hands are free to handle the material being cut, making for efficiency and not tiring the operator as much as the hand-pull saw. This machine is self-oiling and powerful.

The main part of the table is of cast-iron 22 in. by 36 in. long and 33 in. high. The two auxiliary tables or extensions are of hard maple and are fitted with two rollers each. The right-hand section is fitted with a positive stop gage having three adjustable stops.

The forward and back stroke of the saw arbor is adjustable for short or long strokes and the spring mechanism mentioned above prevents jerking and jarring on both forward and return travel of the saw. For belt drive, a countershaft is provided and for motor drive an extended sole plate is furnished in place of the countershaft.

A New Pratt & Whitney 16-Inch Lathe

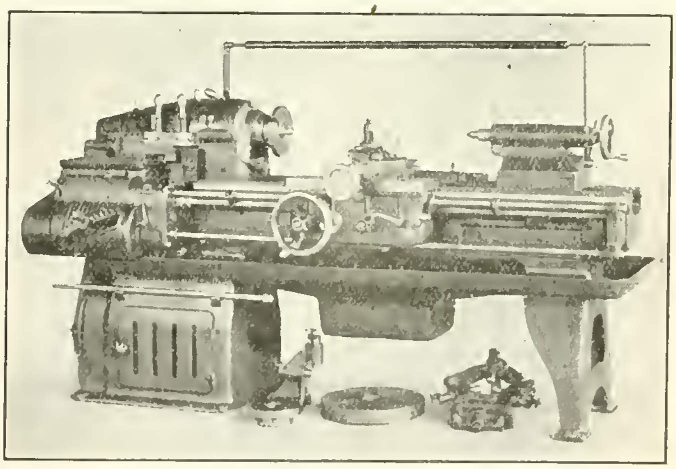
The Pratt & Whitney Company, Hartford, Conn., has brought out a new design of 16-in. lathe, known as Model B, suitable either for toolroom use or for high-speed production work. This lathe is offered either with geared head, for drive by independent motor or single pulley, or with cone pulley head.

By mounting the back gears below the spindle overhanging parts are eliminated, the headstock is centered over the bed and the operator is given greater freedom of movement and uninterrupted light on the work. The back gears are easily engaged from the front of the machine by means of an eccentric lever located under the spindle nose.

The sliding speed change gears, of chrome-vanadium steel, hardened, are fully enclosed and splash oiled and are shifted by two convenient levers on the front of the head. The interlock between the levers is controlled by the stop and start lever at the rear. Eight spindle speeds, ranging from 13 to 525, are provided.

The individual motor drive is compact and equipped with push button control located on the front of the headstock. The motor, which is 5 hp. A. C. or D. C., constant speed, 1,160 r.p.m. is mounted within the cabinet and connects by belt to the main drive pulley. For single pulley, the drive is through guarded pulley at the rear. Eight spindle speeds ranging from 13 to 525 are provided. The cone head has a solid housing and the same back gears as the geared head. A hand brake adds to safety and speed of operation. Spindle speeds range from 9 to 530.

The positions of the ratio lever and rocker arm for any desired feed or thread are instantly located by a large, direct reading index plate mounted on the quick-change gear box.



Pratt & Whitney 16-In. Lathe, Model B, for Tool Room or Production Work

The operator simply moves the ratio lever into position at the end of the proper horizontal line of threads, or feeds on the plate, and sets the rocker arm below the particular one desired. This device permits rapid setting and checking of the feed in use and makes the gear box practically fool proof.

The compound rest hand wheel is set at an angle of 20 deg. above its screw. This allows plenty of hand room and provides space for a large dial graduated in half thousandths to conform to micrometer readings.

Quick withdrawal for thread cutting is accomplished through the regular hand wheel by means of a coarse threaded sleeve on its hub. The compound rest screw is used for feeding, so that after starting the thread neither the feed, depth of cut nor stop needs any special attention. The lever operating the combined stop and reverse rod is at the right end of the apron. This rod is located above the lead screw, thus protecting the latter from damage and permitting the operator to set the carriage stops without stooping or taking his eyes from the work. Fine adjustment is obtained by a micrometer sleeve. For fine threading the hand wheel may be disengaged from the rack pinion. A simple thread chasing dial is made a part of the apron. The apron is also equipped with the usual knob for power cross feed and lever for engaging the screw. Longitudinal and cross feeds range from .0012 in. to .0665 in. For threading, 36 pitches are provided, the range being from 1½ to 80 threads per inch.

The tailstock has a long, solid barrel and a large graduated spindle. This spindle is locked by a long wedge on its lower side in such a way that no loss of accuracy can occur from the locking strain. The tailstock is clamped to the bed by an eccentric shaft parallel to the spindle and the same handle provides a means of moving the tailstock along the bed. The usual cross adjustment is provided.

Various special equipment can be supplied, including taper attachment, elevating tool rest, ball turning, collet attachment, relieving attachment and oil pump.

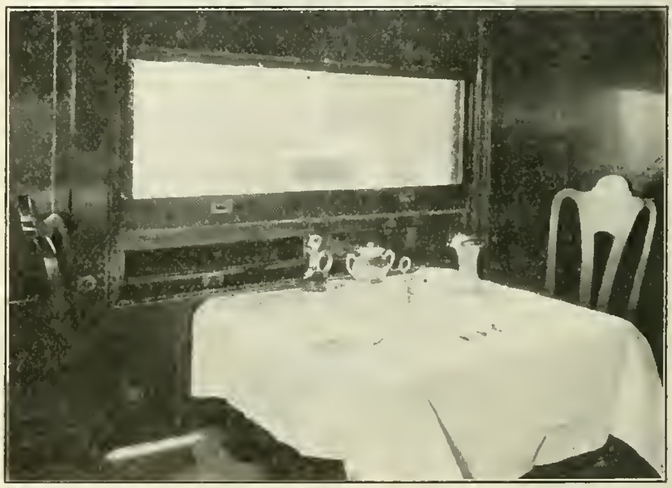
Harrison Ventilator Sash

The Combination Ventilator Company, Richmond, Va., is introducing a novel ventilator for the sash of passenger coaches which is the design of Charles L. Harrison. The primary purpose of the Harrison ventilator, which is an integral part of the sash itself, is to provide the maximum of clean, fresh air to travelers in railway passenger cars of all types, and in such a manner that the amount can be increased or reduced at the will of the individual passenger without interference with the ventilation desired by other passengers in the same car. The control is by means of a hinged shutter that can be operated without effort and without arising from the seat.

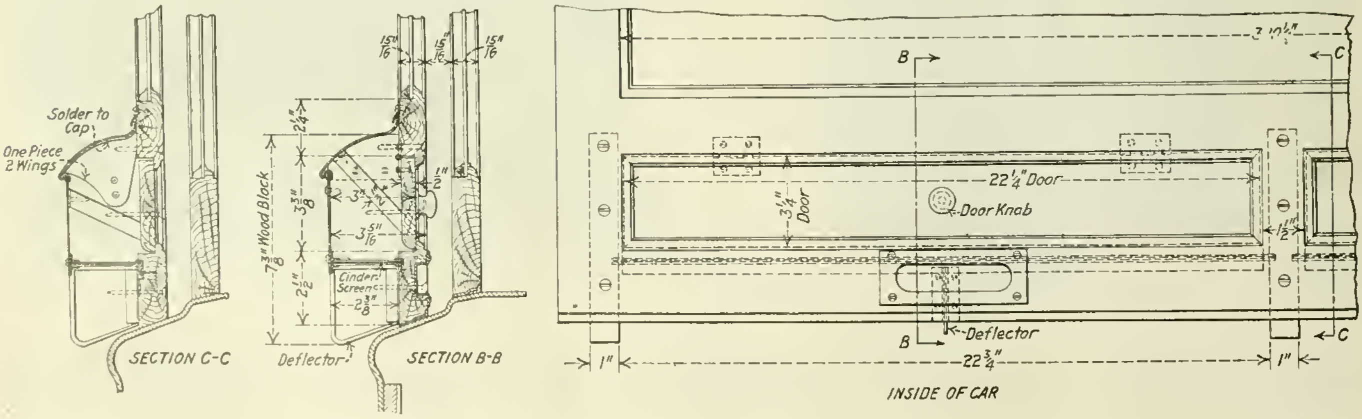
Referring to the drawing, it will be noted that the ventilator is of simple construction, compact and durable, the only moving parts being the control shutter. A slight pressure or pull applied to the knob on the shutter will adjust and lock it in any desired position.

The opening of the sash is fitted with a small removable screen horizontally placed. This screen is made of brass wire, 0.015 in. in diameter, with 22 meshes per inch, and gives a free opening of 45 per cent of the area. This netting opening is 1½ in. wide and practically the full length of the sash. The screen is protected by an outside sheet metal hood and its horizontal position is such that it serves to exclude rain as well as cinders, dust, snow or other flying particles. As it is so placed that it is not exposed to the elements and as the passenger does not come in contact with it, the wear is slight and the period of service correspondingly long. Should replacement prove necessary, a renewal can be made in a few moments with no other tool than a screw driver for the removal of four small screws.

The Harrison ventilator sash requires no change in the frame construction of a car and may be installed in the same manner as the ordinary sash now in use. There being no inward projections, it is adaptable to single or double windows of any size. Where double sash is used, as in Pullman cars, this ventilator sash does not interfere with the raising or lowering of the inner sash. The ventilator projects only 2¼ in. beyond the face of the sash which is usually inside the outer line of other projections. It occu-



Interior View of Car with Harrison Sash Ventilator—Left Half Open—Right Half Closed



Construction of Harrison Sash Ventilators as Applied to Dining or Pullman Cars pies but little more space at the window base than the frame of the ordinary type of sash and eliminates the projecting deflector of the ordinary sash ventilator used on Pullman cars. The small deflector shown in the drawing is employed to divide the air current and thus increase the capacity of the ventilator.

The advantages of a ventilator which will insure an adequate quantity of fresh, clean air and without the sash being raised are numerous and obvious. Among them, the following may be mentioned: The comfort of passengers is increased by the freedom from cinders and dirt. Cars are freer from dirt at the end of a run and require less frequent cleaning.

The air admitted is deflected upward and there is no draft upon passengers. The device does not become useless in stormy weather. It is not necessary to open or close windows in order to secure ventilation or when entering or leaving tunnels. It might even be possible to adopt fixed stationary windows.

The ventilator fixture takes the place of the lower rail of the sash ordinarily used and does not obscure the vision, being an integral part of the sash, there is nothing to remove for cleaning or storage purposes, consequently there is no chance of loss and the risk of damage is likewise materially reduced.

No handling or adjustment is required when the motion of the car is reversed as the ventilator sash operates equally well in whichever direction the car is moving.

Cars standing in yards may be kept fresh through continuous ventilation without the risk of the interior becoming wetted or damaged from sudden rain or wind storms as often occurs when car windows are left open.

The ventilator sash is suitable for washrooms and toilets, offering privacy and convenience and eliminating screen, deflector and roller shades which are not required where this device is installed.

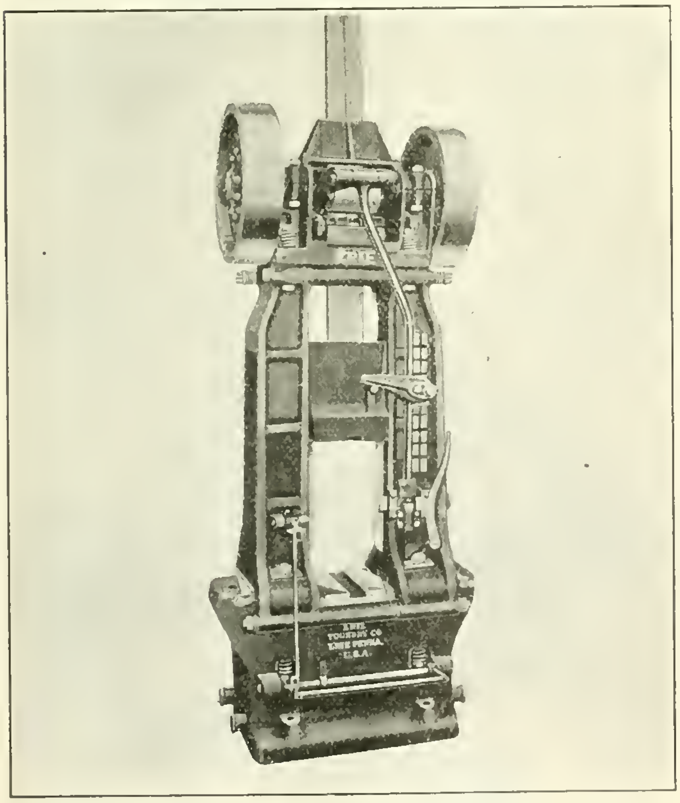
The Harrison ventilating sash has been applied to cars on several roads. Included among the cars thus equipped are a number of dining cars.

Tests that have been conducted have shown that the capacity of the ventilators, all being open, and the car running at a speed of at least 25 miles an hour, is sufficient to effect a complete change of the air contained in the coach in from one to two minutes and that the freedom from dirt and cinders is noticeable.

While designed for use on passenger coaches, the Harrison ventilator sash would be equally effective and advantageous in postal, express or electric cars. They furthermore could be adapted readily for use in windows of offices, hotels or other buildings.

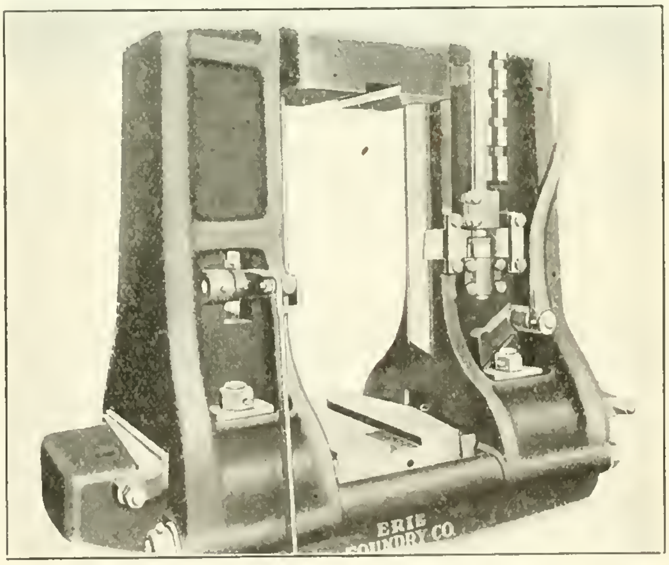
High Production Board Drop Hammers

The Erie Foundry Company, Erie, Pa., has brought out a new line of board drop hammers, characterized by a refinement of detail rather than by any radical departure from accepted principles of construction. Many ideas developed by actual forge shop experience and now considered as standard in heavy steam drop hammer construction have been adapted to the new line of board drop hammers. A thorough study has been made of the troubles experienced with existing types and practical drop forgers consulted as to the best methods of correcting these faults, the idea of the builders being to achieve a machine capable of a high-rate of production at a minimum of operation and maintenance expense, and dependable even under the severe conditions to which drop hammers are subjected.



Erie Board Drop Hammer, Made in Sizes from 200 Lb. to 4,000 Lb., Inclusive

Among the outstanding features of the new hammers are wedge adjustment of the frames across the anvil, the use of tie bolts and separators between the frames at the bottom and a new type of latch. The wedges hold the frames and anvil together as a solid unit, making it easy to maintain the alinement of dies and at the same time making adjustment easier. The use of wedges and the design of the tongue and groove construction between frames and anvil prevents scale from working into this joint and increasing wear.



Close-up View Showing Drop Hammer Latch

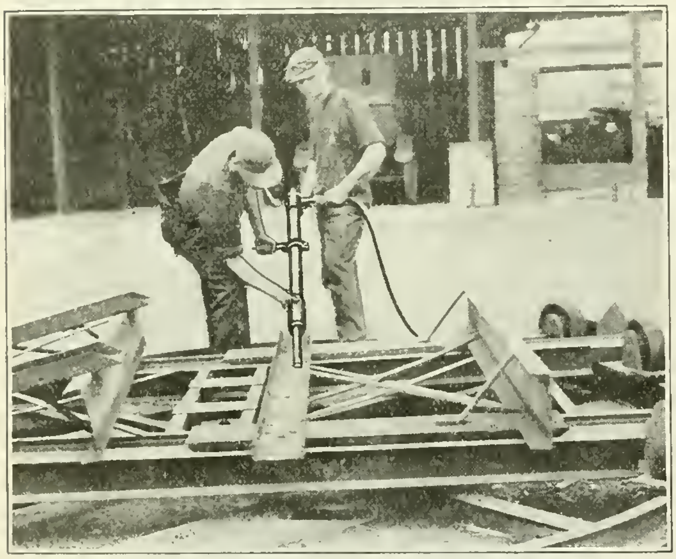
Another factor tending to maintain the alinement of the whole machine is the use of tie bolts and separators between the frames, top and bottom, front and rear. The separators prevent binding of the ram in the guides and yet minimize the amount of play. Their length can be reduced to compensate for wear of the guides or planing down.

The new type Erie hammer has a greatly increased tongue and groove area; also several details of the operating mechanism have been improved. The point of knock-off is easily adjusted, assuring that adjustment will be made as often as desirable and that the rolls will grip the board at just the proper moment. The friction bar drops vertically in guides, the latch bar being moved by the descending ram from under a block which fits against a shoulder on the bar. As the ram ascends, a hickory pin strikes one end of the roll release lever which is pivoted on a block clamped to the friction bar. Thus the friction bar is lifted gradually and without shock. The other end of the roll release lever bears on a pin which is adjustable up and down on a rack cast on the frame by means of which the length of strokes is varied. The crosshead construction used at this point reduces wear and shock.

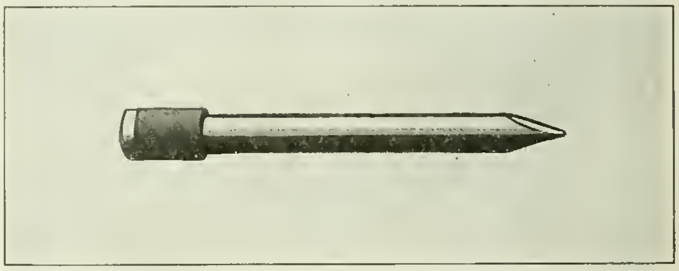
The ram is an open-hearth steel casting, cast by a special process to assure a dense structure of clean metal. The main bearings are bushed with phosphor bronze, and ample bearing area is provided. The anvils can be furnished in the ratio of 15 to 1 or of 20 to 1 to the weight of ram. The pulleys can be of wood, paper, or steel, to suit individual requirements. The new line of Erie hammers is built in sizes from 200 lb. to 4,000 lb. weight of falling parts.

"Red Devil" Two-Man Rivet Cutter

IMPROVEMENTS recently made by the Rice Manufacturing Company, Indianapolis, Ind., make it possible for the Red Devil rivet cutter to be handled successfully by two men. It has been found that a rivet cutter cannot be handled by two men without a retainer chisel. The accompanying illustration shows a chisel which is made by upsetting a flange on the head end, with the body or shaft of the chisel of a uniform diameter without any shoulder all the way down to the cutting end; the cutting end is shaped so that a rubber bumper can be slipped over the cutting end and pushed back to the flange on the other end, then the bushing in the nose piece of the rivet cutter can be taken out and slipped over the cutting end of the chisel, with the threads pointing toward the head of the chisel and pushed back against the rubber bumper. After assembling the chisel with a rubber bumper and bushing, the head of the chisel is inserted into the nose piece of the gun, and pushed until the threads of the bushing engage and is then screwed home. A special handle which clamps on the body of the barrel, is adjustable up or down to any position desired, making it easy for the assistant or second man to handle the gun in guiding it against the rivet. The operator takes his place the same as when operating the rivet cutter with three men.



Red Devil Rivet Cutter with Retainer Chisel Can Be Handled by Two Men

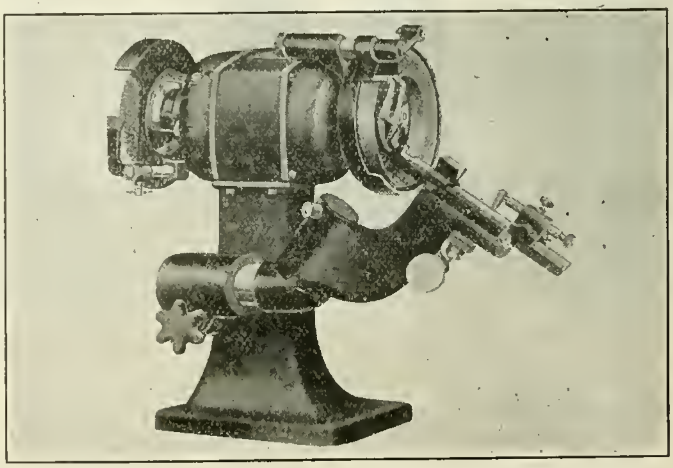


Retainer Chisel with Rubber Bumper

Bench-Type Twist Drill Grinder

THE bench-type twist drill grinder illustrated is an interesting new development of the Gallmeyer & Livingston Company, Grand Rapids, Mich., successor to the Grand Rapids Grinding Machine Company. The grinder is driven by a self-contained motor, enabling it to be placed in any position in the shop toolroom where most convenient.

In the basic principles of design and operation it conforms to other Grand Rapids twist drill grinders. It has a diamond truing device and the diamond is furnished as part of standard equipment for dressing the wheel. The holder is automatically placed in the right relationship with the grinding wheel so that it is close enough to grind the drills accurately and at the same time, the stop makes it impossible to bump the front of the holder into the grinding wheel. The machine illustrated is the A-7-T type with a capacity for drills from No. 52 to ¾ in. It is also made with a drill holder having a capacity of from ⅛ in. to 1½ in. drills, in which case it is designated style B-7-T.



Bench Grinder for Twist Drills From No. 52 to 1¾ In.

These machines are each equipped with a ½-hp. motor and can be driven from the lighting circuit or power lines, the motors being either a.c. or d.c., single-phase or polyphase, as may be desired.

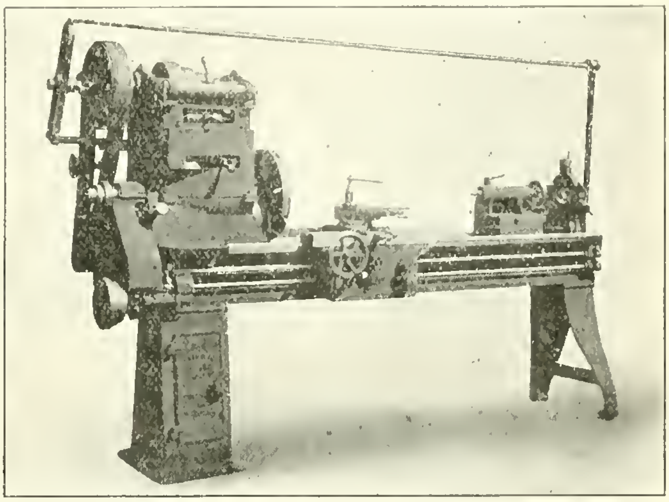
The motor bearings are especially designed and manufactured for this particular machine so as to provide conveniently for adjustment to take up either radial or end wear, and so as to eliminate end play, which is prohibitive in drill grinders. The swivel bearings are of bronze-bushed type, turning on a ground steel stud, with a complete protection from dust and convenient means for clean lubrication which adds greatly to the durability.

Motor Drive Arrangement for Engine Lathes

In order to meet the demand for motor-driven lathes, the John Steptoe Company, Cincinnati, Ohio, has recently designed a compact motor drive arrangement which is applicable to its 14-in., 16-in., 18-in. and 20-in. lathes. This motor-drive arrangement can be readily attached to the lathes in the field, as very little machine work is required with the exception of drilling and tapping a few small bolt holes.

The countershaft unit is bolted over the lathe cone pulley, and is provided with a clutch gear so that the motor can be engaged and disengaged instantly. The countershaft cone pulley can be moved away from the lathe spindle for tightening the belt and the belt from the motor to the countershaft is always kept tight by means of an idler pulley. The motor is placed directly behind the lathe in line with the bed, and is so located that there is no vibration to the lathe. A constant speed motor, running at 1,100 to 1,200 r.p.m. is recommended.

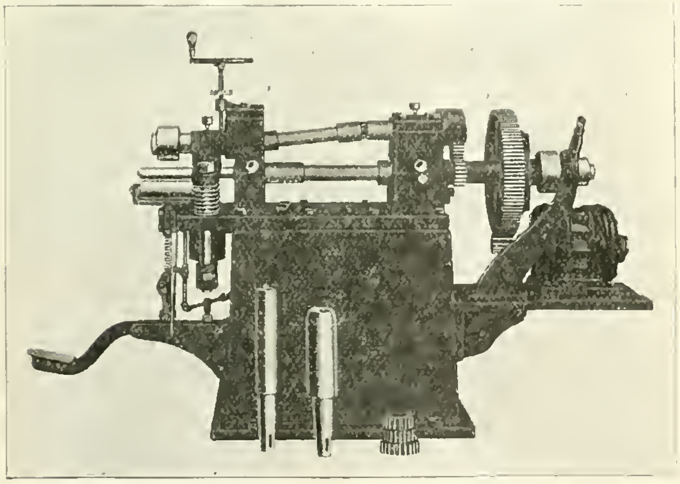
The Steptoe standard engine lathe, equipped with motor drive, is a conveniently-operated production unit for lathe operations within the capacity of the machine. It is adaptable to use in railroad machine shops and toolrooms where the electric drive feature will prove particularly valuable in enabling the lathe to be placed in the most advantageous position, irrespective of the location of line shafting.



Motor Drive Applied to Headstock of Steptoe Engine Lathe

A Roller Type Flue Welder

What is known as the Marshalltown-Schaefer flue welder has recently been developed by the Marshalltown Manufacturing Company, Marshalltown, Iowa. A distinctive feature of this welder is the use of two revolving rolls, one inside and one outside of the flue, between which the weld is made. These two rolls are power driven at a comparatively slow speed and are connected by gears, the ratio of which causes both rolls to operate at the same circumferential speed.



The Marshalltown-Schaefer Flue Welder

The illustration shows the welding machine alone. With it, however, are furnished a 350-lb. anvil with a cone-shaped horn for belling the ends of the flues preparatory to receiving the safe ends, and a ball and roller bearing stand to support the outer ends of the tubes while in the welding machine. After the tube has been prepared to receive the safe end and heated with the safe end in place, the weld is made on the machine by slipping the heated flue and safe end over the lower mandrel or inside roller and bringing the weld under the upper or outside roller. A stop can be provided on the mandrel by placing a short piece of flue of the proper length on the back of the arbor. With the rollers in motion, the upper roller is brought down in contact with the flue by means of an air cylinder operated by the foot lever shown in the photograph. This lever is first pressed lightly while the flue makes two or three revolutions. The pressure is then increased, causing the two rounding rolls shown in the illustration below the inside mandrel, to move up against the flue. Care must then be taken not to continue the rolling too long or the size of the flue may be enlarged. With the roller bearing adjusted so that it is in line with the inside mandrel, the revolving of the flue while the weld is being made aligns the flue and the safe end so that when the weld is complete the whole piece is straight.

The machine has a welding range which will take tubes from 2 to 6 in. in diameter by changing the rolls, and pieces up to 9 in. in length can be welded on the flue. Three sets of rolls are furnished with each machine and a small hand wheel adjustment is provided at the top so that the welding roll may be correctly set about 1 in. above the mandrel in each case.

The Movement of freight, westbound, over the Pittsburgh Division of the Pennsylvania Railroad, on July 3, was the heaviest on record for a single day, 5,091 cars passing Gallitzin. This is 239 more cars than on the heaviest preceding day, which was September 15, 1919.

GENERAL NEWS

A crew of four men built a freight car in the shops of the Texas & Pacific at Marshall, Tex., on July 27, in 5 hr. and 55 min. The crew was one of eight engaged in a contest in building standard 36 ft. stock cars. The maximum time consumed in the contest by four men in building one of the cars was 6 hr. and 40 min.

The shopmen of the Central of New Jersey who went out on strike in July, 1922, have abandoned their strike. This action, according to Charles MacIntosh, leader of the strikers, is the result of a recent meeting held in Elizabeth, N. J., attended by about 100 men. The road's shops were fully manned long ago by new men and by strikers who returned as new men.

The Missouri Pacific dedicated its new hospital at St. Louis, Mo., on July 29. The building is six stories high, of brick and stone construction and contains 300 beds and six operating rooms. It also has ample sun parlors, dressing rooms, serving rooms and dining rooms. The building cost $1,000,000, which was furnished by the Missouri Pacific Hospital Association.

Boiler Inspection Act

The Circuit Court of Appeals, Sixth Circuit, holds that, while the Interstate Commerce Commission is authorized to make rules and orders in furtherance of the enforcement of section 2 of the Boiler Inspection Act, requiring boilers in operation to be in proper condition, the failure of the Commission to make a rule or order covering every defective condition or construction within the meaning of the section does not relieve the railroad from complying with its provisions.—Baltimore & Ohio v. Groeger, 288 Fed. 321.

Locomotive Shipments and Orders on Hand

The following table was prepared by the Department of Commerce showing July shipments of locomotives from the principal manufacturing plants, based on reports received by the Bureau of the Census from the individual establishments:

LOCOMOTIVES

	July, 1923	June, 1923	July, 1922	Seven months' total January to July 1923	Seven months' total January to July 1922
Shipments:					
Domestic	211	221	122	1.543	342
Foreign	28	11	6	101	148
Total	239	232	128	1,644	490
Unfilled orders (end of month):					
Domestic	1,652	1,854	712	...	...
Foreign	86	104	99	...	...
Total	1,738	1,958	811	...	...

Condition of Equipment

Fifty-nine per cent of the locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during the month of July were found defective, according to the monthly report of the commission on the condition of railroad equipment. The number inspected was 5,197, of which 3,077 were reported as defective; and 568 were ordered out of service. The percentage found defective compares with 61½ per cent during the first six months of 1923, and 68½ per cent during the last six months of 1922. The number of accidents occurring in July and caused by the failure of some part or appurtenance of locomotive or tender, as reported by the carriers, was 115.

The Bureau of Safety reports that it inspected 97,412 freight cars during July, of which 5.2 per cent were found defective and 1,994 passenger cars, of which 1.2 per cent were found defective. For July, 1922, the corresponding percentages were 7.8 and 1.3. During the month of July 109 violations of the safety appliance act were reported for prosecution.

Wage Statistics for May

The Interstate Commerce Commission's summary of monthly reports of employees, service and compensation filed by Class I railroads for the month of May, 1923, shows that the number of employees and the amount of compensation were greater than for any month since the revision of the classification, July 1, 1921. The number of employees reported for May, 1923, shows an increase of 267,991 or 16.5 per cent over the number reported for the same month last year, and an increase of 52,567, or 2.9 per cent over the number reported for April, 1923. The total compensation for May, 1923, was 19.8 per cent greater than in May, 1922, and 5.6 per cent greater than in April, 1923. Compared with the same month last year the average straight time hourly earnings for all employees reported on an hourly basis decreased from 58 to 56 cents, and overtime hourly earnings decreased from 77 to 75 cents. But owing to more regular employment the employees as a whole averaged 222 hours in May, 1923, as against 210 hours in May, 1922, which resulted in an increase in the average monthly earnings from $128 to $132.

A New Department on the Rock Island

A department of personnel and public relations, headed by H. S. Ray, assistant to the president, who now has the title of director of personnel and public relations, has been established on the Chicago, Rock Island & Pacific. The department will function under two divisions. A. B. Ramsdell, assistant vice-president in charge of labor, will be assistant director of personnel and W. E. Babb, editor of the Rock Island Magazine, will be assistant director of public relations. The new department will attend to: Supervision of wages and working conditions; supervision of recreational activities among employees, including social clubs, outings, musical organizations and athletic teams; development of educational activities to help employees prepare for promotion and to assist them in developing their capacity; development of housing facilities for employees, together with the supervision of Y. M. C. A. and other rest houses at terminal points; plans for the improvement of the health of employees and conditions surrounding their work; supervision of the Rock Island Monthly Magazine and other employee publications; supervision of advertising literature of an institutional character; contact with civic and community organizations and with the public, to the end that a better mutual understanding may be developed and maintained.

The Booster Tested in English Passenger Service

The locomotive booster has been applied to an Atlantic type locomotive of the London & North Eastern Railway for experimental purposes—the first booster to be applied in England. The locomotive, which, according to the Railway Gazette (London) is the company's No. 1419, was built in 1910. This locomotive has 20 in. by 24 in. cylinders, is equipped with a superheater and weighs 165,984 lb. in working order, exclusive of the tender. It develops 17,340 lb. tractive force at 85 per cent of boiler pressure without the booster and to this the booster adds another 8,500 lb., giving an increase of almost 50 per cent. The locomotive is in passenger service and it is in this service with an 18-car train that the booster is being tested.

The company has 120 locomotives of this type, the first of which were built in 1902, and all of which have been successful in service.

With the increasing train-load, however, the low tractive force of the type has made their operation increasingly difficult. If the application of the booster is successful in overcoming the difficulties of starting and of operation on heavy grades, it is thought that the period of usefulness of the locomotives may be considerably extended. The application of the booster and the tests are under the supervision of H. N. Gresley, chief mechanical engineer of the company.

Tank Car Specifications

The general committee of the A. R. A. has announced that at the request of certain owners and upon recommendation from the committee on tank cars, the effective date of the requirements of Section 7 (c) of the Specifications for Class I and II Tank Cars, and the last paragraph of Section 7 (d) of the Specifications for Class III and IV Tank Cars is further extended to February 1, 1924. The sections of the Tank Car Specifications referred to provide that no nipples, valves or other attachments shall project below the bottom outlet cap except while car is being unloaded.

France Adopts the Westinghouse Brake

The Superior Council of Railways of France has ratified the decision of a special commission appointed by the Ministry of Public Works adopting the Westinghouse air brake as the standard for French railways. The special commission tested three brakes, viz., the Westinghouse, the Lipkowski and the Clayton-Hardy vacuum. It is now proposed that the French Minister of Foreign Affairs should call a meeting of representatives of the allied countries in accordance with the Peace Treaty with the view of standardizing air brakes in continental Europe. The choice of the Westinghouse brake is said not to involve its exclusive use, but that any other similar pressure brake capable of being operated with the Westinghouse might be allowed.

Fuel Association to Determine Relative Values of Coal and Oils for Locomotives

The International Fuel Association is investigating the relative values of various locomotive coals and fuel oils available for locomotive use and will present the results in the form of a paper at its next annual meeting. The relative value of solid and liquid fuels is not represented by their comparative B.t.u. content principally because the standby losses with fuel oil are much lower than where coal is burned. The results of this investigation will be of particular value to the railways in determining the relative prices they can afford to pay for coal and oil. This will also establish the true relative fuel efficiency of railroads burning fuel oil in comparison with coal burning roads. The Interstate Commerce Commission now requires railways burning fuel oil to report the equivalent consumption of coal per freight ton mile and per passenger car mile on the assumption that 3½ barrels of fuel is equivalent to one ton of coal.

The association has further planned to make an extensive study of locomotive fuels being mined in various parts of the country and will present at its next annual meeting a symposium on methods best adapted to utilize such fuels as are now available. This will relate particularly to the availability of lignite, peat and other low grade fuels for locomotive use. The association also contemplates an investigation of the interrelation of the numerous fuel economy devices now available. The result of this investigation, which will also be presented at its next annual meeting, will show the savings that can be anticipated from a combination of several locomotive fuel economy devices such as the brick arch, superheater, feed water heater, syphon, etc. The facts to be developed in this report are of importance since the use of several of these devices in combination is becoming quite general.

The American Railway Association has recently expressed a desire to co-operate with the International Railway Fuel Association with a view to putting into general practice methods developed and recommended by the latter. Consequently, it will be the purpose of this association to devote considerable time henceforth to the solution of such detail problems relating to fuel use as are referred to it by the A. R. A. joint committee on fuel conservation. The immediate problem now under consideration is that of co-operative research, whereby the testing laboratory facilities of several universities can be utilized by the railways to determine the relative value of new locomotive devices and the comparative efficiency of various grades of coal in locomotive use.

MEETINGS AND CONVENTIONS

Southeastern Carmen's Association

The second session of the Southeastern Carmen's Association will be held at the Hotel Ansley, Atlanta, Ga., September 17 and 18. The following papers will be presented for discussion: Co-operation, W. W. Waits, Southern; Care and Maintenance Freight Air Brakes, A. G. Huston, Westinghouse Air Brake Company; Handling of Explosives and Inflammables, W. H. Evarts, Bureau of Explosives; Claims Prevention, F. Whittemore, New York, Chicago & St. Louis; A. R. A. Billing, B. F. Jameson, Southern.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical. V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago. Meeting September 4, 5 and 6, Hollenden Hotel, Cleveland, Ohio.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—W. C. Stephenson, Atlantic Coast Line

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio. Convention October 8-12, Ballroom William Penn Hotel, Pittsburgh, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting Hotel Statler, Buffalo, N. Y., Sept. 13. Motion pictures and dancing.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting Hotel Sherman, Chicago, October 3, 4 and 5.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in each month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in each month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting, beginning September 11, 1923, Chicago. Exhibit by Railway Equipment Manufacturers' Association.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Air Reduction Company, Inc., brought into production on July 15 its new plant at Sharon, Pa.

Charles E. Meyer, formerly secretary and treasurer of the Bagnell Timber Company, St. Louis, Mo., died on August 4 at his home in that city.

D. T. Harris, who has been associated with the sales department of the American Steel Foundries since 1904, died in Rochester, Minn., on July 25.

The Union Railway Equipment Company has discontinued its Montreal office and will handle Canadian business through its general office at Chicago.

P. J. Willis, formerly purchasing agent for the General American Car Company, Chicago, has become associated with the Coale-Fraser Lumber Company, Chicago.

The Flannery Bolt Company, Pittsburgh, Pa., has appointed the W. S. Murrian Company, with offices in the Cal Johnson building, Nashville, Tenn., as its southern representative.

H. L. Erlicher, formerly assistant to the general purchasing agent of the General Electric Company, Schenectady, N. Y., has been appointed assistant general purchasing agent.

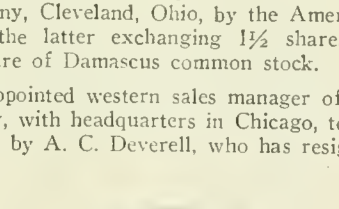
John R. Hayward has been appointed southern representative of the Davis Brake Beam Company, Johnstown, Pa. Mr. Hayward's headquarters are in the First National Bank building, Roanoke, Va.

The Oilgear Company, Milwaukee, Wis., has appointed the E. A. Kinsey Company, 235 South Meridian street, Indianapolis, Ind., as the selling agent for Oilgear products in the states of Indiana, Kentucky and Tennessee.

J. Leonard Replogle, president and chairman of the executive committee of the Vanadium Corporation of America, New York, has resigned on account of ill health. Mr. Replogle remains as a director of the corporation.

Negotiations have been completed for the purchase of the Damascus Brake Beam Company, Cleveland, Ohio, by the American Steel Foundries, Chicago, the latter exchanging 1½ shares of preferred stock for each share of Damascus common stock.

A. N. Willsie has been appointed western sales manager of the Locomotive Stoker Company, with headquarters in Chicago, to fill the position recently vacated by A. C. Deverell, who has resigned to go into business for himself. Mr. Willsie started his railroad experience in the master mechanic's office on the Chicago, Burlington & Quincy in April, 1880. He worked in various capacities with the Burlington for 39 years, serving consecutively in the offices of the timekeeper, locomotive shops, car shops, and later became locomotive fireman and locomotive engineman and road foreman of engines. He was then division master mechanic, also division superintendent and for a number of years filled the position of supervisor of fuel economy at the general office in Chicago until he entered the service of the Locomotive Stoker Company as district engineer, which position he held up to the time of his appointment as western sales manager, as above noted.



A. N. Willsie

The American Brake Shoe & Foundry Company, New York, has purchased a four-acre site in North Kansas City, Mo., where it will manufacture brake shoes and iron castings. The construction of the building will be started at once and it is hoped to have it completed by fall.

E. F. Boyle, Monadnock building, San Francisco, Cal., has been appointed Pacific Coast representative for the Grip Nut Company, Chicago, and J. L. Stephenson, Munsey building, Washington, D. C., has been appointed a representative for the Grip Nut Company on certain railroads.

Harry J. Bell, secretary and manager of the Chicago Safety Council and formerly in charge of the safety program of the roads in the Northwestern region of the United States Railroad Administration, has resigned to become manager of the safety division of the Milwaukee Association of Commerce.

Henry J. Bailey, vice-president of the Consolidated Machine Tool Corporation of America, Rochester, N. Y., has been elected president, to succeed W. H. Marshall, deceased. Mr. Bailey began work with the Hilles & Jones Company, Wilmington, Del., in 1890, as a messenger boy, when he was 14 years old. He later served as shipping clerk and stenographer, in 1900 was appointed secretary of the company, subsequently assuming charge of sales, and upon the death of Alfred R. Jones in October, 1918, Mr. Bailey was elected president of the same company. During his service he worked in all the different departments of the business. On the formation of the Consolidated Machine Tool Corporation of America in June, 1922, of which the Hilles & Jones Company forms a part, Mr. Bailey became vice-president of the new corporation in charge of the Hilles & Jones works at Wilmington, and now becomes president of the corporation, with headquarters at Rochester, as above noted. The general offices of the corporation have been removed from New York City to Rochester, but its district selling organization will be continued at 17 East Forty-second street, New York City.

H. J. Bailey

The Pawling & Harnischfeger Company, Milwaukee, Wis., manufacturers of excavators, cranes and machine tools, has appointed the Laughlin Barney Machinery Company, Pittsburgh, Pa., to represent it in western Pennsylvania and eastern Ohio as sales agents for the company's horizontal boring, drilling and milling machines.

E. H. Hall, formerly superintendent of the car department of the Chicago-Great Western, with headquarters at Oelwein, Iowa, has been appointed special representative of the Robert M. Lucas Company, Chicago, manufacturers of flexible corrosion-proof cements for railroads for the territory west of the Mississippi river to the Pacific Coast. Mr. Hall's headquarters will be in Chicago.

F. H. Rood has been appointed engineer of tests of the Pittsburgh Testing Laboratory, with headquarters at Pittsburgh, Pa. Mr. Rood is a civil engineer graduate of Syracuse University. For many years he served as engineer of tests for the New York State Highway Commission and for three years was assistant engineer of tests, Pittsburgh Testing Laboratory; then for two years a research engineer with the U. S. Bureau of Public Roads.

The Surplus Steel Exchange, Inc., New York City, which was recently organized, has opened an office in Chicago at 2257 Oakdale avenue, in charge of A. E. Thiffault and Raymond I. Caspers, both of whom have been affiliated with the steel trade for many years. Mr. Thiffault was formerly with the American Sheet & Tin Plate Company, and Mr. Caspers was formerly with the Illinois Steel Company and the American Sheet & Tin Plate Company.

Waldo H. Marshall

While boys of his age were preparing for college Waldo H. Marshall was chief draftsman of the Rhode Island Locomotive Works. His ideas of engineering design particularly concerning locomotives and his ideals of managing men began to take form during his machinist apprenticeship at those works. Industrious study, deep thought, ability, a remarkable mind, clear and balanced, a lovable character, all combined in 35 years of constructive life, give the world a valuable and unusual legacy. Nearly all his work was either for or directly with railroads. With grade schools and night school as a foundation he became an engineer and an administrator. Because he was not a college man he was the more careful and thorough. Many a college educated engineer had to go back over his work and correct it because of the direct thinking, common sense methods of analysis of his superior.

W. H. Marshall

In his early work he profited by association with David L. Barnes. He succeeded Mr. Barnes at the Rhode Island Locomotive Works. Then he went to New York on engineering work for the New York elevated and cable railroads. Before the World's Fair he took the editorship of the Railway Review in Chicago and later became editor of the Railway Master Mechanic, also in Chicago. During this time he designed the details of the movable sidewalk at the World's Fair. He also designed and patented the Simplex truck bolster, which represented the beginning of his influence upon the design of railroad rolling stock in the direction of maximum strength per unit of weight. That unnecessary weight should exist in either cars or locomotives troubled him. He must be credited with beginning systematic improvements in this direction.

He continued editorial work with M. N. Forney on the American Engineer (now the *Railway Mechanical Engineer*) in New York, but with a strong desire for a railroad opportunity which came to him in 1897 in the position of assistant superintendent of motive power, Chicago & North Western. The Lake Shore & Michigan Southern made him superintendent of motive power in 1899 and here he began to give us the locomotive policy that not only this but every railroad needs. Track and bridges on that road were proverbially light. He began an epoch making series of locomotive designs, the best and most powerful the rails would take. He helped to get heavier track and bridges and followed with power developed in parallel with the means for carrying it. He was one of the pioneers in locomotive terminals and then in shop development. Results brought him into the operating department in 1902, first as general superintendent and then as general manager. During this time he found and advanced many a young man whom he trusted and who abundantly justified his judgment. In these men his ideas and ideals are going forward for the improvement of transportation. Many a young man must say that Waldo Marshall made him. The one who writes these words says it of himself. Waldo Marshall himself was trusted. He once told an intimate friend that in his railroad career he was only once turned down when he made a recommendation. That was when the road, without his knowledge, had already bought a small road that he thought should be acquired. The young railroad officer who "gets" this lesson from his life is fortunate.

At the time when railroads were beginning to realize the necessity for more powerful locomotives he was called in 1906 to the American Locomotive Company as its president. He not only helped materially to meet this need, but contributed a vital part in the direction of the change in locomotives from mere pullers of trains to efficient power plants.

In the World War he rendered service with J. P. Morgan & Company and with the Naval Consulting Board. At the close of the war he became chairman of the board of Gillespie & Company. At the time of his death he was chairman of the board and president of the Consolidated Machine Tool Corporation of America and director of several companies and financial institutions.

Through his life he sought to serve others. He served them well.

He was born June 7, 1864, in Providence, Rhode Island. He died at Barnstable, Massachusetts, August 23.

G. M. Basford.

H. W. Johnston and A. C. Steinmetz have been appointed service engineers of the Franklin Railway Supply Company, Inc., New York City. Mr. Johnston was formerly supervisor of machinery and tools of the Delaware, Lackawanna & Western and later in the service of the Baltimore & Ohio, reporting to the general superintendent of motive power, and Mr. Steinmetz was formerly an engineman on the Cleveland, Cincinnati, Chicago & St. Louis, who also served as a member of the Board of Locomotive Engineers.

The recently organized Midvale Company, successor to the historic Midvale Steel Company, reports that it is operating its various departments on a fair schedule in the production of forgings, tires, large and small rings, roll shells, large crank shafts, hardened and ground rolls, special designs of extrusion cylinders and liners, piston and hammer rods, and forged members to withstand shock and fatigue. It is also producing, as a special product, large quantities of iron and steel castings, rough and machined, for nearby industries. There is an active increase in its business of carbon and high speed tool steels, and its purpose is to expand its tool steel output in the near future to include all analyses and sizes.

In charge of the plant is Dr. H. L. Frevert, who started with Midvale about 15 years ago, after graduating from Harvard University. In addition to the other departments, the Midvale Company continues to conduct its research work under the supervision of Dr. Frevert and John Lyman Cox.

The Midvale plant, in addition to the steel works, forge and hammer shops and rolling mills, has eight large machine shops. These include one tire machine shop, a slicing shop, two roughing shops and four shops for general finished machined work. In addition to previously mentioned units, the Midvale Company has iron, steel and brass foundries. These foundries are utilized principally for the production of large castings to go along with forgings.

The following officers of the company have been elected: Alva C. Dinkey, president; Dr. Harry L. Frevert, vice-president; James M. Milliken, secretary and treasurer; Stuart Hazelwood, vice-president in charge of sales.

John N. Reynolds, formerly western manager of the Railway Age—an announcement of whose death in San Diego, Cal., on July 10 was published in the August issue of the *Railway Mechanical Engineer*—was for many years widely known among officers of railways and railway supply companies, especially the latter. He commenced newspaper work with the Boston Advertiser in 1872. In the same year he became associated with Edward Vernon and others in preparing and publishing, in 1873 and 1874, the "American Railroad Manual of the United States and the Dominion." From 1874 to 1881 he was connected with Poor's Manual of Railroads. From 1875 to 1883 he did his first work in the business department of the Railroad Gazette. From 1881 to 1894 he was connected with the National Car and Locomotive Builder; and in 1881 he published the first directory of street railways of the United States, Canada, Mexico and South America. From 1894 to 1901 Mr. Reynolds was western representative of the Railroad Gazette.

John N. Reynolds

In May, 1901, he became vice-president of the Railway Age, which position he held until May, 1908. On June 1, 1908, the Railroad Gazette, which was published in New York, and the Railway Age, which was published in Chicago, were consolidated, and Mr. Reynolds was appointed western manager of the consolidated paper. He continued to hold this position until January, 1913, when he retired, later moving from Chicago to San Diego, Cal., where he lived until the time of his death. Mr. Reynolds' active connection with railroad publications extended over a period of 40 years.

Mr. Reynolds was born in England, August 24, 1846. The accompanying photograph was taken some years ago. We are printing it because none of the later pictures was a true likeness.

H. H. Pleasance, general manager of sales of the United Alloy Steel Corporation, and H. C. Thomas, assistant general manager, with headquarters at Canton, Ohio, have been promoted to vice-presidents, with the same headquarters. Mr. Pleasance entered business with the Standard Oil Company of Cleveland, Ohio, in whose employ he remained until 1903, when he entered the service of the Cambria Steel Company at Cleveland. After a short time in the Cleveland office he was transferred to the Detroit district, which embraced lower Michigan and northern Indiana. In 1913, he resigned from the Cambria Steel Company to enter the employ of the United Steel Company as sales manager, with headquarters at Cleveland, Ohio. In January, 1917, he entered the employ of the United Alloy Steel Corporation as assistant general manager of sales, which position he held until May 1, 1917, when he was promoted to general manager of sales. He held the latter position until his recent promotion.

H. H. Pleasance

Mr. Thomas entered the employ of the Wheeling Steel & Iron Company as a chemist in 1900 and subsequently was connected in chemical, metallurgical and operating executive capacities with the Alan Wood Iron & Steel Company and with the United States Steel Corporation's plants at Braddock, Pa., Duquesne, Donora, Clairton and Gary, Ind. From 1908 to 1918 he was assistant general superintendent of the United States Steel Corporation's plant at Gary, Ind. On the latter date he resigned to enter the employ of the United Alloy Steel Corporation as general superintendent which position he held until September, 1922, when he was promoted to assistant general manager.

H. C. Thomas

The co-partnership of Robert W. Hunt & Co., Chicago, on July 2 was incorporated under the name of Robert W. Hunt Company and the officers are now as follows: John J. Cone, president, D. W. McNaugher, vice-president and treasurer, C. B. Nolte, vice-president and general manager, W. A. Gresens, secretary and assistant treasurer. The board of directors includes the above officers, also Luther V. Rice and J. C. Ogden. The official personnel of the corporations, 20 domestic and 8 foreign, or international offices, remains unchanged.

TRADE PUBLICATIONS

Rivet Forges.—A 4-page, illustrated bulletin, No. 504, describing a new suction feed type Venturi fuel oil-burning rivet forge, has recently been issued by the Hauck Manufacturing Company, Brooklyn, N. Y.

Portable Oil Heaters.—A 16-page illustrated bulletin, No. 503, describing the latest Venturi oil-burning torch for making locomotive steel car and rip track repairs, has recently been issued by the Hauck Manufacturing Company, Brooklyn, N. Y.

Zinc Roofing.—The New Jersey Zinc Company, New York, has issued a small leaflet outlining the adaptability of standing-seam Horse Head zinc roofing for many types of buildings. The leaflet is illustrated with sketches showing how the roofing is applied.

Alternating Current Motors.—The Reliance Electric & Engineering Company, Cleveland, Ohio, has just issued a 14-page illustrated bulletin, No. 5018, descriptive of its new line of Type AA induction motors for two and three phase alternating current circuits. These motors, which are of the squirrel cage type, range in sizes from ½ to 25 hp., and in speeds from 900 to 1,800 r. p. m.

Riveters.—The Hanna Engineering Works, Chicago, has recently issued a 64-page illustrated booklet, Catalogue No. 5, fully describing the design and construction of its compression yoke riveters, which range in sizes from 4 in. to 21 ft. reach, and in capacities from 10 to 150 tons. These riveters are particularly adapted for use in the boiler, tank, structural, bridge, car, and steel shipbuilding industries.

Stools, Chairs and Factory Equipment.—The Angle Steel Stool Company, Plainwell, Mich., is distributing a 40-page illustrated catalogue, showing many patterns of angle steel constructed stools and chairs, including specially designed folding chairs for car usage and steel and wood seated stools and chairs of both the stationary and revolving types for the shop and office. Bench legs, chip pans, tote boxes, staves and trucks for shop use are also listed.

Mixing Coal.—In a 12-page illustrated bulletin, the Roberts & Schaefer Company, Chicago, present a number of excellent photographs and a description of the South Junction coaling station of the Delaware & Hudson, which was designed to mix anthracite and bituminous coal in delivering this coal from the track hoppers to the storage bin. Illustrations and brief descriptions are also given of other coaling stations recently built by this company on various railroads.

A Test of Integral Waterproofing.—In an eight-page folder issued by the Truscon Laboratories, a report is presented of tests made by Samuel R. T. Very, architect, on the increased impermeability of concrete containing an integral waterproofing compound. The report is presented in an entertaining way with no similarity to the exceedingly prosaic style commonly used in reporting such tests. The conclusions obtained are also presented in a concise way so that the busy reader has no difficulty in getting at the fundamental facts. As pointed out in the report, the tests were conducted so as to approximate as nearly as possible the kind of workmanship commonly obtained in actual concreting rather than that secured under laboratory conditions.

Oil Storage Systems.—An attractively prepared bulletin containing 49 8-in. by 10-in. pages devoted to oil storage systems has been issued by S. F. Bowser & Co., Inc., Fort Wayne, Ind. This bulletin is intended primarily for reference by railroad men who have to deal with the pumps, tanks and devices used in storing or handling oils, gasoline and other liquids. Clear-cut illustrations in color accompanied by appropriate descriptive data are given in various parts of the equipment, including agitators, agitator tanks, barrel-filling equipment, carload storage tanks, gravity-filling devices, measuring systems, oil pumps, mixing tanks, self-measuring pumps, signal oil pumps and out-pits, and many others. Several interesting illustrations are included of oil supply cars which are now in satisfactory service, effecting important economies in handling and supplying oils to outlying points. The bulletin explains the advantages of Bowser equipment in economy, convenience, safety, dependability and long service.

EQUIPMENT AND SHOPS

Locomotive Orders

The Savannah & Atlanta has placed an order for one 2-8-2 type locomotive with the Baldwin Locomotive Works.

The Toronto, Hamilton & Buffalo has ordered two 4-6-2 type locomotives from the American Locomotive Company.

Sul Miniera Rede de Viacao, Brazil, has ordered two 2-8-0 and six 4-6-0 type locomotives from the Baldwin Locomotive Works.

The California Western Railroad & Navigation Company has ordered one 4-6-0 type locomotive from the Baldwin Locomotive Works.

The Richmond, Fredericksburg & Potomac has ordered two 4-6-2 locomotives from the American Locomotive Company and two 4-6-2 type from the Baldwin Locomotive Works.

Locomotive Repairs

The St. Louis-San Francisco is to convert the passenger locomotives on its lines between St. Louis, Mo., Oklahoma City, Okla., Memphis, Tenn., and Kansas City, including all locomotives on suburban runs and also switching engines, to oil burners, and intends to complete the job by October 1. With this change 14 passenger engines will be released for freight service, since the oil burners will make longer runs.

Passenger Car Orders

The Havana Central has ordered 3 Mack gasoline rail motor cars from the International Motor Company for use on the United Railways of Havana.

The Missouri Pacific has ordered 18 coaches, 12 chair cars and 10 baggage cars from the American Car & Foundry Company, and 9 divided coaches, 3 cafe club cars and 8 dining cars from the Pullman Company.

Passenger Car Repairs

The Lake Erie & Western is having steel center frames and axle lighting equipment installed on 15 coaches in its shops at Stoney Island, Chicago.

The New York Central is making repairs to 10 coaches in the Collinwood, Ohio, shops. The improvements include putting steel underframes on these coaches.

Freight Car Orders

The Canadian National has ordered 1,000 automobile cars from the Pressed Steel Car Company.

The Wabash has ordered 75 steel underframes for freight cars from the American Car & Foundry Company.

The Chicago & North Western has placed an order with the General American Car Company for 1,000 stock cars.

The New York, Chicago & St. Louis has ordered 100 steel underframes for box cars from the Pressed Steel Car Company.

The General Sugar Company, New York City, has ordered 100 cane cars of 30 tons' capacity from the Gregg Company, Ltd.

The Mexican Petroleum Company has ordered 25 tank cars of 8,000 gal. capacity from the General American Tank Car Corporation.

The Standard Oil Company of New Jersey has ordered 12 50-ton steel dump cars from the American Car & Foundry Company.

The Chicago & North Western has ordered 50 center constructions for freight cars from the Western Steel Car & Foundry Company.

The Shell Company of California (San Francisco), has ordered 60 tank cars of 10,100 gal. capacity with 50-ton trucks from the Pennsylvania Tank Car Company.

The Pere Marquette has ordered 300 underframes from the Pressed Steel Car Company. These are to be used for refrigerator cars to be built in the railroad company's shop.

Freight Car Repairs

The Atlanta & West Point will rebuild 75 box cars in its shops at Montgomery, Ala.

The Pere Marquette ordered 25 steel center constructions for caboose cars, from the Pressed Steel Car Company.

The Carnegie Steel Company has ordered repairs to 22 gondola cars from the Tonawago Car Company, Warren, Ohio.

The Philadelphia & Reading has arranged for the repair of 500 steel hopper cars with the Standard Steel Car Company, at Middletown, Pa., and for the repair of 200 steel hopper cars with the Pressed Steel Car Company.

The New York Central has given a contract to the Standard Tank Car Company for the repair of 500 all-steel hopper cars of 55 tons' capacity for the Pittsburgh & Lake Erie, instead of for converting 500 old box cars to stock cars as was reported in the August *Railway Mechanical Engineer*. The conversion of the 500 box cars to stock cars will be carried out by the Standard Steel Car Company.

Machinery and Tools

The New York Central has placed an order for a 42-in. lathe.

The Texas & Pacific has ordered a five-ton hand power crane from the Whiting Corporation.

The Chicago, Burlington & Quincy has ordered one 20-ton locomotive crane from the Browning Company.

The Southern Pacific has placed orders for a 200-ton locomotive lifting crane and a 215-ton crane for its Los Angeles shops.

The Pere Marquette has placed orders for a number of tools including 3 axle lathes; a plate flanging clamp; 3 steam hammers of 1,500-lb., 2,500-lb., and 6,000-lb. capacity, respectively; a locomotive axle journal turning lathe; a 100-in. tire boring and turning mill; a 36-in. planer; a 36-in. slab miller; a 66-in. vertical miller; 3, 5-ft. radial drills; a two-spindle rod borer and some miscellaneous types of tools, including milling machines and lathes.

Shops and Terminals

Detroit Terminal.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the installation of an electric cinder handling plant at Detroit, Mich.

Kansas City Southern.—This company will rebuild its car repair shop at Shreveport, La., which was damaged by fire on July 11, with a loss estimated at $125,000, including equipment.

Pere Marquette.—This company has awarded a contract to the Arnold Company, Chicago, for the construction of a 16-stall brick roundhouse and the installation of a 100-ft. turntable at Erie, Mich.

Missouri Pacific.—This company has awarded a contract to the Folweil-Ahlskog Construction Company, Chicago, for the erection of a one-story, concrete boiler house adjacent to the new grain elevator at St. Louis.

Chicago & North Western.—This company has awarded a contract to the Howlett Construction Company, Moline, Ill., for the erection of a 200-ton frame coaling station, with automatic electrical equipment, at Waseca, Minn.

Union Pacific.—This company has awarded a contract to the Graver Corporation, East Chicago, Ind., for a 25,000 gallon per hour capacity water treating plant at Armstrong, Kansas, and a plant of the same capacity at Marysville, Kans.

New York, Chicago & St. Louis.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 700-ton reinforced concrete coaling station with automatic elevating equipment, at Conneaut, Ohio.

Lake Erie & Western.—This company has authorized the construction of improvements and additions to its shops at Lima, Ohio, at a cost of approximately $150,000. When the new facilities are completed, the Lima shops will constitute the largest repair shops on the consolidated Nickel Plate system.

Illinois Central.—This company has awarded a contract to the Graver Corporation, East Chicago, Ind., for the installation of water treating plants at Webster City, Iowa Falls, Parkersburg and Dixon, Ill. The company has also authorized the construction of a new 18-stall roundhouse and coaling station at Council Bluffs, Iowa, and has awarded a contract to the Howlett Construction Company, Moline, Ill., for the construction of a 500-ton reinforced coaling station at Central City, Ky.

Chicago, Rock Island & Pacific.—This company has authorized the construction of the following new facilities and betterments: Water treating plants at Cedar Rapids, Iowa; Albert Lea, Minn.; Faribault and Owatonna, Minn.; Fairbury, Neb.; Scandia, Kan., and Willard: a 400-ton coaling station and cinder pit at Rock Island, Ill., a 200-ton coaling station and cinder pit at Council Bluffs, Iowa, a 400-ton coaling station at Eldon, Iowa, and a 300-ton coaling station at Dalhart, Tex.; extension of four roundhouse stalls, replacing of a cinder pit and building a drop pit at Haileyville, Okla.; the construction of four new stalls and the extension of 13 stalls in the roundhouse at Shawnee, Okla.

PERSONAL MENTION

General

Leo Burke has been appointed master car builder of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn.

Eugene S. Marsh has been appointed general storekeeper of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, succeeding William Hunt, resigned.

O. T. Rees, assistant chief chemist of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., has been promoted to chief chemist, succeeding W. A. Powers, resigned.

H. W. Johnson has been appointed superintendent of motive power and rolling stock of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., succeeding William Gemlo, resigned. Lee Chapman has been appointed assistant superintendent of motive power and rolling stock, with the same headquarters.

J. E. O'Brien, manager of the mechanical department of the Seaboard Air Line, will hereafter be chief of motive power and equipment. Mr. O'Brien will, as heretofore, report to the vice-president and general manager; also to the president.

G. N. DeGuire has been appointed manager of the Department of Equipment, United States Railroad Administration, succeeding Frank McManamy, who has been appointed Interstate Commerce Commissioner. Mr. DeGuire was born at Appleton, Wis., on March 31, 1880. At the age of 17 he entered the shops of the Valley Iron Works, Appleton, Wis., as a machinist apprentice. After serving four years in that capacity, he entered the service of the Chicago & North Western at Kaukauna, Wis., as a locomotive fireman, and was promoted to locomotive engineman in 1905. Seven years later he was granted a leave of absence covering a large portion of each year and which extended over a period of four years, so as to permit him to visit the principal railroad terminals in the central and eastern parts of the United States for the purpose of making a study of shop and enginehouse operation and the construction and maintenance of locomotives and cars. Following this Mr. DeGuire arranged for and supervised a special course at the Chicago shops of the Chicago & North Western covering construction and maintenance of locomotive boilers. In 1916 he was appointed inspector in the Bureau of Locomotive Inspection in the Philadelphia district. On January 1, 1918, when the railroads were placed under federal control Mr. DeGuire was appointed general supervisor of equipment, division of operation, in charge of shop and enginehouse operation on lines east of Chicago, and was later promoted to assistant manager, department of equipment, which position he was holding at the time of his recent promotion.

Master Mechanics and Road Foremen

F. E. Hillman has been appointed assistant road foreman of engines of the Northern division of the Chicago Great Western, with headquarters at Rochester, Minn.

S. H. Bray has been appointed road foreman of engines of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Cal., succeeding C. W. Jones, who has been assigned to other duties.

C. B. Rogers has been appointed master mechanic of the Minneapolis & St. Louis, with headquarters at Marshalltown, Iowa, succeeding L. D. Brown, resigned. The position of master mechanic at Minneapolis has been abolished and Mr. Rogers' jurisdiction will extend over the entire system.

P. Campbell, assistant superintendent of motive power of the Chicago Junction, with headquarters at Chicago, has been appointed to the newly created position of master mechanic, with the same headquarters, and the office of assistant superintendent of motive power has been abolished.

Purchasing and Stores

G. A. J. Carr, division storekeeper of the Chicago, Milwaukee & St. Paul, with headquarters at Minneapolis, Minn., has been promoted to assistant district storekeeper, with the same headquarters, and will be succeeded by H. E. Rice, division storekeeper, with headquarters at Austin, Minn., who in turn will be succeeded by W. M. Glenny.

Obituary

M. S. Montgomery, fuel supervisor of the Northern Pacific, with headquarters at St. Paul, Minn., died in that city on August 8.

George A. Nolpe, grand vice-president of the Brotherhood of Railway Carmen of America, died in Cincinnati, Ohio, on August 11.

George L. Harvey, who was an early designer of steel cars and the inventor of the Harvey friction draft gear spring and also of a photographic apparatus, died in Chicago on August 13.

Albert B. Corinth, general inspector of the Atlantic Coast Line, with headquarters at Rocky Mount, North Carolina, died at his home on August 21. Mr. Corinth was born on January 2, 1854, at Philadelphia, Pa. He was educated at Girard College at Philadelphia, Pa., graduating with the class of 1870. He entered railway service on July 22, 1872, as apprentice on the P. & E. division of the Pennsylvania at Renovo, Pa. Since July 22, 1876, he had been consecutively six years in charge of cabinet shops of the Louisville & Nashville at Louisville, Ky.; one year in charge of freight car building with the Ohio Falls Car Company, Jeffersonville, Ind.; five years master car builder, Georgia division, East Tennessee, Virginia, and Georgia, at Atlanta, Ga.; three years in charge of freight equipment, Chicago & North Western at Chicago; three years in charge of the car department, Georgia Pacific division, Richmond & Danville at Birmingham, Ala.; six years foreman, car repairs, Southern Railway, Knoxville, Tenn. From January 30, 1900, to February 1, 1908, he was assistant superintendent Motive Power, Atlantic Coast Line, in charge of car department at Wilmington, N. C.; from February 1, 1908, to the day of his death he was general inspector of the same road at Rocky Mount, N. C.

A. B. Corinth

Railway Mechanical Engineer

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Charting Shop Organizations

The practice of drawing up charts showing the type of organization and manner of control has been common to industrial concerns for a number of years. Because of the type and character of work performed in the average railroad shop, the practice of charting such organizations has been limited to the larger railroads. In many shops the duties and scope of each officer, foreman and workman have been explained when they first start in the work of a new position, or in many instances the individual already knows from previous experience in the organization the scope and limits of activity of the new position that he is about to step into. Every now and then someone oversteps his authority and if this happens too frequently, friction between individuals and departments is bound to occur. It is not difficult to work up a chart showing the relationship between departments, the scope of activities and the limits of authority of various officials and department heads. Keeping such charts up-to-date will show up the weaknesses and shortcomings of the organization and indicate possible procedure to remedy such defects. Organization charts posted in offices and at various places throughout the shop will give the official and the men a visual understanding of what their duties are and their relationships to one another. Charts also tend to arouse a feeling of confidence in officers and men. They will shed light on many phases of shop organization and management that otherwise might remain in the dark.

Check Your Machine Operations

It will pay our readers to study carefully the report of the General Foremen's convention published elsewhere in this issue. The convention was addressed by James C. Davis, director general of railroads, and was highly inspirational in making foremen appreciate the importance of personnel problems and seeing beyond their own particular departments. In addition, many more tangible, if perhaps less generally important, practical suggestions were made regarding shop methods and devices.

In discussing machine shop work, Karl Berg, superintendent of the McKees' Rocks locomotive shops of the Pittsburgh & Lake Erie, said in effect that *foremen should constantly question if present machine methods are most economical.* This advice is sound and should be taken to heart by railroad shop foremen because, as pointed out by Mr. Berg, labor prices are subject to change; material prices are constantly changing; what is economical machine practice today may be costly practice tomorrow. The margin between what it costs a railroad to make certain articles or to purchase them is frequently small and, without a constant check on costs, articles may continue to be made in local shops when they could be bought for less money.

Mr. Berg also commented emphatically on several phases of the shop equipment situation to which the *Railway Mechanical Engineer* has given considerable attention in recent months. He explained the need of most railroad shops for more modern machine tools and labor-saving equipment in view of present high labor costs. He advised the more general use of manufacturing methods in large shops and centralized production departments where the manufacture and assembly of interchangeable parts present marked opportunities for economy. This is plainly a vital point and one deserving more attention in the future than it has received in the past. Not only can specialized high production machinery thereby be used with a favorable reduction in cost, but having these parts finished or semi-finished in advance insures the return of bad-order equipment to service with a minimum delay.

Elimination of Waste—Competition

Just three elements enter into the product of industry, whether it be manufactured articles, such as furniture and automobiles, or repaired and rebuilt locomotives and cars. They are material, the use of facilities, and labor. All three elements are placed at the disposal of the supervisor and the cost of his output depends on the efficiency with which he uses them. The last two resolve themselves into the use of time—the time of machines and the time of men. There are great possibilities for reducing waste in all three of these elements. Some of the causes of waste, particularly in the time element, are, it is true, not within the control of the railroads and certainly not within the control of the individual foreman or shop executive. The problem of unemployment created by periodical depressions, for instance, is one which will require the co-operative action of every part of our entire industrial system. But is there a railroad shop in which there are not still many opportunities for the better utilization of the time of facilities, or for making the time of employees more effective? Few shops have as extensive crane facilities as might be desired. Is it not possible, for instance, that a slight reorganization of the operations depending on crane service may reduce the waste of the time of these facilities at certain idle periods and make them much more effective? Are there not numerous cases where a few simple special tools or jigs have effected a marked conservation in the time of a lathe, a planer, a shaper, or a milling machine, as well as the time of the men operating it and the time of others whose work depends upon its output? Are there not also still many opportunities for reducing the waste of material, either by reclamation or by better shop practice? These examples do not begin to cover the wide range of opportunities that no doubt will suggest themselves to every one of our readers. What has been done in one shop may be highly suggestive of opportunities still available for further improvement in some other equally well managed shop. Therefore, to answer these questions and to make our columns a clearing house for the most productive methods of conserving material and time, we are offering a first prize of $50 and a second prize of $35 for the two best articles received on or before November 15, telling of actual instances of the elimination of such wastes. The prizes will be awarded on the basis of the constructive value of the suggestions contained in the articles submitted. The articles should be specific and accompanied by illustrations wherever possible. Articles to which prizes are not awarded, but which are used in our columns, will be paid for at space rates. Don't miss this opportunity to be of real service to your industry.

What About the Standard Box Cars?

The attempt to establish standard box car designs, with the single exception of the establishment of uniform standard time, is probably the biggest project ever undertaken by the American railways, acting together voluntarily through the American Railway Association. The project has now been brought to completion in the standard box car designs placed before the Mechanical Division at its annual meeting in June, and it only remains to be seen whether or not the effort has been in vain after the returns from the letter ballot now in the hands of the members have been counted.

It is not the purpose of the *Railway Mechanical Engineer* to enter into a discussion of the details of the design. As stated in these columns last month, no question has been raised but that the general designs will produce good cars. Just how good, relatively, will remain a matter of controversy until the question is settled by experience over a considerable period of service with large numbers of the cars built from these designs. It is evident beyond a doubt, however, that the designs do represent a balancing of the various opinions as to what are the most important requirements to be met in box car construction, including such factors in the problem as price, strength and weight. The members of the committee that developed and presented these designs were chosen to represent all sections of the United States and Canada, and collectively represent the ownership of at least two-thirds of the freight car equipment of America. Furthermore, on this committee were representatives of railroads that are diametrically opposed in their policy with respect to the relative importance of the greatest strength on one hand and the least possible weight on the other. It may be concluded, therefore, that the acceptance of the designs as they now stand will require as little compromise on the part of the members of the American Railway Association as any designs that could be developed by the Car Construction Committee, either with its present or an entirely new personnel.

In voting for or against the adoption of these designs, the question is not one to be settled purely on the basis of the selfish interests of each railroad. The real question is what advantages do these designs offer to the railroads as a whole in return for the sacrifice of certain individual opinions as to the merits of the details of the committee's designs.

In the first place, it offers the large number of railroads that have no mechanical engineering departments, or departments of limited capacity, highly developed designs from which cars can be secured advantageously in numbers large or small. In time the use of these designs by such roads will relieve the large systems handling traffic in heavy volume of much of their present difficulty with weak cars in interchange. Their use will also ultimately greatly facilitate the shopping of cars whenever and wherever they need attention away from home.

But, considering the matter from the interests of the individual railroads, the proposed designs give practically unrestricted freedom to each railroad in the selection of specialties. This leaves the field open for free competition in the commercial development of the important details, such as roofs, ends, draft gears, and the truck details which have not already been standardized. This is important to the railroads collectively as well as individually since dependence must be placed on the companies in the supply field for the commercial development of improvements in all these important details, even though the ideas for the improvements may originate in the railroad service.

The *Railway Mechanical Engineer* believes that the interests of the railroads as a whole can best be served by the adoption of these designs. The railroads will thereby have accomplished their long established purpose and will have demonstrated their ability to co-operate toward constructive ends. With this ability demonstrated, a standard design for other types of cars, such, for instance, as the double-sheathed box car of composite construction, can be developed by the Car Construction Committee with reasonable assurance that such further effort will not be wasted.

The Apprentice Competition

The two apprentice competitions, one for regular apprentices and the other for specials, or college graduates, closed on September 1. Both of them were a decided success. No competition that we have ever held has brought out as many contributors as did the competition for the regular apprentices. Because of the great number of manuscripts which were received the judges have as yet been unable to make a decision as to the prize winners for this class.

Naturally, fewer contributions were received in the competition for special apprentices. The judges have awarded the first prize to Dale C. Sheffield, a special apprentice on the Chicago, Milwaukee & St. Paul at Bedford, Ind., and a graduate from the engineering department of Montana State College. The second prize goes to Roy Eckart, a special apprentice with the Atchison, Topeka & Santa Fe, at Raton, N. M., and a graduate of the Kansas State Agricultural College. Two other contributors pushed Mr. Eckart so hard for second place that the judges have asked that they be given honorable mention. These men are Alfred H. Burnham, Jr., special apprentice on the Baltimore & Ohio, at the Mt. Clare shops, Baltimore, Md., and a graduate of the School of Engineering of Johns Hopkins University; and E. B. Fields, a special apprentice on the Atchison, Topeka & Santa Fe at Albuquerque, N. M., and a graduate of the mechanical engineering department of Pennsylvania State College.

All four of these articles will be published in the *Railway Mechanical Engineer.* Some of the suggestions which are made are excellent and should help the railroads to make better use of college graduates. The contribution by Mr. Burnham will be found elsewhere in this issue. It is published first, and before the prize winning contributions, only because the illustrations for use with the other articles were delayed and those for Mr. Burnham's article were the first to come to hand.

If Mr. Burnham's point of view is a typical one for recent graduates from schools of engineering, it would indicate that a considerable change has taken place in transferring the emphasis in university engineering training from purely technical things to those which concern the human element. There is no question but that the last quarter of a century has shown a marked change in this respect and it argues well for the future. If the college trained man is to go to the top and exert the influence which he should in railroading, he must have a thorough appreciation of this whole problem of human relations in industry. It is important, also, that those who have to do with the training of college men on our railroads should appreciate this modern point of view.

The practical suggestions in the contributions all indicate that the special apprentices are ready to accept a larger responsibility than is usually placed upon them. They feel that their training is such as to entitle them to this, at least if they are to be developed as quickly and as broadly as would seem advisable in the best interests of the railroads. Might it not be a good idea if those who have charge of the development of college trained men, were to spend some time in finding out just what training they have received at college and just how this can best be supplemented on the railroads, in order to make the best use of them? Some of us who were graduated from college not so many years ago, do not recognize the changes and improvements that have been made in engineering college courses in recent years. Possibly the suggestions which will be found in the four articles from the special apprentices, which will be published in this and succeeding issues, will help to give a better idea of how these young men are being prepared in these days.

Standard Cutting Tools

Two of the most important points brought out in the International Railway Tool Foremen's convention, are the need for greater production in railroad shops, and the toolroom's function in providing proper tools so that this high production can be obtained. Tool foremen ordinarily are not credited with much interest in shop output and it was especially gratifying, therefore, to note how many members of the association commented on the need of co-operation with all the other shop departments in developing tools and jigs which will speed up the work. Obviously, no railroad shop can function as efficiently as it might with any single department failing to measure up to its share of the responsibility.

Railroad shop toolrooms, as pointed out by several tool foremen, can be a vital factor in the output, particularly of machine departments, by supplying sharp cutting tools for lathes, planers, shapers, etc., ground to the correct shape for most efficient cutting. For a given set of conditions of machine, speed and material to be cut, there is one combination of cutting tool rake, side slope and clearance which will give the best results. And yet almost no two so-called practical machinists will agree on what those angles should be. In shops where this subject has not been studied and worked over, tools will be found in service with as many different angles as there are machinists. Some of these are bound to be wasteful in power consumption and time required for the operations, and they also frequently turn out a poor quality of work.

One of the papers read at the Tool Foremen's convention, appearing elsewhere in this issue and freely giving credit for much of the information to F. W. Taylor's book, "The Art of Cutting Metals," proposes a set of standard rake, clearance and side slope angles, which have been used with marked success on several roads, notably the Santa Fe. Tools are ground to these standard angles by means of a set of template gages, which are illustrated in the article and deserve the careful consideration of machine shops and tool foremen throughout the country.

In addition to better work, decreased time and power consumption, secured with these standard cutting tools, they can be made in quantities at reduced manufacturing cost and shipped to various points on each system. They can also be kept on hand at local toolrooms and distributed at regular intervals to machine operators in place of dull tools, thus eliminating idle machine time caused by operators grinding their own tools. It usually proves a real saving to have a boy or special man, assigned to this work, make a round of the machine shop once or twice a day, supplying machine operators with freshly-ground tools in place of those which are dull, the latter being brought back to the toolroom and reground to the standard shape by a grinding machine operator, who becomes rapid and expert on this work.

What Our Readers Think

Modern Motive Power and What Should Be Accomplished in Research Work

Chicago.

To the Editor:

The proceedings of the Mechanical Division of the American Railway Association as given in the July issue have been read with interest. While the committees followed the trend of actual accomplishments of the preceding year, yet it seems necessary for the foremost engineers of the country to get together for the purpose of discussing the designs of modern motive power. We are at a point now where we have reached the limit, and at times have exceeded the limit, of locomotive construction along conventional lines. The simple reciprocating engine has played its part well and will probably be used for a long time to come, but is there anything being done that is a radical departure for the better? Modern electrifications with current generated by water power are rapidly developing with a general outlook for the future but still there is a vast field for modern motive power reconstruction and research. There seems to be a tendency of trying to improve our present standards of power by equipping them with all sorts of appliances which will produce some slight economy—safety devices, labor saving devices, etc., and while it is generally acknowledged that with the applications of such devices there is some gain in the efficiency and economy of a locomotive, yet this is not starting from the fundamental principles of reconstruction. It seems as though the railroads were afraid of modern research, which would end ultimately in enormous savings, smoother running and lighter power.

Today everything is sacrificed to maintain present standards of motive power to haul tonnage. This is desirable as far as our present analysis of operation is concerned. But the future—are we looking far enough ahead in order that modern engineering may benefit the railroads? What we are interested in nowadays is mostly weight on rail, tractive force and tonnage hauled over heavy grades. The larger the locomotive, the better it is liked—until the rails start to give way and the cost of maintenance increases to such an extent that it is finally decided that they are too large economically to be effective.

There is no question that we will have to make some radical changes sooner or later, already some steps are being made in the direction towards lighter power by analyzing the journal bearing situation. Some good results have been obtained in Sweden, England and in this country with roller journal bearings. Other questions to be thoroughly studied are the modern methods of exhaust steam condensation for maximum economy, induced draft, the application of the turbine, the Diesel engine, and the turbo-electric engine. Considering the complicated machinery and the results of the initial trials, there is no question in my mind that results can be obtained if the railroads would put heart and soul into these things and develop a research organization of the highest grade. W. B. Storey, president of the Santa Fe mentioned this in his address before the American Railway Association. There is an evident need for this kind of work. The American Railway Association meeting followed the labor situation very closely, but with the exception of more modern facilities for the handling and repairing of motive power, we are, and will remain in the same predicament in relation to the labor organizations for a long time to come. Good engineering can cut down the cost of labor, and in my opinion is better than experimenting with employee organizations.

Much has to be done in the future and the sooner it is started the quicker will be the benefit to public service and the railroads.

E. Gelzer,
Leading Locomotive Designer, Illinois Central.

New Books

Proceedings of the Air Brake Association 1923. *Edited by the secretary, F. M. Nellis, 165 Broadway, New York.* 285 *pages, bound in leather.*

This book contains the proceedings of the Thirtieth Annual Convention of the Air Brake Association which was held in Denver, Colo., May 1, 2 and 3, 1923. The reports submitted cover Expediting Train Movement; Charging Freight Trains; Causes for Slow-Acting Air Compressors; Feed Valve Tests; Relation of Train Control to the Air Brake; Service Records and Maintenance Costs; Standardization of Air Brake Repairs; Laundering Air Compressors, and Maintenance of Air Compressors.

Proceedings of the Master Boiler Makers' Association 1923. *Edited by the secretary, Harry D. Vought, 26 Cortlandt street, New York.* 120 *pages, 6 in. by 9 in. bound in cloth.*

This book contains the proceedings of the Fourteenth Annual Convention of the Master Boiler Makers' Association which was held in Chicago, May 22 to 25, 1923. The reports submitted included Hammer Testing of Staybolts; Maintaining Combustion Chamber Boilers; Finished Plates; Detecting Defective Boiler Sheets; Automatic Stokers; Method of Applying Flues; Life of Superheater Tubes; Steam Leaks; Recommended Practices, and Care of Stationary Boilers.

Fire Losses—Locomotive Sparks. *By L. W. Wallace,* 203 *pages, 6 in. by 9 in.,* 111 *illustrations, bound in leather. Published by Barr-Erhart Press, New York.*

Comparatively little has been printed on the subject of fire losses from locomotive sparks and means for minimizing such risks. The need of spark arresters, however, was appreciated even during the early development of the steam locomotive. One portion of this book describes their evolution up to the present day. Valuable contributions to the knowledge of spark arresters was obtained from the experiments made at Purdue University in 1902, the results of which were embodied in a book entitled Locomotive Sparks, by W. F. M. Goss, and also from the report to the Railway Master Mechanics' Association in 1906. Since that time a number of laboratory and road tests have been conducted which have furnished considerable new data. This information has been placed in book form and is now available for the first time. Additional material on the subject of spark fire prevention and regulation of railroad fire hazards has been included which will be of interest to those desiring a knowledge of the subject.

The Electrical Handling of Materials, Volume Four, *by H. H. Broughton, Member Institute Mech. Engrs., Member Institute Elec. Engrs., etc.,* 1923. 334 *pages, 8⅛ in. 10½ in. Bound in Cloth. Published by Ernest Benn, Ltd., 8 Bowverie St., E. C. 4, London.*

The volume is the final one of four on the design, construction and application of cranes, conveyors, hoists and elevators. The present book concerns itself with machinery and methods. There are 12 chapters in the book which bear the following titles: Elevators and Conveyors, Belt Conveyors, Automatic Feeders, Handling Materials Automatically with Skip Hoists, Lessons from America in Bulk Handling of Materials, Handling and Storing of Grain, Suction System of Discharging Grain, Handling and Storing of Coal, Ore, and Similar Bulk Materials, Handling and Storing of Coal, Ore, and Bulk Materials (continued), Belt Shipping Plants, Panama Coaling Stations and Handling of Foodstuffs and General Merchandise. The above outline is significant of the wealth of material which the book contains. There are 279 illustrations showing in great detail the design and application of the various equipments described. A large number of tables are also included which give specific information concerning the numerous details of the many different kinds of belt conveyors, bucket hoists, elevators, etc.

Laminated Springs. *By T. H. Sanders.* 519 *pages, 6 in. by 9 in.,* 282 *illustrations, bound in cloth. Published by the Locomotive Publishing Company, Ltd., London, and Spon & Chamberlain, New York.*

As far as we are aware, this is the only complete treatise on laminated springs which has been published in English. The book is divided into two parts, the first being devoted to the subject of calculation and design and the second to manufacture. In the first half, the subjects taken up include stress and strain, elasticity, deflection, formulas, testing, thickness and lengths of plates, finish of ends, center fastenings, resiliency and weight, periodicity, and methods of making necessary calculations. The second half treats of questions relative to the character of spring steel, analysis, work in the forge shop, fitting and heat treating, banding and finishing, together with illustrations and photographs of machinery and other equipment used in spring manufacture. The book is thoroughly illustrated both by drawings and photographs, and contains a very complete index. While the treatment of the subject matter is somewhat more inclusive of British practices, considerable space is also given to American and European practices and equipment. The book should prove of material value to those responsible for the design of elliptic and semi-elliptic springs used on locomotives, passenger cars and automobiles, as well as to the shop man having oversight of the manufacture of such springs.

Kent's Mechanical Engineers' Handbook. *Robert T. Kent, editor-in-chief. Tenth edition;* 2,247 *pages, 4¼ in. by 7 in., illustrated. Bound in morocco. Published by John Wiley & Sons, Inc., New York.*

Kent's handbook needs no introduction to the engineering public, particularly in the mechanical field. Since the first edition was published in 1895 and throughout the succeeding eight editions, it has been widely used as a practical reference book of engineering data. These editions have largely been revisions of the material in the first edition, with the addition of new material from time to time as the scope of the mechanical engineering field changed and broadened. The result has been the gradual development of a lack of balance of the material in the book, some divisions of the science which 28 years ago held first rank now being of relatively minor importance while other divisions have taken their place. In the present edition the book has been completely rewritten by a large corps of contributors each chosen for his fitness to select and prepare the material for one of the sections. The editor-in-chief is the son of the late William Kent, the founder, and he has followed the latter's fundamental ideas that this be a book of engineering practice rather than engineering theory. Among the new subjects appearing for the first time in this edition are Aeronautics, Automobiles, Heat Insulation, Reinforced Concrete, and Safety Engineering and Machine Design. Many other sections have been rewritten so as to be practically new. The book contains over 50 per cent more matter than the previous edition. It has been carefully edited to insure the greatest practical convenience in the user.

Left: Electrical and Mechanical Engineering Building and Part of Civil Engineering Building, Johns Hopkins University. Center Same Buildings from Gilman Hall Portico. Right: Gilman Hall and Quadrangle

Opportunities for College Graduates

Also Suggestions as to How Railroads Can Make the Best Use of These Men

By Alfred H. Burnham, Jr.*
Special Apprentice, Baltimore & Ohio, Mt. Clare Shops, Baltimore, Md.

Alfred H. Burnham, Jr.

THE college graduate has had roughly 16 years of schooling. Taking the average of the class and leaving out the two extremes, *i.e.*, the loafer who just skins through, and the leader of the class scholastically, one finds a boy who is a worker and who is ambitious. During these 16 years he has been busy acquiring knowledge from books, and he has missed the thing that the boy who quits school early in life has obtained—rubbing elbows with the wage earning world.

Opportunities

Three opportunities present themselves to the college graduate who enters railroad service:

First, the opportunity of rubbing elbows with industry.

Second, the opportunity of studying labor as a class and human nature individually.

Third, the opportunity of studying industrial organization.

The first is important because it is necessary that he take stock of himself. He soon learns that pluck and grim determination are two of the best assets he must have to win success in the railroad field, with its vast number of employees and the hard work attached to it.

It is vital for him to recognize the second of these opportunities, because in any field, and particularly the railroad field, a thorough understanding of the attitude of labor as a class, and his individual attitude is necessary. My point is this: He has set before him a goal which means that sooner or later he will be in some position as one of the executives of the road. He will be a failure in that position if he does not have the ability, from his study of human nature, to get co-operation from those under him down to the last man. Co-operation will bring results. The opportunity to do this is always present, whether in normal times, or when labor is stirred with strikes and unrest.

Assume that he avails himself in every way of the second opportunity, he will not make much headway, if he overlooks the third opportunity; *i.e.*, that of studying the organization of which he is one little member. Most probably he finds himself in one of the repair shops of the road, and his opportunity to study and learn the shop methods and the whole system of shop management is always present. After knowing the existing methods, he will be able to see and make good suggestions for improvements. His study is made much easier under an organized apprentice system, due to the fact that he moves in regular sequence through all the shops and departments.

A college apprentice, or, in fact, any apprentice, has offered to him all the past experiences of the men who have gone before him—this in the form of an apprentice organization with some of these men behind it. Based on their experience, these men plan for him schedules and assign him to places where they think he will get the most necessary and most important information appertaining to the work of the mechanical department. If experience of others counts for anything to an apprentice, then this is certainly a *real* opportunity.

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*Graduate of Johns Hopkins, School of Engineering, Class of 1922.

An apprentice under such a system has unlimited opportunities for advancing himself, his ability developing with time and with what he puts into his studies. Furthermore, such plans make the earnest apprentice feel a responsibility always to do his best, in view of the effort that is behind him to give him an opportunity to learn.

What the Railroads Can Do

How can the railroads best use the college boy apprentice? Looking back again to this boy in school, it is discovered that during the 16 years he has acquired the habit of thinking out problems for himself. This asset he brings with him to the railroad. After a reasonable period has gone by in which his "stick-to-it-tiveness" has been tested (for some weaken and quit because the road seems too hard and too long), give him a job that will require him to do some of this thinking to which he has been accustomed. In the first place it will keep him more interested in his work, and, second, it makes him feel like a part of the organization. Not that he has not been thinking. He has. But give him a job that will make him feel that some one higher up is holding him responsible for something that he must work out himself.

To illustrate: The test department of a certain railroad was running tests on a number of rebuilt Consolidation locomotives. It so happened that that department was very busy and no men were available to work up the data which were accumulating from the dynamometer car. The head of the department sent to the shops and obtained two special apprentices who had been there quite some time. He gave them instructions and explained the method for submitting the reports and data, and the rest was up to them. The result was that the men were pleased and contented with their work. In addition to this, they acquired considerable information as to the respective merits of the old and the new class of locomotives. They also felt, through their conferences with the department head, that they were a part of the organization.

Here is another instance in which the results were just as favorable: The shop order bureau wanted an investigation of production in the forge shop. A special apprentice was detailed to do the job. He was greatly pleased with the opportunity of learning something about the forge shop production methods.

The answer, therefore, to the question of how the railroads can best use the college boy apprentice is to give him the job that is a little different and requires a touch of his own personality. He will try hard, he will give his best, and will be a most loyal employee. He has been trained to do so.

[This article received honorable mention in the Special Apprentice competition. For the prize winners, see the editorial on page 674.—Editor.]

The new type of condensing locomotive designed by David M. Ramsay, a Scottish engineer, has attained a speed of 60 miles per hour over short runs and pulling heavy loads, according to the Times (London). The steam is generated at a boiler pressure of 200 lb. per sq. in. and superheated 300 deg. F. It is then passed through a turbine and on to the condenser, whence it is pumped back as water into the boiler, so completing the cycle. A second engine of the kind is to be constructed.

Oil Burner Control Connections

By E. P. Hill

Central of Georgia, Savannah, Ga.

On oil-burning locomotives a number of levers, rods and joints are required in the connecting mechanism between the fire control handle in the cab and the valve which supplies the oil to the burner located in front of the firebox. To insure accurate control of the oil supply, lost motion in these connections must be kept at a minimum and this adds to the cost of maintenance and to the attention required at terminals. An arrangement which has been in successful operation for a number of years with practically no expense for maintenance and adjustment is shown in the accompanying illustrations.

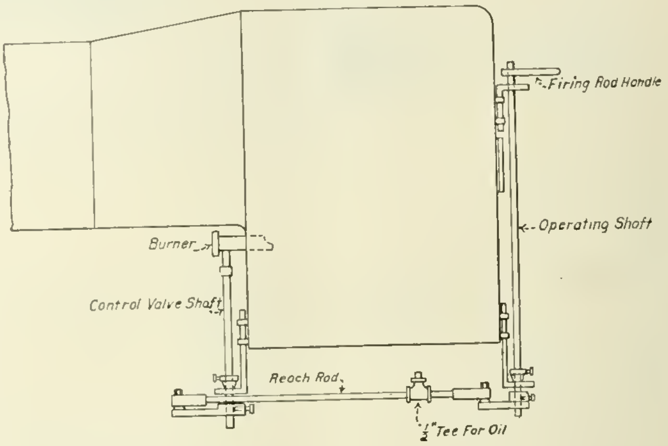


Fig. 1—General Arrangement of Oil Burner Control

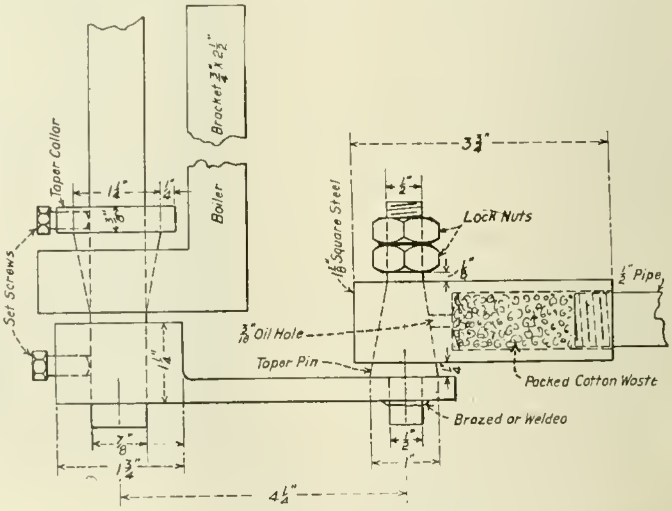


Fig. 2—Details of Construction

The essential feature of this control mechanism is the use of lubricated taper connections, which take care of such lost motion as may develop from constant use. As will be noted, taper bushings (held by set screws) are used on the operating and control valve shafts and taper pins are used to connect the reach rod to the arms on the two shafts. The reach rod is of ½-in. extra heavy pipe with ends made from $1\frac{1}{8}$-in. square steel. These ends are hollow and packed with cotton waste. A tee, located at a convenient point in the reach rod, is used for filling it with oil. The employment of waste prevents the oil passing with too great rapidity to the 3/16-in. holes leading to the pin bearings and still supplies enough for ample lubrication. A single filling of the reach rod with a half pint of engine oil is sufficient to last three months. The taper pins have a clearance of from ¼ in. to ⅜ in. between the reach rod end and the lever arm and from ⅛ in. to 3/16 in. clearance between the nut and the top of the end header, which permits of free operation.

American Locomotive a Success in France[*]

Two-Cylinder Superheater Simples of Pacific Type More Efficient Than French Compounds on Paris-Orleans Railway

By M. Lunier

Inspector of Equipment, Paris-Orleans Railway

The Paris-Orleans railway in 1921 placed in service 50 Pacific type locomotives with simple cylinders and equipped with superheater. The purchase of these locomotives, which had been deferred until after the summer season of 1920, was decided upon at that time to meet the resumption of express service beginning with the summer of 1921. Because of the quick delivery required, the order was entrusted to the American Locomotive Sales Corporation.

The design was worked up by the engineers of the American Locomotive Company with the collaboration of representatives of the Paris-Orleans railway, with the object of introducing in the American type the detail arrangements which are standard on the Paris-Orleans line and necessary in view of the operation as organized on this line.

The locomotives, No. 3591 to No. 3640, are of the Pacific type, with 76¾ in. driving wheels, 38¼ in. leading truck wheels and 48¾ in. trailing truck wheels. They are simple expansion with two outside cylinders and use superheated steam.

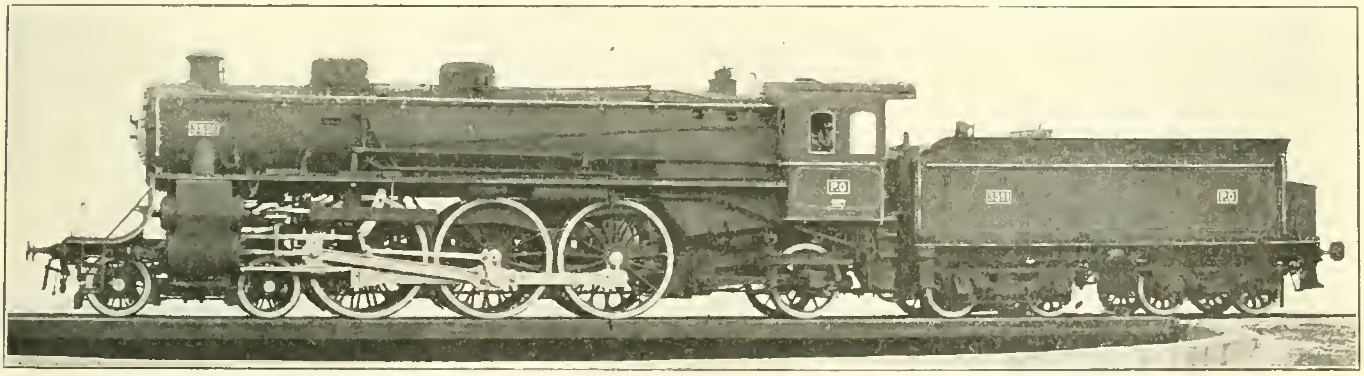
The boiler is of the straight-top type with entire firebox of steel plate. The staybolts are of iron and drilled at the two extremities with a ¼ in. hole. The firebox crown is radial and is supported by radial stays, having a ¼ in. hole through their entire length. Flexible staybolts to the number of 515 are applied on the four sides of the firebox, located in the zones where breakage ordinarily occurs. The three front rows of crown stays are flexible.

The fire door is in three sections and opens upward toward the interior of the firebox. This door has been applied since 1907 on powerful locomotives with large grate area on this road. The rectangular grate is of the rocking type, formed of four sections.

The safety valves are two in number, 4½ in. in diameter, and of the Coale type. The water is fed to the boiler by two vertical Nathan No. 10 automatic restarting simple non-lifting injectors. The water enters the boiler at the top near the front tube sheet, the delivery pipes ending in the steam above plates with tooth edges. The water gage is of the Klinger type with valves which can be operated at a distance.

The throttle is a balanced valve placed in the dome. Under the throttle a water separator is installed, the function of which is to throw back into the boiler before its entrance into the throttle the water which might be carried up in the steam.

The variable exhaust nozzle is of the Nord type. The smokebox is supplied with a basket netting in two parts held by keys, which permit it to be taken down rapidly. The superheater is of the type furnished by the Superheater Company. The damper has been omitted, as has been done for several years on all superheated engines on this road.



Fifty American Built Locomotives of This Design Are in Service on the Paris-Orleans Railway

The frames are of the American bar type. In the manner of supporting the boiler, spring suspension and equalization as well as in the design of leading and trailing truck American practices also are followed.

The cylinders are furnished with a by-pass valve operated by a steam cylinder for running with closed throttle. They also are provided with vacuum valves placed on the steam chests and with relief valves attached to the cylinder heads. The piston valves are of the type used on the Chemin de Fer de l'Est and have inside admission. The piston rod and valve stem packing is of the Sullivan type. The cylinders are lubricated by a Detroit five-feed hydrostatic lubricator; two feeds go to the steam pipes a little above the steam chest, two others go directly to the cylinders. The fifth feed takes care of the lubrication of the air compressor. The valve motion is the Walschaert type, with a screw reverse gear.

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[*] Translated and abstracted from an article in the July, 1923 issue of the French publication Revue Generale des Chemins de Fer et des Tramways.

The pistons have three rings and are screwed onto the piston rods. They have a piston rod extension, with guide, of the Coale type. The crossheads, of the alligator type, are of cast steel. The heads of the main and side rods are of the European type with solid ends and are equipped with an adjusting wedge for taking up the wear.

A cylinder brake is employed and, to permit running against steam pressure, the locomotives are equipped with two valves—one for the admission of steam into the exhaust passages of the cylinders, the other for the admission of water into the steam chests. The automatic air brake is of the Westinghouse type, operating on all the wheels with the exception of those on the trailing truck. The braking effort is 65 per cent of the weight on the rails for the driving wheels and only 40 per cent for the engine truck wheels. The straight air brake operates only on the locomotive and tender.

The locomotives are equipped with the following apparatus and specialties: A Hausshalter speed indicator and recorder; a Lambert sander, which sands in front of the second pair of drivers, and a hand sander to sand in front of the first pair of drivers; a steam heat apparatus with Mason reducing valves and flexible connections of the Westinghouse type, also a cleaning valve for the smokebox and one for the ash pan.

The accompanying table gives the principal characteristics of the locomotives and tenders.

Principal Characteristics of Locomotive

Boiler pressure	171 lb.
Grate area	50.6 sq. ft.
Heating surface, firebox	154 sq. ft.
Heating surface, tubes	2,248 sq. ft.
Total heating surface	2,402 sq. ft.
Superheating surface	775 sq. ft.
Ratio total heating surface + grate area	47.5
Length of tubes between sheets	19 ft. 10½ in.
Tubes, number and diameter	165—2 in.
Flues, number and diameter	26—5⅜ in.
Cylinders	24.4 in. by 25.6 in.
Diameter of driving wheels	76¾ in.
Diameter of engine truck wheels	38¼ in.
Diameter of trailing truck wheels	48¾ in.
Driving wheel base	13 ft. 4 in.
Total wheel base of engine	36 ft. 7$\frac{11}{16}$ in.
Weight in working order—	
On drivers	116,500 lb.
On front truck	47.500 lb.
On trailing truck	37,000 lb.
Total engine	201,000 lb.
Tender	120,600 lb.
Tender—	
Water capacity	5,812 gal.
Coal capacity	6.6 tons

The stability has been perfect at speeds which have reached 77½ m. p. h. and on runs of 62 m. p. h. average speed. This average speed has been reached at different times without experiencing a "nosing" or vibration any greater than that which is observed on the four-cylinder compound locomotives.

One of the most interesting peculiarities of these Pacifics is the reduction of frictional resistance which they show in relation to compound locomotives. The chart, Fig. 5,* gives a clear idea of this and shows conclusively the superiority in this respect of the two-cylinder superheater machine over the four-cylinder machine.

In regular service, these machines give the best of results. Their fuel consumption is slightly lower than that of the compound machines used in the same service, as is shown in the following table, which gives the fuel consumption in regular service recorded for compound superheater Pacifics and for the simple expansion superheater Pacifics described. The locomotives chosen for this comparison were in the same state of good repair and had made from the time of coming out of the shop to the beginning of these records, practically the same mileage (25,000 miles). They were in the same service and driven by crews of equal skill. Neither one of the two types was equipped with feedwater heater.

Locomotive number	Type	Kilometers run	Metric ton km. engine and train	Fuel consumption kg.	Average consumption per 100 ton km. kg.
3,537	Compound	7,809	4,118,439	112,450	2.73
3,539	Compound	7,588	4,094,268	112,740	2.75
	Average for the compound locomotives				2.74
3,632	Simple	7,939	4,377,974	108,130	2.47
3,629	Simple	7,694	4,001,415	110,070	2.75
3,638	Simple	8,436	4,515,289	112,070	2.48
3,636	Simple	7,981	4,157,723	100,990	2.43
	Average for the simple locomotives				2.53

The allotment of fuel to the enginemen for the two-cylinder locomotives is 5.26 per cent less than that for the four-cylinder compound superheated locomotives.

It should be noted that these locomotives, in which the superheating surface is 775 sq. ft. against 684 sq. ft. for the four-cylinder compound locomotives with which they are compared, operate in general with a temperature of superheater steam at the admission to the cylinders higher than that which can be obtained with the compound.

During the comparative tests made in July and August, 1921, the average temperature of the superheated steam was 642 deg. F. on the simple locomotive and only 556 deg. F. on the compound locomotive for identical trains. This temperature was measured by means of a Fournier pyrometer of the most recent type, having in place of the old cylindrical reservoir with a protecting bushing, a reservoir formed of a helical tube plunged directly into the current of steam.

These locomotives require very little maintenance and are greatly appreciated on this account by the engine drivers and master mechanics.

These tests confirm the results obtained by American railroads with two-cylinder Pacific locomotives. This type promises excellent service on French roads. These locomotives are simpler and have a smaller resistance to movement than the four-cylinder compound locomotives. Their maintenance is easier. As to their fuel consumption, it has been less but it may be that they owe this superiority to their higher superheat. At an equal superheat, it would seem that the consumption of these two types of machines would be substantially equal, the theoretical advantage which their better expansion gives to the compounds, being overcome by the increase in resistance caused by the four cylinders.

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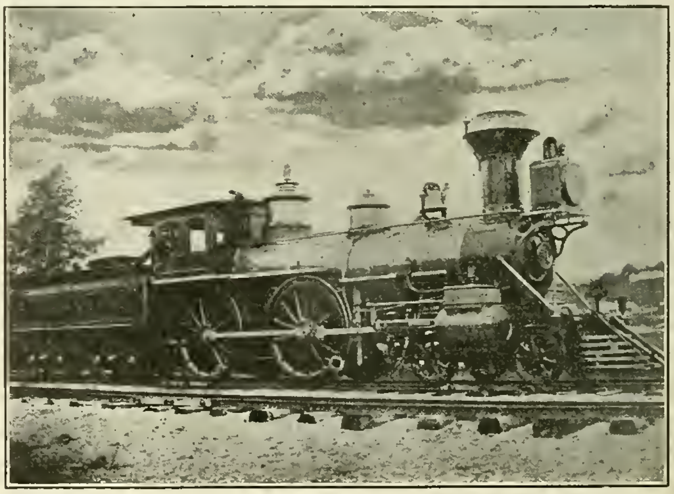

Published by Courtesy of the Railway and Locomotive Historical Society.

B. & M. Locomotive "Saxon" Equipped with Magoon Feedwater Heater Operated from Crosshead. Used Between Boston and Exeter About 1874

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*Chart, not reproduced, shows an increased resistance for the compound locomotive ranging from 20 per cent at low speeds to 13 per cent at high speeds.

Traveling Engineers Hold Live Meeting

Convention at Chicago Emphasizes Economies in Long Engine Runs and Feed Water Heaters

TWO of the subjects which received most attention at the thirty-first annual convention of the Traveling Engineers' Association, held at the Hotel Sherman, Chicago, September 11 to 14, inclusive, were the economies possible by extended locomotive runs and the extended use of feed water heaters. The program was broad, however, and other subjects of vital interest to traveling engineers and highly essential to the efficient handling of railroad motive power were discussed at length. The convention was featured by addresses by Frederick Kerby (B. & O.), president of the association; G. M. Basford, Lima Locomotive Company, and J. W. Scott (B. & O.), general superintendent, West Virginia district.

Election of Officers

In accordance with the usual custom the officers of the Traveling Engineers' Association were advanced, the officers elected for 1924 being as follows: President, T. F. Howley (Erie); first vice-president, W. J. Fee (Grand Trunk); second vice-president, J. N. Clark (Southern Pacific); third vice-president, J. B. Hurley (Wabash); fourth vice-president, J. D. Heyburn (Frisco); fifth vice-president, James Fahey (N. C. & St. L.); treasurer, David Meadows (Michigan Central). Four members of the executive committee were retained, J. C. Simino (Southern Pacific) being elected to take the place of James Fahey, who was made fifth vice-president.

President Kerby's Address

In his opening address President Kerby spoke in part as follows:

One year ago today all of our railroads were in the midst of one of the largest strikes in their history. During the strike the motive power and rolling stock reached the worst condition we have known for some time, just when the country was most in need of good equipment to handle its heavy business. But the roads have now recovered and have handled the largest business in their history. This was brought about by peace and the co-operation of all interested as well as by the energetic and economical management of the officers, in which the members of this association deserve some of the credit for the part they have taken.

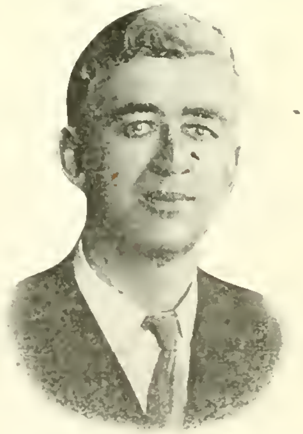
The railroads loaded more than four million freight cars in both May and June of this year, the heaviest traffic ever carried by American railroads in a similar period. Despite the record-breaking movement, the number of freight cars in good repair and immediately available for use continued to increase, so that on July 31 a surplus of 76,453 serviceable freight cars was recorded. Team work and co-operation among the railroads and the shippers, and among the men within the various organizations, brought this about.

To meet the heaviest transportation demands in the history of America, the railroads fixed high standards of operation efficiency: First, 85 per cent of the locomotives in serviceable condition by October 1; second, 95 per cent of the freight cars in serviceable condition by October 1; third, 30 tons of freight as the average car load; fourth, 30 miles per day as the average car movement. In progressing toward this goal, the railroads as a whole increased the number of serviceable locomotives from 75.9 per cent on January 1, 1923, to 83.8 per cent on July 1, with three months more to make the other 1.2 per cent, which they will do. They increased the number of freight cars in serviceable condition from 90.5 per cent on January 1, 1923, to 91.6 per cent on July 1, with 3.4 per cent to make in three months, which they will do. The heavy loading of cars for all of the railroads increased from 27.8 tons in April to 28 tons in May, the last month for which complete data is available. The railroads increased the average daily movement of freight cars from 27.3 miles in April to 29.6 miles in May, as compared with 22.7 miles in May, 1922. With the additional new locomotives and new cars that are now ordered and will be delivered by October 1, the roads are in better condition to handle the increased traffic than ever before. We are a prime factor in accomplishing this work, and that is one of the reasons for our being here today.

Any railroad officer who does not feel that there is sufficient benefit derived from these conventions to send his men is not properly informed in the reports that you give him on your return from the meetings. Efficiency in railroad

Frederick Kerby (B. & O.)
President

T. F. Howley (Erie)
First Vice-President



W. J. Fee (Grand Trunk)
Second Vice-President

work is a matter of education and experience and is mostly obtained through association with others.

Address by G. M. Basford

Wednesday afternoon the association was addressed by G. M. Basford, who suggested that the new operating conditions required by the highly developed modern locomotive present a great opportunity for the association. Speaking in part as follows, Mr. Basford gave his opinion of the direction in which this opportunity would be found:

"In its history of 31 years of consistent constructive work this association has been perfectly preparing for one of the greatest services that can be rendered to the railroads. During the latter half of this period the creators and builders of locomotives have transformed them from crudity into an advanced state of perfected development. With respect to efficiency today they are fully prepared for comparison with power plants of equal capacity—either stationary or marine. What stationary or marine power plants of 3,000 to 4,500 hp. capacity can operate at the rate of 1.83 lb. of coal per hp. hour? You have contributed to this progress and you more than any other agency can render the progress most effective in performance.

"You are highly regarded not only as an organization but as vitally necessary railroad officers and as individuals. You are operating men no matter to whom you report. You have the advantage of a knowledge of the locomotive itself, of its handling and also of railroad operation. Strictly operating officers are handicapped by lack of time to know what you know of the machine. Strictly mechanical men lack the opportunity to know what you know of railroad operation. Moreover, you have the opportunity for intimate contact with operating officers to interpret to them the meaning of the improved power plant that is in their hands.

"There is much the locomotive is ready to do to increase the capacity of a line and to reduce the cost of moving tons, but other things are involved to prepare its way. Many important operating improvements have already started and are working wonderfully well. They need your active assistance and continuous support. Let us glance at a few of them.

"Operation of one track of a double track line in the reverse direction saves many idle hours for equipment and for men. Scheduling freights, watchful tonnage rating, determination of most economical speeds, the 'turn around' plan, operation of traffic by signals without train orders, the substitution of '19' orders for '31' orders, 'main trackers,' long locomotive runs, machine handling of outlying siding switches, application of train control without limiting capacity of track and of equipment—all these are matters wherein your influence and help are needed.

"Think of a 'main tracker' saving an hour in every 88 miles or 12.5 hours in 1,100 miles. Think of 53 per cent increases in locomotive mileage by increasing the length of runs. Locomotives have been designed and built for short runs. They will be designed and built for long ones. Your influence in this will be very great.

"You have remarkable power over the question of locomotive terminals and their equipment, coal and ash facilities, the washing of boilers, the firing up of engines and the all-important boiler water question. Your printed records are filled with accomplishments mainly on the mechanical side of these questions. It now remains to reveal that everything you do is really an operating and not a mechanical function.

"It is an impressive fact that with all its increased complication to provide its increased power the physical task of running a locomotive is easier than it ever was. But how about the handling to get the necessary work from the new locomotive? As the locomotive began to approach the stage of efficiency of stationary power plants with turbines and condensers, as it began to increase its power per pound of metal and per pound of fuel, the difference in performance because of difference in handling on the road became greater. This presents an ever new problem in the education and training of the men who fire and who run the locomotives of today and those will run the locomotives of the future.

"It is most important that the new locomotive power plant should not be hampered in its earning capacity by limitations that are a legacy from the days of light power. No one else can do as much to make the locomotives of today and those that are to come earn what they should earn as the traveling engineer."

Economy of Long Runs

The committee received answers to questionnaires from numerous roads. The information gathered from the questionnaires will be referred to throughout the discussion.

In the following table the term "Past Practices" refers to the operation of locomotives in both passenger and freight service over one operating division, the operating mileage varying with the length of the division. By the term "Present Practice" the committee refers to the mileage that is now being regularly operated in freight or passenger service, many roads reporting the extension of runs to more than one division, though it seems that the extension of runs in freight service has not gone as far as the extension in passenger service.

Mileage of Locomotive Runs in Passenger Service

Roads	Past practice	Present practice	Increased mileage
A	144–187	331	187–144
B	101–175	175	174–100
C	173	375	202
D	161	289	128
E	100–183	234–300	134–117
F	303	603	300

On the M. K. & T. runs of 678 miles, on the Union Pacific, 484 miles to 564 miles, and on the Burlington 483 miles, stand out as examples of high mileage which can be made per run with passenger locomotives. Sixteen roads reported substantial increases in the mileage per locomotive run, in most cases this increase amounting to double the former practice. The questionnaire was only sent to 18 roads concerning which the practice of extending locomotive runs had been given more or less publicity.

Decrease in Number of Locomotives

While at many points it has been found possible to increase the mileage of individual runs by 100 per cent, it has not always followed that the average miles per locomotive in the group considered would amount to 100 per cent, though the average mileage per period of time has shown substantial increases, ranging from 30 per cent to 100 per cent. At several places the same service is being maintained with one-half the power which was formerly required. In the answers to the questionnaires, one road reported five engines now covering the service formerly requiring nine engines; on another road two engines are used as against four engines; on another five engines are used as against six; on another 26 engines are used as against 52; another shows 38 as against 40; another shows six engines as against 11, while another shows 47 as against 54 engines.

From the reports it is evident that the cost of handling power per dispatchment varies largely in different parts of the country. At one large eastern terminal the present cost of dispatchment is in the vicinity of $12 and the present mode of operation reduces the dispatchments from that point by 28 per day; in other words, it can be claimed that there is a direct saving at this point of $336 a day, which amounts to approximately $10,000 per month resulting from running the engines over two divisions. It is proper to claim the present cost per dispatchment when multiplied by the number of dispatchments saved, as a saving to be credited to the extension of locomotive runs.

The cost per individual dispatchment resulting from this change seems to have decreased materially at many points. This decrease seems to result from the more efficient handling of the particular terminal, due probably to reducing its capacity to normal. One example of this increase in efficiency at the terminal is shown by the reduction in cost per locomotive dispatched from $8.39 to $4.20, another reduction from $12.99 to $11.72, another from $16.60 to $12.70, and another from $14.03 to $9.89.

Increasing Railroad Capacity

At one of the eastern terminals where passenger facilities are overcrowded, it is noted that by running engines through this terminal there are saved for each eastbound engine operated three movements per engine through an interlocking plant, four movements for each westbound engine through a second interlocking plant, two movements per engine over a draw-bridge, and in fact this particular terminal was so crowded at times that it was almost impossible to find storage room for locomotives while awaiting trains when power was changed at this point. Running the locomotives through this terminal avoided the necessity of having to find this storage room. At another point on the New York Central where freight and passenger business was handled through the same terminal considerable reduction in terminal delays to freight trains has been avoided by running passenger engines through this terminal.

Practice Required by Longer Runs

The reports from questionnaires indicate that in places it is necessary to fill grease cups at intermediate terminals, at other points it is necessary to shovel coal ahead, while some of the roads report that coal passers on the engines are making this unnecessary. No attention is given to the fire, other than a program of education for the fireman. A similar educational program is required for the engineman in regard to inspection and oiling. Several railroads report that a stop is made for additional coal enroute.

J. N. Clark (So. Pac.)
Third Vice-President

J. B. Hurley (Wabash)
Fourth Vice-President

W. O. Thompson (N. Y. C.)
Secretary

It has been found advisable on most roads undertaking the extension of runs to begin with a few runs and gradually increase the number until all the runs available are so operated. On the New York Central it was found necessary to instruct enginemen to watch both cylinder and journal lubrication more closely than had formerly been necessary. Enginemen were instructed to report personally to the relieving engineman relative to locomotive conditions as observed during his run, and at the final terminal the report was made to include all items observed by all enginemen operating the engine since leaving the initial terminal. It was also found necessary to follow these reports closely to insure that the enginemen were giving them proper attention.

The most difficult matter in the education of the fireman was with respect to the sort of fire to be brought into the terminal at which he is relieved. This instruction plan changed his manner of firing to insure as nearly as possible at all times a clean fire, with some grades of coal requiring a slight shaking of the grates possibly twice on the division, while with other grades of coal a slight shaking of the grates possibly three or four times.

The reports from the extension of runs on the New York Central indicate that at the start when the first few trains were operated and the supervision was very close, the engine failures were reduced very materially, and at the present time when all trains which can be handled are so operated, the engine failures apparently are not affected by the mileage which the locomotive makes. Analysis of a large number of these locomotive failures show that the majority take place on the first division over which the locomotive operates. The analyses further prove that the mileages of the individual runs have little or no effect upon the number of engine failures accumulated.

Effect on Schedules

From the replies to the questionnaire it is evident that locomotive terminal time has been slightly increased. The time allowance at terminals, for instance, on one road increased from 6 hr. 55 min. to 8 hr. 29 min.; another road reports an increase from 7 hr. 30 min. to 10 hr. 8 min.; another road reports at one end of the run terminal time of 6 hr. 40 min, and at the other end of the run terminal time of 15 hr. 45 min. One road reports an average terminal time of 6 hr., this including only running repairs; another road reports terminal time of 12 hr.; another from 7 to 9 hr, while another road reports a short turn-around of 3 hr. and long turn-around from 10 to 12 hr.

The effect on passenger train schedules is nil. It has been found that the terminal time allowed through passenger trains is practically sufficient to do whatever work has been found necessary on the engine, and in a great many cases this work is completed in a shorter time than would have been required to change engines.

Terminal Savings

The importance of the saving in coal which results from increasing locomotive runs over two or more divisions should be given consideration. A large quantity of coal is lost in the operation of cleaning the locomotive fire and more coal is necessary in the re-building of the fire. This is estimated to be from one to two tons per engine dispatched, and with coal costing from $3.50 to $5.00 per ton, it is an item of importance in the reduction of expenses.

Another item of terminal saving is the cost of deadheading the engine between passenger or freight terminal and the roundhouse. Many roundhouses are located at considerable distances from the terminal and it is necessary to make a mileage allowance for the crews moving these engines back and forth. At one of the eastern terminals this amounts to 56 cents per dispatchment.

In answer to the questionnaire, the saving in operating expense on one road amounts to 49 per cent; on another a saving of $5.33 per dispatchment with one-half the dispatchments formerly made in operation, and coupled with this a saving of one-half the locomotives and of one-fifth of the fuel consumption when expressed on a unit basis. Another road reports an estimate of $9,500 per month saving in passenger service and $3,500 per month in freight service. Another road reports a saving of crew expenses of $503 and engine house expenses of $13,962 per month. Another road reports a saving in operating expenses of $8,943. Another road reports a saving of $2,418 per month, while another road reports a saving of $10,000 per month.

Difficulties of Increasing Locomotive Runs

No information was obtainable from questionnaires as to the difficulties experienced from increasing the mileage per locomotive run, possibly due to the fact that the difficulties had been overcome.

On the New York Central the one difficulty which has given the most trouble has been the water. By close supervision and test observations, this difficulty was overcome and very little trouble is now experienced.

Water and the education of enginemen and firemen, and the question of coal and lubrication represent the total of the difficulties which have been experienced with this new method of operation. The matter of assigned engines to trains is a difficulty present at all times and is probably slightly enlarged by lengthening runs of locomotives. On the New York Central it has been found necessary to supervise the power assignments rather closely in order to insure an assigned engine on a regular train.

The report is signed by W. L. Robinson (B. & O.), Chairman, Edward R. Boa (N. Y. C.), Wm. Daze (A T. & S. F.), D. J Bergin (Wabash), and J. A. Cooper (Erie).

Discussion

In answer to a question the chairman of the committee stated that savings reported in the paper were clear savings and not obtained at one terminal at the expense of another. The importance of good water, good fuel and the co-operation of the crews in getting maximum results from long locomotive runs was emphasized. In one instance six crews handle three locomotives over a 400-mile division, each crew always operating the same locomotive and thus obviating the disadvantages of pooling. The chairman emphasized the fact that long locomotive runs do not necessarily imply pooling of locomotives. Several members maintained that the operation of locomotives over two or more divisions is not a panacea for all ills, but must be governed by local conditions. Some other points of interest were developed as follows: (1) It is not best to pass terminals with repair facilities and allow locomotives to lay over at small points where necessary repairs cannot be made. (2) Without careful planning, lay-overs will frequently absorb additional mileage gained by long runs. (3) Locomotives operating succcessfully over divisions with low ruling grades frequently cannot be used on extended runs over the next division because of a high ruling grade. (4) Intermediate fuel and water facilities must be considered; also the mileage obtained between shoppings. These factors must all be considered before lengthening locomotive runs with the expectation of marked operating economies. The favorable influence of the Superior flue blower in facilitating long locomotive runs was testified to by several members. In general, the advantages of long runs as pointed out in the paper were admitted by members of the association, who feel that this practice will be greatly extended in the future.

Work of the Traveling Engineer

In considering the questions, "How can the work of the traveling engineer be made more effective? and, Can the usual number of traveling engineers properly take care of the duties expected of them?" the members of the committee realize that this is a subject of importance and that their task is not a light one. We know of no position of which there is a greater difference of opinion than regarding the qualifications and duties of the traveling engineer. A traveling engineer's knowledge of his work and duties is a big asset towards making his work effective—still we do not believe he must be a past master in all that pertains to a locomotive. His personality and the way he deals with the men under his direct supervision, also with the officers and associates in his work, has a material effect on results obtained. He should be a man whose name carries weight with both officers and men, one having the courage of his convictions to say "Yes" or "No" as the case may require, not given to seeking for petty things to criticize, yet not allowing careless and indifferent work or violation of rules to go unnoticed. He should cultivate the faculty of seeing both sides to every question, controlling his temper and getting along with all kinds of men, remembering that much of his success lies within himself. He should shun "gum shoeing" as there is nothing that will more quickly cause his men to lose confidence in him and consequently lessen the results of his endeavor.

The position of traveling engineer is what the name implies; that is, one who travels or puts in the major portion of his time riding on the engines with the engineers and firemen, it being understood that his training has been such that he is a competent critic of the condition of an engine and the work of the engineer and fireman.

By frequently riding on the engines he can keep in such close touch with his power that defective conditions which cause fuel losses and are detrimental to good locomotive operation can be detected and handled for correction before they become serious. Also, when he has young and inexperienced engineers and firemen he is in the right place to learn how they are doing their work and put them right when such is necessary.

The traveling engineer should use his best ingenuity to instill a spirit of honest endeavor in the enginemen so they will use the engines, fuel, tools and supplies in their care as though they purchased them themselves. The success or failure of the traveling engineer's efforts depend very much not only upon his own mental attitude, but upon that of his enginemen and upon the support he gets from his master mechanic as well as the co-operation of the roundhouse foreman. If his superiors have him doing part of every man's work, from the call boy to the superintendent, and holding investigations of all delays, staying in terminals in order to instruct flue-borers, etc., he cannot do justice to his work. He will not have time to ride each engine on his division at least a short distance every 30 or 40 days, nor to instruct such of his enginemen as need close supervision.

From the foregoing we do not want to be understood as advocating that the traveling engineer should put in all of his time on the road and none at the shops, roundhouses or terminals, and assisting at investigations. When an engine fails for steam or fails to make the time and handle the tonnage, and the engine is not found to be defective—when handling calls for an investigation and where damage is done on account of rough handling and in case of emergency, he should hold or attend investigations, as his knowledge gained by long experience and service in the transportation department is of importance and value to the superintendent in many questions involving transportation. The same thing applies to the master mechanic, who should consider the traveling engineer his trusted assistant, and one to be consulted in many things connected with the successful upkeep and handling of engines. He should see that the recommendations of the traveling engineer are given due consideration and that the reported defects are corrected. If the traveling engineer is allowed to follow up his work and is given the authority which the position deserves, his services will be most effective. Otherwise the usual number of traveling engineers cannot properly take care of the duties expected of them.

The report was signed by J. D. Heyburn (St. L.-S. F.), chairman; J. J. Rossiter (N. Y., C. & St. L.), J. T. Sullivan (B. R. & P.), B. J. Feeny (I. C.), W. E. Preston (Sou.).

Discussion

Emphasis was placed by a number of the members who took part in the discussion on personality as the most important factor in the success of the traveling engineer. He must inspire a degree of loyalty and support such that the crews will do as well or even better by themselves as they do when the traveling engineer is with them, or his work will be a failure. The importance of this quality in dealing with shop forces was also referred to. Observation has shown that the road foreman who inspires a spirit of co-operation in the enginehouse foreman by fairness and direct dealing succeeds in getting attention to mechanical conditions which he wants corrected, with less delay and friction than the one who relies on reports through official channels. The need for improvement in the character of work reports was also touched on, having become so unreliable under the pooling system, that they are a source of unnecessary expense to the railroads. This condition, it was pointed out, is one which should be corrected by the traveling engineer. Because of the impossibility of giving close attention to all locomotives and crews under his supervision, several speakers emphasized the importance of some reports showing the condition of all locomotives and the performance of the crews as a guide to the traveling engineer in concentrating his attention.

Universal and Other Types of Brake Control

In order to limit the subject within reasonable bounds, reference is made only to passenger car brakes now in use. These, in the order of their introduction, are the P. M., L. N., P. C. and U. C. equipments. The development of brakes has been brought about by a need to meet the increasing demand for transportation and to bring about certain necessary results, the end in view being safety of life and property and increased traffic with minimum cost.

The conditions to be met included increased weights, higher running speeds and greater frequency of trains. The objects to be attained were : (1) More flexible control of the train, greatly reducing possibility of shocks; (2) more uniform braking power; (3) constantly recharging auxiliary reservoirs, which increases safety; (4) better protection against excessive braking power service applications; (5) shorter, smoother and more accurate stops.

An up-to-date brake must be reliable, flexible and effective; reliable in that it must operate when required, and if there are any failures, they will be on the side of safety; flexible, in that certain retarding force between a minimum and fixed maximum can be obtained as conditions require; effective, in that it will result in a moving train being brought to a stop in a reasonably short distance.

P. M. Equipment

The P. M. equipment, first introduced in 1887, was known as the quick-action brake to differentiate it from the plain automatic brake of 1872. As cars became heavier and service more frequent, the pressure was increased from 70 lb. to 110 lb. and the high-speed reducing valve was added in 1894. For modern cars, with large brake cylinders and long trains, the use of P. M. equipment is undesirable, because: (a) Its function is materially affected by length of train and condition of valves; (b) effective service applications cannot to be obtained in quick succession due to the recharge all coming from the brake pipe; (c) of the liability of undesired quick action due to the same piston controlling both service and emergency functions; (d) of the inability to obtain quick action after a service application; (e) of the possibility of brakes creeping on due to fluctuations of brake pipe pressure; (f) of the possible loss of braking pressure without warning; (g) of the necessity of using valves of different size for various size brake cylinders.

L. N. Equipment

The P. M. equipment gave satisfactory service until the railways put into use passenger cars requiring brake cylinders 16 in. to 18 in. in diameter with proportionate size auxiliary reservoirs. The large brake cylinders and auxiliary reservoirs meant greater volumes of air to be handled in a given time. Also, it was necessary on account of the increased length of trains to obtain means whereby a more uniform service application be made, and to obtain a better control of the release of brakes. To meet these conditions and requirements the L. N. equipment came into use in 1908. It has the same general features of the P. M. equipment, with the following added: (a) Quick service; (b) graduated release; (c) quick recharge of auxiliary reservoir; (d) high brake force in emergency.

P. C. Equipment

The P. C. equipment was designed to meet the demand made on the air brake by the introduction of cars weighing 120,000 lb. or more. Heavier cars brought about the adoption of heavier and more powerful locomotives and the average speed of trains was increased. All this required a more efficient brake. This equipment possessed all the features of the older types with the following additional features: (a) Fixed flexibility for service operations; (b) certainty and uniformity of service operations; (c) quick rise in brake cylinder pressure; (d) uniform brake cylinder pressure, independent of piston travel; (e) maintenance of brake cylinder pressure against leakage; (f) limiting of service brake force to a predetermined amount; (g) service and emergency features widely separated, although controlled by the same piston; (h) automatic emergency when brake pipe pressure is depleted; (i) emergency brake force obtainable at any time.

This equipment did not come into general use.

Universal Brake Equipment

The U. C. equipment was designed and introduced for the same reasons as brought out the P. C. equipment and contains all its essential features. This equipment is made up of the following parts: One U-12 universal valve; one auxiliary reservoir; one service reservoir; one emergency reservoir (when two brake cylinders are required two emergency reservoirs are used); one brake cylinder (two brake cylinders are used when car weight exceeds 153,000 lb.); one conductor's valve; one centrifugal dirt collector; cut-out cocks, angle cocks, hose couplings, etc.

In order to obtain all the benefit from Universal Brake Control it is essential that an efficient foundation brake gear be provided. Up to recent years it was the prevailing practice to equip car trucks, of either the four or six-wheel [illegible] rigging having but one brake shoe per wheel. With this type of brake rigging it is impossible to keep the piston travel uniform. The shoes being hung below the center line of the wheel, when the brake is applied, brake hangers are pulled down, piston travel is lengthened, thereby increasing volume of cylinder and causing a low cylinder pressure and a longer time than would be required to obtain it.

The disadvantages of using this type of gear may be summarized as follows: (a) Rough handling in starting due to violent running of slack, slowing down and stopping due to slack action in train caused by unequal piston travel; (b) inability to make time because of train pulling hard on account of short piston travel, resulting in improper amount of shoe clearance and dragging brake shoes; long drawn out stops due to the engineer trying to avoid shocks by "dribbling" brakes on; (c) useless expense in excessive fuel and water consumption and reduced locomotive capacity due to the power necessary to overcome shoe friction; slid flat wheels due to uneven distribution of brake force; damage arising from shocks and break-in-twos as the result of short piston travel; hot boxes due to journal being pushed from under brass when brake is applied; burned brake shoes due to rubbing on wheel tread while brakes are released.

The clasp brake type of gear provides two brake shoes per wheel, hung practically on the center line of the wheel; this arrangement makes it possible to maintain piston travel constant for all cylinder pressures. The engineer is enabled to obtain the desired pressure with a given reduction of brake pipe pressure, thus insuring greater accuracy and smoothness in making stops. The brake shoe pressure is divided between two shoes and there is less wear of shoe metal.

It is well known that efficient handling of any train is the proper control of slack. All shocks are brought about by a sudden change of velocity of different vehicles in the same train, and the brake that will produce an effective retarding force with the least change in velocity between the front and rear portions of a train must be the best. Such a brake is one that when a brake application is desired, the brake pipe reduction and rise in cylinder pressure will occur simultaneously on each car in the train. The universal valve electrically controlled will do this efficiently and consistently.

The report was signed by Russell M. Smith (Penn.), chairman; H. H. Burns (Westinghouse Air Brake Company); F. F. Wentworth (New York Air Brake Company); J. R. Scott (St. L.-S. F.); Wm. Smith (B. & A.), and Jas. Fahey (N. C. & St. L.).

Discussion

There was a long discussion of this report, one of the things which received the most attention being the graduated release feature. Several of the members maintained that it was advisable to use this equipment in direct release in view of the fact that mixed trains must be run. Other members strongly advocated having the graduated release cut in whenever 50 per cent of all of the cars have this feature. The advantages are a much better and more accurate control of passenger trains on descending grades and when making station stops. There is also a decrease in air consumption.

The possibility of getting an emergency after a service application with this equipment was pointed out, which is an advantage from a safety point of view. Care must be exercised not to get an emergency application at low speed, however, owing to the possibility of pulling out a drawbar. Another advantageous feature of this equipment is that by means of a special cut-out cock in the brake cylinder pipe, the brake on the car can be released without losing the reservoir pressure. This enables brake shoes to be replaced or brake rigging repaired without interfering with train line pressure or the reservoir pressure which maintains water level in the car. Another point which received considerable attention was the use of a back-up or tail hose when backing trains into stations, difficulty being experienced in getting accurate stops with this method.

President Kirby (B. & O.), summed up the matter in the statement that every train operated under normal conditions into Washington, D. C., is backed into the station by the engineman, operating the engineer's brake valve in accordance with communicating signals from the rear end.

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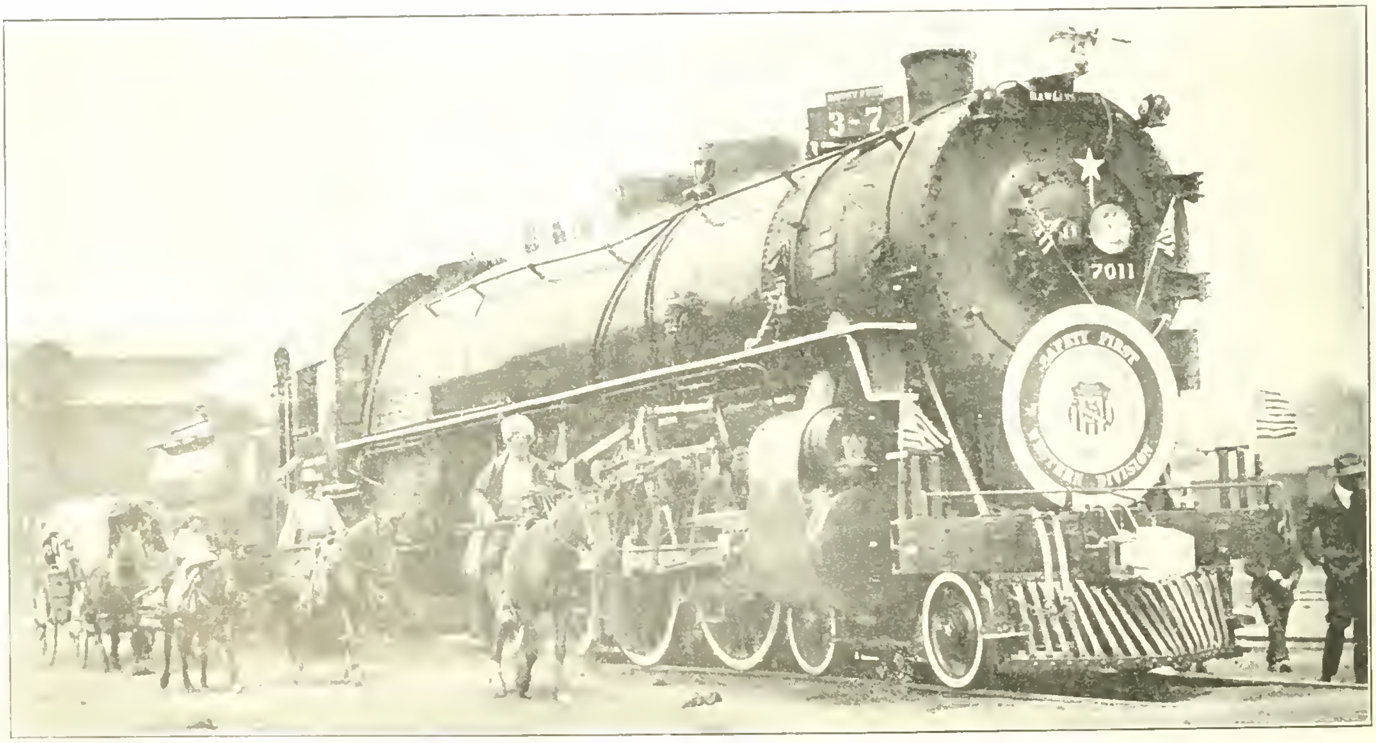

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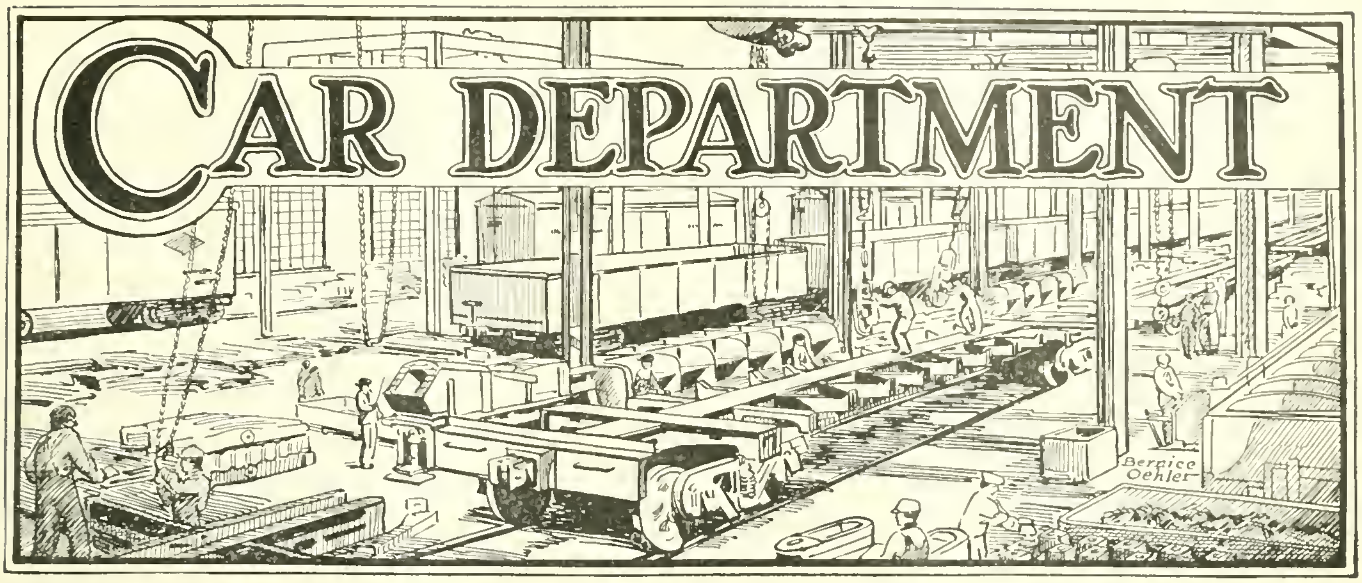
A Pageant of the Overland Trail—the Pioneer Trapper, the Pony Express, the Prairie Schooner and One of the Union Pacific's New Mountain Type Locomotives



Master Painters Meet in Cleveland

Possibilities of Spray Painting and Protection of Steel Passenger Cars Thoroughly Discussed

THE Equipment Painting Section, Mechanical Division, American Railroad Association, held its first annual convention since 1920, at the Hollenden Hotel, Cleveland, Ohio, on September 4, 5 and 6. John Purcell, assistant to the vice-president, Atchison, Topeka & Santa Fe, and chairman of the Mechanical Division, prepared the opening address which, in his absence, was read by the secretary, V. R. Hawthorne.

Mr. Purcell's Address

An abstract of Mr. Purcell's address follows:

"You represent a department whose part in the successful operation of the railroads has been misunderstood and underestimated by the general public, as well as by a great many railroad officials; indeed, many painters seem to think that painting is done only for ornamentation. Improving appearances, while a desirable function of paint and varnish, is, after all, only incidental to the preservation of the equipment. On account of this misunderstanding your Section has not been given the recognition in the past that it deserves. You may be partly responsible for this, due to lack of unity in your recommendations as to the best methods to pursue. Your committee reports may not have always been positive enough in outlining the action that should be taken. Have you shaded your opinion to conform to general practice, when you knew the practice was wrong?

"Your responsibility has been greatly increased since the advent of steel car construction. Corrosion is the greatest enemy of steel or iron and as paint is the only method we have to prevent their deterioration, we look to your Section, through its committees, to try out and report the best materials that will accomplish this purpose. Do not leave it all to the committees. Be free, but fair in your criticism of reports; go on record with your opinion, whether it is for or against the reports. We expect you to devise economical methods of classifying repairs and getting equipment through the shops in the least possible time, consistent with the preservation of the equipment. You know the parts that are the most subject to corrosion. Do not fool yourself or your employer by thinking that because these parts are generally out of sight, that anything will do to get by. This is not economy, but a wilful waste of time and material that will eventually cause the blocking of shop output when the time comes that repairs cannot be further postponed. It is better to spend a dollar more for paint protection now than it is to later spend ten dollars for steel repairs.

"I would like to impress on you the necessity of having men trained ready to take the place of any man you have in your shops. One great fault of the paint foreman is failure to have men properly trained to do high-class graining or ornamental sign work, and then having recourse to the rather unfair method of recommending the elimination of the work and the substitution of another method which does not require as much skill but cheapens the appearance of the equipment and in reality costs more to maintain in the long run. Teach your men, and especially your apprentices, that the main function of paint is to preserve the equipment. Train your apprentices in the knowledge of what constitutes a good paint, what causes corrosion and how to prevent it, and you will be giving the company you work for the service that we all desire and that our stockholders are demanding."

Maintenance At Terminals

Several subjects having been assigned or referred to this committee for such action or report that said committee deems proper, this committee reports to Equipment Painting Division for their consideration as follows:

The subjects assigned to this committee were sent out to different railroads in the form of questionnaires, and 104 replies were received.

Question 1.—Do you use car renovators? Do you consider their use advisable, and why? There were 83 railroads using renovators, considering their use advisable, and 17 not using them, and 4 not operating passenger equipment. The committee deems it advisable to use renovators if they largely consist of vegetable oils, and not petroleums. Their use has a tendency to feed the varnish, and when used on interior of coaches, they add to the appearance.

Question 2.—Have you adopted enamel for the outside of bodies of passenger equipment cars? If so, have you eliminated varnishing of outside of passenger car bodies entirely? Advise number of cars which have been so enameled by classes, how long used, and with what success? There are 12 railroads that have adopted enamel for outside of bodies, eliminating varnish entirely. Some of them state that they do not clean up readily as a varnish car. There were 87 railroads that have not adopted the use of enamel on all of their equipment, nor eliminated the use of varnish on the outside of passenger cars entirely. One railroad is using oil color because it can be done at a lesser expense. Four railroads are not operating passenger equipment. The committee taking into consideration the maintenance, cleaning and care of cars at terminals, recommends that the first class passenger equipment, be varnished on the outside of bodies, but at the option of the different railroads. Second class equipment that is not given terminal attention may be enameled outside of bodies, at shopping periods.

Question 3.—Have you used enamel on outside of passenger cars with varnish? If so, advise number of cars which have been so enameled and varnished by classes; how long used, and with what success? There are 33 railroads that have used enamel outside of bodies and then varnished them with success, stating that appearance and durability is improved.

Question 4.—Do you use flat color and varnish on outside of bodies of passenger equipment cars? If so, advise number of cars so painted, by classes, how long used and with what success? There are 77 railroads using flat color and varnish, 12 enamel, 1 oil color, 10 enamel and varnish, and 4 not operating passenger equipment. The committee, in view of the above, would recommend that on all passenger equipment that was considered as first class only, flat color and varnish be used. Considering the appearance, durability, maintenance and cleaning at terminals, this practice has been carried out on this class of equipment for many years, by a large majority of railroads.

Question 5.—Have you ever used enamel for outside of passenger equipment cars, and abandoned this practice and resumed use of flat color and varnish? There are 23 railroads that have used enamel, abandoned the practice and resumed the use of flat color and varnish, 12 using enamel, 1 oil color, 54 that were using flat color and varnish, 10 that were using enamel and varnish and 4 not operating passenger equipment. The committee recommendation is given in answer to Question 4.

Question 6.—Do you use gold for lettering of passenger cars? There are 69 railroads using gold leaf, 2 aluminum leaf, 1 copper leaf, 1 decalcomanias, 27 yellow paint, and 4 not operating passenger equipment. The committee, recommends the gold leaf, especially when using flat color on outside of bodies of passenger equipment.

Question 7.—Do you use color paint for lettering of passenger equipment cars? If so, with what success? There are 27 railroads using yellow color paint or gold color paint on all passenger equipment, 42 on all second class equipment, 29 using gold leaf on all passenger equipment, 1 using aluminum leaf, 1 copper leaf, and 4 not operating passenger equipment. The committee considers it advisable to use gold color paint on all second class passenger equipment, or when enamel or enamel and varnish is being used on outside of passenger bodies.

Question 8.—Do you use enamel or oil paint for painting of extensions on non-passenger carrying passenger train cars? There are 54 railroads not using enamel or oil paint for non-passenger carrying passenger train cars, but finishing same as their regular passenger equipment cars, 19 using oil paint, and 4 not operating any cars. Each individual road's local conditions would largely determine their practice.

The members of the committee were: A. H. Phillips (D. & H.), chairman; J. W. Houser (Cumberland Valley); J. Gratton (B. R. & P.), and J. N. Voerge (Canadian Pacific).

Report on Specifications

The committee of consultation on specifications for paints, oils, varnishes and paint oils, met with the Specification Committee of the Mechanical Division only once, although it corresponded with the chairman of that committee and gave its views, which in substance are as follows:

Specifications for mixed paints do not prevent the substitution of inferior goods. The latitude allowed by chemists in all their analyses is such that they are only an aid to the manufacturer, who is adept in using the lowest grade of materials which will pass the tests, or who strives to find a way to beat them. Only the simplest paint mixtures can be analyzed with any degree of accuracy and after the various ingredients are separated, it is exceedingly difficult to determine their quality. This is particularly true of pigments of which there are so many different grades, though all grades analyze practically the same.

Tests made by the committees representing the Equipment Painting Section have conclusively proved that a heat processed linseed oil properly treated will give better protection against the elements causing the deterioration of railway equipment than raw linseed oil, but the chemist will not

Courtesy of the Cleveland Press

Four Old Time Members Were in Attendance at the Convention—Left to Right: H. M. Butts, 73, Albany, N. Y.; C. E. Copp, 75, North Billerica, Mass.; Warner Bailey, 90, Concord, N. H.; and A. J. Bruning, 72, Evansville, Ind.

specify this class of oil in a paint because he cannot analyze it. Why insist on analyzing a cheap paint like mineral or carbon when we buy our high-priced primers, surfacers, enamels and varnishes upon their durability and appearance, and the reputation of the manufacturer to maintain the standard adopted after a practical test? Specifications should describe the service the paint will be subjected to and the color and finish desired. Specifications of this kind will give the expert paint manufacturers an opportunity to compete for business and railroad equipment will be given the protection it is so much in need of.

The question will be asked, "But how are we to determine whether the paint purchased will give us the protection desired before the paint is applied and put in service?" The answer is by film test. If a film of the paint, enamel or varnish is made and subjected to an accelerated test of the elements it will be required to meet in service, a determination of its ability to answer requirements can be made in a comparatively short time.

Specifications to determine quality of turpentine and turpentine substitutes, oils, etc., are deemed advisable and necessary by the committee.

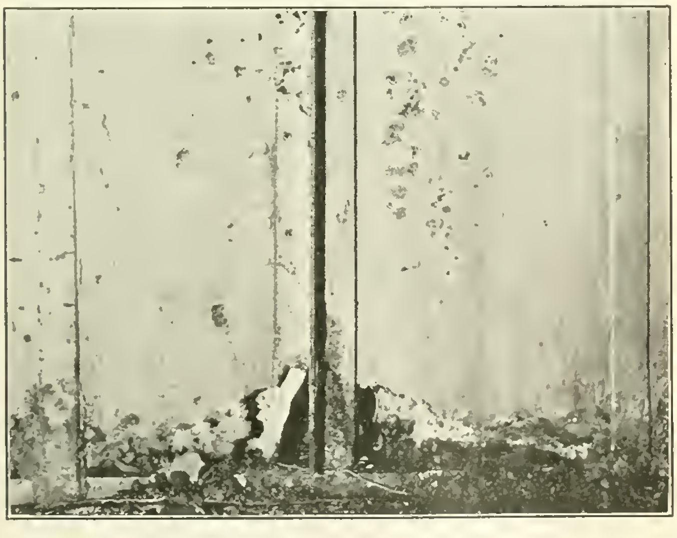
The report was signed by J. W. Gibbons, A. T. & S. F., chairman, and J. F. Gearhart, Penn.

Protection of Steel Equipment

The special committee was assigned several subjects pertaining to the preparation of steel equipment for paint and the best method of preserving it with paint.

Sandblasting

It seems to be the unanimous opinion of all painters that in the preparation of steel for painting or the removal of old paint for the purpose of repainting steel equipment, the sandblast is the most economical and presents a better surface for the paint to adhere to than any other known method. The question has been asked, "What is the advantage of removing old paint by sandblast over the emulsion or so-called paint remover, if the mill scales are properly removed by sandblast before the initial painting of the car? Information as to the cost of removing paint by removers and sandblast obtained from shops in the eastern and western parts of our country, all indicates that paint can be removed by sandblast for one-half the cost by removers.

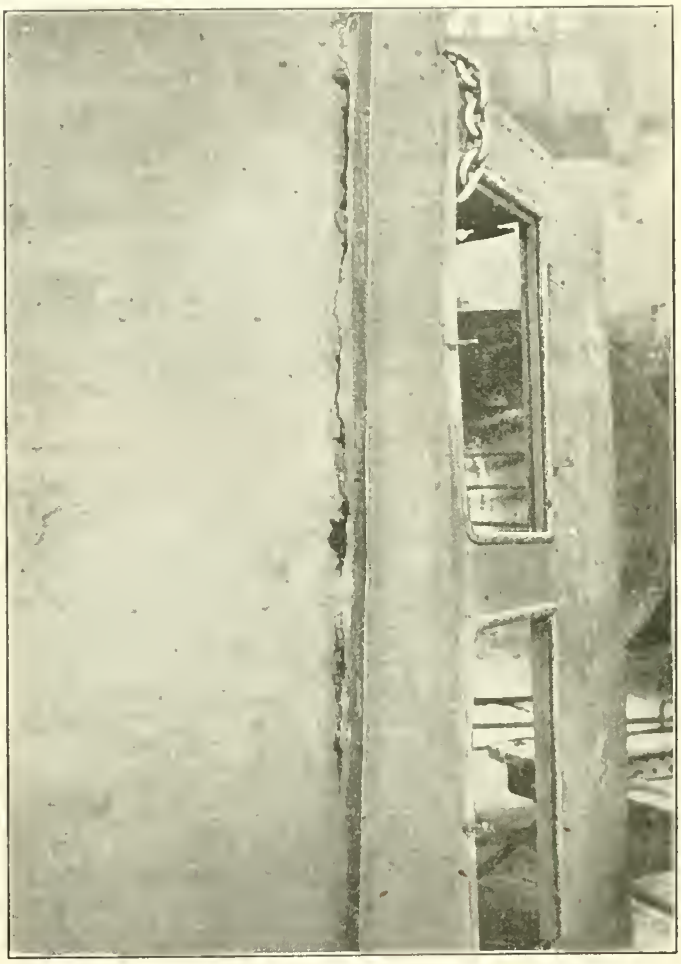


Effect of Corrosion on the Interior of a Steel Baggage Car

Outside the question of cost, the use of the removers that contain volatile matter (and they all do so except the alkali compositions) increase the fire hazards and are far more detrimental to the health of the operator than the sandblast. The sandblast will also remove all rust that may have accumulated, while the remover will not.

Bad results have been experienced from the use of emulsion paint removers. Cases have been reported where the remover would run into crevices where it was impossible to wash it out, and after the surface was primed and in some cases after the car had been finished, the remover would run out and destroy the surface. In other cases the paraffine base would not be thoroughly removed and when primers were applied, they would not dry uniformly.

The sandblast is the best method of removing paint from the interior and exterior of all steel equipment, unless the sheets are so thin that the sandblast will warp the sheets. It will warp sheets of No. 22 gage unless they are thoroughly and closely braced.



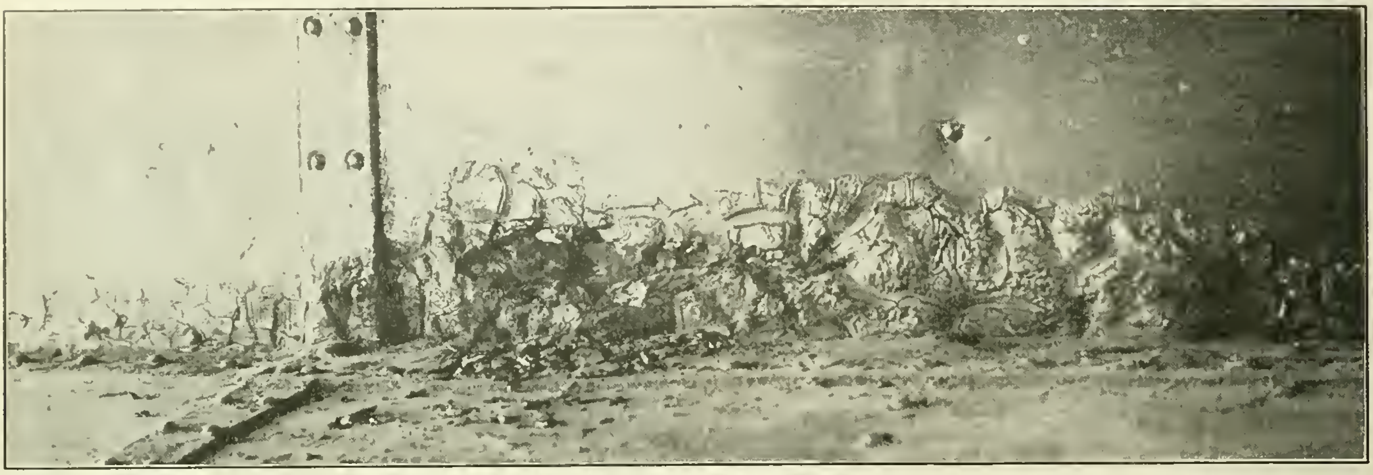
Corrosion Through a Locomotive Cab Roof Sheet

Corrosion

All parts of equipment where pockets are formed that will hold cinders, dust or gases, such as rain guards on roofs, window rails on cabs, deck sash on passenger equipment, steel underframes on locomotives as well as on freight and passenger cars, hold the coal dust and dirt and these, mixed with water, form an acid that accelerates the action of corrosion and quickly destroys the metal.

One of the photographs of the interior of an express car shows the sheets badly corroded several feet above the floor and entirely destroyed at the bottom. The principal reason for this was the construction of the car. Between the angle iron and the sheets, a copper plate was placed, evidently with the idea of making a tight joint and keeping out the moisture. This combination of three metals created an electrical action when moisture was present that accelerated the corrosion. On the interior of the sheets a piece of cloth was pasted to assist in the insulation of the car. This cloth acted as a wick and carried the moisture up almost to the top of the car and caused the sheet to corrode as shown in the illustration.

The remedy is to construct all equipment so as to eliminate the cause as much as possible by making these parts dust and moisture proof, putting in drains and keeping them clean. The painter can assist in this work by painting these parts with good inhibitive coatings and filling up the crevices with some of the accepted plastic compositions that are now on the market for this purpose. All parts that are inaccessible after assembled should be given at least two coats of a proved inhibitive paint made as near water-proof as possible. A composition paint with a red lead or sublimed blue lead base, mixed with a proper heat treated processed linseed oil will give the most satisfactory service. This should be followed by one coat of carbon black mixed with the same grade of oil.



Corrosion at the Junction of the Upper Deck and Side Roof Sheets of a Passenger Car

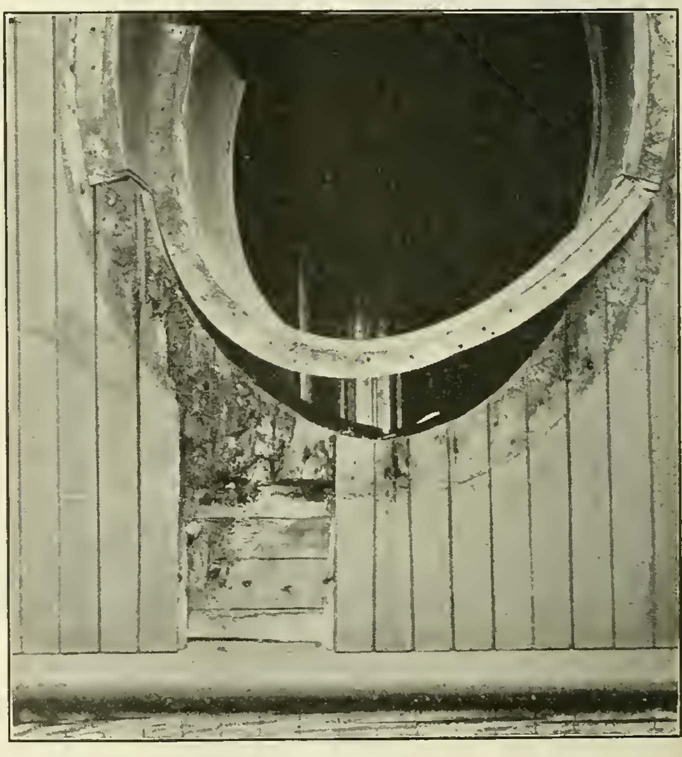
During assembly and fabrication all parts where metal is laid on metal should receive a thick coating of paste paint of the same materials as above. Steel freight equipment, steel roofs, underframes, etc., on all classes of equipment, should be sandblasted and given three coats of paint mixed as outlined above, the primer to be a composition of red lead or sublimed blue lead base paint mixed with a processed linseed oil. The second coat should be a mixture of the first and last coats, the third should be a proved acid resisting carbon paint.

In 1916 we were given permission by the Atchison, Topeka & Santa Fe, to paint two coal carrying cars with a paint of this character. They were inspected from time to time, the last time in February, 1923, just before going into the shop for repairs. The report showed the condition of this paint to be good, no corrosion having been started at any point under the paint. The only abrasions on parts of car where paint had come off were caused by mechanical defects or where ballast or other solid matter had struck the car, and there were only a few of these. The cars were in such condition from appearances that the paint would have lasted several years without recoating, but in order to protect the abrasions, orders were issued to touch up spots and apply one coat of carbon. With this evidence of the kind of protection that can be obtained by good paint, can there be any excuse for deterioration of equipment by corrosion? We have demonstrated in shops where the above instructions have been followed that it was possible to reduce the renewal of steel parts from an average renewal of 12½ per cent to less than one per cent of the parts where corrosion had taken its greatest toll prior to the time they were adopted.

One photograph shows the deterioration of a wooden car due to decay because of excess moisture. The same method of keeping moisture out of joints, laps and hidden parts should be followed as on steel equipment, except white lead paste should be substituted for red lead.

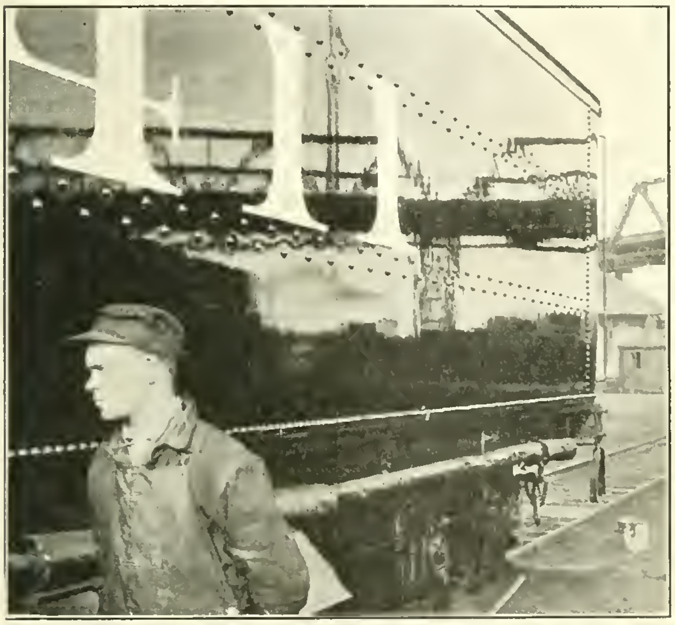
Spray Painting

In years past, there has been a prejudice against the application of paints by the spray method, which was the outgrowth of the crude sprays that were first used in the application of paint and the unwarranted exaggeration as to their virtues indulged in by men who thought they were catering to the wishes of their superiors for economy. This led to the wide use of what really should have been called a paint squirt gun which proved to be very expensive in first cost when cost of material was considered, and, owing to the unevenness of the coating, it neither wore well nor presented a creditable appearance. This prejudice took such a



Wood Sheathing Decayed by Moisture Entering at the Joints Around the Window deep root in the minds of the painters as well as the operating officers of the railroads, that the only method they saw for economizing was the elimination of all ornamentation. This was followed by the reduction of the number of coats of surfacers and varnish on both the interior and exterior of passenger equipment and on locomotives.

Last year we had the opportunity to see a train of steel cars finished under this system alongside of a train of cars painted with a good practical surfacer system protected with varnish. The first presented the rough appearance that can only be produced by applying varnish over a rough surface. If durability only was desired, why not save one coat by applying three coats of good oil paint that would have given better protection and would not have accentuated the rough appearance of the iron? With these facts before us, are we to close our eyes to the great advancement that has gradually been made in the paint spraying devices in the past few years? One of the great objections formerly made against the spray was that the air passing through the paint, enamels or varnish left air bubbles in the paint film; and that the moisture in the air was detrimental to paint (Dr. Dudley, late chief chemist for the Pennsylvania, has advocated 5 per cent moisture in paint). Devices have been perfected that will remove the moisture from the air and spray guns are now in use that do not in any manner mix air with the paint, enamel or varnish, but only use it to atomize them so as to apply a good even coat on the surface to be protected or ornamented.


All Coats Except the Knifing Coat Were Applied to This Tank With the Spray

The committee submits photographs* of different classes of railway equipment that have been painted and varnished with "air guns." Every coat applied on these jobs except the kniving coat, was applied with the "gun." Note the smoothness, depth and brilliance of the surface on the locomotive tenders in the exhibit.

In view of our present knowledge of the improvements made and the increased demands for economy, are we fair to our employers, the public, or ourselves in letting our prejudices close all doors to economy except that which leads to uncleanliness and disease in turning out equipment that is not only uncouth but unsanitary?

Your committee, believing that the mind, disposition and to a great extent the health of the individual is affected by their surroundings, firmly believe that the traveling public are entitled to have their temporary home, the passenger car, maintained in a cheerful, sanitary condition, recommend that it is the sense of this division of the A.R.A. that the present tendency of destroying the appearance of the passenger carrying equipment is not in accord with good business principles or economy in upkeep.

The members of the committee were J. W. Gibbons, A. T. & S. F., chairman; J. F. Gearhart, Penn., and A. E. Green, C. & N. W.

Discussion

The sand blast was favored as the best means of removing paint, as recommended by the committee. Cases were cited where failure to get rid of all traces of the remover solution from cracks of other inaccessible places, had resulted in the destruction of the finish subsequently applied. Where an alkali remover had been used, the finish would not dry in spots. In one case these spots were still tacky when the car returned to the shop after a service of two years. J. T. St. Clair, acting engineer of car construction, Atchison, Topeka & Santa Fe, expressed the opinion that the time is not far distant when the railroads will insist on the use of the sand blast on new steel equipment to remove all mill scale and properly prepare the surfaces for their protective coatings. Calling attention to the photograph showing the badly rusted interior sheets of a baggage car, he said that about two feet of the lower ends of these sheets are now being applied as separate units, and that the backs of the sheets were coated with a heavy plastic cement.

The discussion on the use of the paint spray clearly indicated that the apparatus and the methods of using it have been developed to a point where its practicability for a wide range of work is beyond question. There was, however, considerable difference of opinion as to the extent to which it should be adopted under the average unfavorable shop conditions. It was suggested that a certain portion of the shop should be set aside for the use of the spray, where carpenters and others would not be exposed to the mist thrown off by the spray. It was reported that there are now machines available with which the operator gets almost as close to the car as with a brush and from which very little mist is thrown off. It has also been found that with proper equipment a very slight current of air serves to keep the atmosphere surrounding the work free from any objectionable mist. The

A View Under the Running Board of a Tank Car Completely Painted With the Spray

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* The exhibits included photographs of steel underframe, wood sheathed baggage and express cars, which are not here shown.

discussion brought out the fact that the use of the spray is effecting net savings of from $1 to $3 each in painting box cars and from $5 to $20 in painting locomotives.

A resolution was finally adopted by the association in which was included the recommendation that materials known to be poisonous, such as white lead and red lead, should not be used in atomized form unless the vapors created can be eliminated or the operators, as well as others exposed, be safeguarded.

Classification of Painting Repairs

The shopping of cars should be determined by the length of time in service or the general condition of car. As a general proposition the class of painting repairs should be determined by the Paint Foreman on arrival of car at Shops, and should receive the following treatment according to class of painting repairs.

Schedule of Class A Repairs

Steel Dining or Private Cars

Outside Operations—Body—First day—Sand-blast and prime. Second day—No operation. Third day—Coat of surfacer. Fourth day—Putty and knife in pitted and uneven surface. Fifth day—Coat of surfacer. Sixth day—Coat of surfacer. Seventh day—Coat of surfacer. Eighth day—Rub with rubbing brick and water or rub to a smooth surface with sand paper or emery cloth in oil. Ninth day—Sand and touch up rubbed through spots, if any, with primer. Tenth day—First coat color. Eleventh day—Second coat color. Twelfth day—Letter and varnish. Thirteenth day—No operation. Fourteenth day—Varnish.

Note: Where flat color is used three coats of varnish should be applied. At shops where no sand-blasting is done but a standard paint remover is used in its place on all steel equipment the second day's operation should be priming.

Roof and Deck—First day—Sand-blast and prime with approved pigment and oil primer. Stand over at least 48 hours. Paint roof with two coats of standard roof paint. Paint deck with two coats of body color in oil or standard roof paint according to railway company's standard practice.

Trucks, Platform and Underneath Work—Trucks, platforms and battery boxes: Paint with one coat of oil color, followed by one coat of truck enamel. Underneath work, paint with two coats of oil color.

Inside Operations—When necessary to remove paint and varnish: First day—Remove paint and varnish with approved varnish remover or sand-blast. Second day—Prime. Third day—No operation. Fourth day—Surfacer. Fifth day—Putty and knife in pitted and uneven surface. Sixth day—Coat of surfacer. Seventh day—Coat of surfacer. Eighth day—Rub with rubbing brick and water or rub to a smooth surface with sand paper or emery cloth in oil. Ninth day—Sand and touch up, rubbed through spots, if any, with primer. Tenth day—Coat of ground color. Eleventh day—Coat of ground color. Twelfth day—grain. Thirteenth day—Varnish. Fourteenth day—Stripe, number and necessary notices applied. Fifteenth day—Varnish. Sixteenth day—No operation. Seventeenth and Eighteenth day—Rub to produce standard finish as required by railway company.

Note: The surfacer should be of a shade as close to the graining ground color as is possible to obtain.

Head Lining Operations—First day—Prime. Second day—No operation. Third day—Coat of surfacer. Fourth day—Sand and coat of enamel. Fifth day—No operation. Sixth day—Coat of enamel. Seventh day—Stripe.

Eighteen days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 21st day.

Steel Coach

Outside Body—First day—Sand-blast and prime with approved steel car primer. Second day—Stand to dry. Third day—First coat of approved surfacer. Fourth day—Sand paper, putty, and knife in uneven and pitted spots, or whole car if necessary. Fifth day—Sand paper and apply coat of surfacer. Sixth day—Sand paper to a smooth surface and apply first coat of body color. Seventh day—Apply coat of car body coating or varnish color. Eighth day—Necessary lettering applied. Ninth day—First coat of varnish. Tenth day—Stand to dry. Eleventh day—Second coat of varnish.

Note: Where flat color is used three coats of varnish should be applied. At shops where no sand-blasting is done but a standard paint remover is used in its place on all steel passenger equipment the second day's operation should be priming.

Outside of body sash and end doors and both sides of vestibule doors to receive the same treatment as body of car.

Inside Operations—Where necessary remove old paint with sand-blast or varnish remover. First day—Prime with approved primer. Second day—Stand to dry. Third day—First coat of approved surfacer. Fourth day—Sand paper, putty and knife in uneven surface or whole car if necessary. Fifth day—Sand paper and apply second coat of surfacer. Sixth day—Sand paper to a smooth surface and apply coat of color, ground in Japan, thin to a brush coat with pure turpentine. Seventh day—Second coat of color as above. Eighth day—Lettering and ornamenting. Ninth day—First coat of varnish. Tenth day—Stand to dry. Eleventh day—Second coat of varnish.

If rubbed finish is desired stand to dry at least 48 hours before this operation. Eleven days consumed to finish this class of car, followed by two days for trimming and O. K. on the fourteenth day.

Note: Head lining, roof and deck, trucks, platforms and underneath work to receive same operations as those scheduled for dining and private cars.

Steel Mail, Mail and Baggage, and Baggage

Outside Operations—Body—First day—Sand-blast and prime. Second day—No operation. Third day—Coat of surfacer. Fourth day—Sand paper, putty and knife in uneven surface or whole car if necessary. Fifth day—Sand and coat of body color in oil. Sixth day—No operation. Seventh day—Finishing coat of body color in oil. Eighth day—Letter.

If the railway company's standard will not permit of the above appearances the schedule as applied to coaches, etc., can be applied. Roof and deck to receive same operation as those used on dining and private cars. Trucks and underneath to receive two coats of oil color.

Inside Operations—First day—Prime with lead primer. Second day—Putty. Third day—Coat of oil color, standard shade. Fourth day—No operation. Fifth day—Coat of oil color, standard shade. Sixth day—Paint steam coils, and guards, and necessary stenciling.

Note: The finishing coat for mail, and mail end of mail and baggage cars to be applied as per specifications issued by the United States Railway Mail Service. Eight days consumed to finish these classes of cars, followed by one day for trimming, and O. K. on the tenth day.

Wood Dining or Private Cars

The outside operations on this class of cars are the same as used on the steel type of coaches, with the exception that wood cars shall have the paint and varnish burned off.

Roof and Deck—Where canvas roof is applied, roof boards to be primed with a mineral paint. After canvas is applied, roof to be finished according to railroad's standard practice. Deck to receive three coats of body color in oil. When roof composition that needs no painting is applied, the deck to receive three coats of body color in oil. Trucks, platforms and underneath work to receive same treatment as applied to steel dining and private cars.

Inside Operations—When necessary to remove paint and varnish with varnish remover: First day—Remove paint and varnish with varnish remover. Second day—Sanded and cleaned up by carpenters. Third day—Fill. Fourth day—Varnish. Fifth day—Stripe, number, and necessary notices applied. Sixth day—Varnish. Seventh day—No operation. Eighth day—Varnish. Ninth day—No operation. Tenth day—Rub with fine pumice and water. Eleventh day—Rub with rotten stone and oil.

Head lining to receive same treatment as applied to steel dining and private cars. Eleven days consumed to finish this class of car, followed by two days for trimming, and O. K. on the fourteenth day.

Wood Coach

Wood coaches receive the same treatment as wood dining cars, in and outside, roof, trucks, underneath work, etc.

Wood Mail, Mail and Baggage, and Baggage Cars

Outside Operations—When necessary to burn paint, which is very rare due to the use of body color in oil, the following operations to be applied: First day—Burn off paint. Second day—Sanded by carpenters. Third day—Prime with body color in oil. Fourth day—Putty and knife in if necessary. Fifth day—Sand paper and coat of body color in oil. Sixth day—No operation. Seventh day—Coat of body color in oil. Eighth day—Letter.

Roof and deck to receive the same treatment as accorded wood coach. Trucks and platforms and underneath work to receive same treatment as accorded wood coach. Inside to receive same treatment as accorded steel type of this class of cars.

Schedule of Class B Repairs

Steel Dining or Private Cars

Outside Operations—Car to be washed; after necessary repairs are made the following treatment to be accorded: First day—Prime new or bruised parts. Second day—Touch up parts with surfacer. Third day—Putty and knife in parts. Fourth day—Sand, and color. Fifth day—Second color. Sixth day—Letter. Seventh day—Varnish. Eighth day—No operation. Ninth day—Varnish.

Inside Operations—First day—Prime new or bruised parts. Second day—Touch up parts with surfacer. Third day—Putty and knife in parts. Fourth day—Sand and ground color parts. Fifth day—Grain parts. Sixth day—Varnish newly grained parts. Seventh day—Varnish all over. Eighth day—No operation. Ninth day—Rub with pumice and water or oil.

Roof to receive two coats of standard roof paint. Deck to receive two coats of body color in oil. Trucks, platforms and battery boxes to receive one coat of enamel. Underneath work to receive one coat of oil color. Nine days consumed to finish this class of car, followed by two days for trimming, and O. K. on the twelfth day.

Steel Coach

The outside operations on a steel coach to be the same as those on dining and private cars.

Inside Operations—First day—Prime new or bruised parts. Second day—Touch up with surfacer. Third day—Putty and knife in parts. Fourth day—Sand and touch up new parts with color. Fifth day—Varnish all new work. Sixth day—Stand to dry. Seventh day—Varnish whole car if necessary.

If rubbed finish is desired, stand to dry at least 48 hours before this operation. Roof to receive two coats of standard roof paint. Deck to receive two coats of body color in oil. Trucks, battery boxes and underneath work, one coat of oil color. Platforms, one coat of enamel. Nine days consumed to finish this class of car, followed by two days for trimming, and O. K. on the twelfth day.

Steel or Wood Mail, Mail and Baggage, and Baggage Cars

After the car is washed and necessary repairs made, the following treatment to be accorded: First day—New or bruised parts touched up with body color, in oil. Second day—Putty. Third day—Sand and coat of body color in oil. Fourth day—No operation. Fifth day—Coat of body color in oil. Sixth day—Letter.

Roof to receive two coats of standard roof paint. Deck to receive two coats of body in oil. Trucks, battery boxes and underneath work, one coat of oil color.

Inside Operations—First day—New or bruised parts touched up with color. Second day—Putty. Third day—Sand paper, putty, and coat of baggage or mail car color. Fourth day—No operation. Fifth day—Coat of baggage or mail car color. Sixth day—Paint steam coils and guards, and necessary stenciling.

Six days to be consumed to finish this class of car, followed by one day for trimming, and O. K. on the eighth day.

Class C Repairs

Steel or Wood, Dining or Private Cars and Coaches

Car to be washed. After necessary repairs are made the following treatment to be accorded: Outside of car, new or bruised parts touched up with primer and surfacer, puttied, sand papered and cut in with color around letters and numbers. Apply one coat varnish. Roof to receive two coats of standard roof paint. Deck to receive two coats of body color in oil. Trucks, battery boxes and underneath work, one coat of oil color. Platforms, one coat of enamel.

Inside Operations—To be touched up and given only sufficient operations to make presentable and maintain railroad company's standard. Six days consumed to finish this class of cars, followed by one day for trimming, and O. K. on the eighth day.

Shopping

We would recommend that all first class equipment, steel or wood, be returned to the shops for attention at the expiration of 15 months. All second class equipment should be returned to the shops for attention at the expiration of 18 months.

All others, such as, excursion cars, etc., should be returned at the expiration of 21 months.

The members of the committee were D. C. Sherwood (N. Y. C.), chairman; W. N. Lamb (Penn.), M. Thierry (N. & W.), Thos. Marshall (C. P. R.) and W. Mollendorf (I. C.).

Discussion

Some objection was raised to the specific time allowances given by the committee. In answer, the chairman explained that the schedules were intended to meet average conditions, and were merely something to aim at, but that allowances could be made for conditions which made it impossible to meet them in detail.

Other Reports and Papers

Reports were also presented on Standards, Tests, and Safety and Sanitation. During the opening session the association was addressed by F. W. Brazier, assistant to the general superintendent rolling stock, New York Central, on the importance of Loyalty to the attainment of success. Moving pictures were also presented, by the Pullman company, showing the development of railroad cars, and the process of building Pullman sleeping cars. Abstracts of the above reports will appear in a later issue.

Election of Officers

The following officers were elected for next year: W. A. Buchanan (D. L. & W.), chairman; F. W. Bowers (Erie), first vice-chairman; A. E. Green (C. & N. W.), second vice-chairman.

Gasoline Motor Coach for the C. & N. W.

Trial Run Shows Practicability of Synchronized Double Motor Drive and Double End Control

A CHICAGO & NORTH WESTERN passenger coach of wood construction has recently been equipped with two gasoline motors, each driving on one of the trucks, by the Oneida Manufacturing Company, Green Bay, Wis. This arrangement of separate driving units has been made possible by the development of a system of synchronized electro-pneumatic control, installed in each end of the car so that it may be operated with equal facility in either direction.

The car recently made a trial run from Green Bay, Wis., to Pulaski, and return, after which it was turned over to the Chicago & North Western for further test under service conditions. On the trial run the easy riding qualities of the car and absence of vibration were noticeable, even at 45 miles an hour, the highest speed attained. The run was informal, no records being kept of speed, fuel consumption, temperatures, etc., but the car demonstrated its ability to run with either one or both driving motors in operation, when controlled from either end. A speed of about 20 miles an hour was made on the maximum grade of 0.7 per cent.

An interesting feature of the trial was the switching demonstration in which the coach was coupled to two loaded 50-ton box cars, which it readily moved back and forth on a siding. After the cars were started one motor was stopped and the other proved sufficient to keep them in motion.

This car has not been in service long enough to prove the present arrangement the most desirable in every detail. The two motors, for example, develop 70 hp. each and, with a loaded car weight of about 71,000 lb., the total weight per hp. is over 500 lb. If the car proves to be under-powered, higher rated motors can be readily applied, as the clutches and transmissions have been designed to transmit 140 hp. to each truck if necessary. A lack of adhesion to the rails was also noticeable on the trial run when the two pairs of driving wheels slipped in starting the loaded freight cars. It is believed that this condition can be improved by using larger steel wheels, instead of the present 33-in. cast iron wheels, and four wheel trucks in which a greater proportionate weight of the car will rest on the drivers.

Advantages in Design

The following are some of the advantages which the designers have endeavored to attain with the motor equipment applied to this car: (1) Safety of operation, secured by applying motor equipment to standard railway cars with no essential change in the car design; (2) reliability, obtained by using well established standard units for the motors, transmissions, clutches, air compressor, electric generating set, etc.; (3) low initial cost, by installing these standard units on equipment already owned by the railroads; (4) economy and flexibility in operation by using two relatively light, high-speed motors to get the car up to speed and then cutting out one; (5) electro-pneumatic, synchronized motor control, maintaining the speeds of the two motors the same within extremely close limits, well within the requirements for motors driving separate axles; (6) double end control, eliminating the necessity of turning the car at the end of its run, either on a turntable or wye; (7) arrangement for two or more cars to be coupled as multiple units and operated by a single motorman from the front end; (8) provision of two power units, enabling the car to reach its destination with one motor driving should the other become disabled; (9) a minimum number of gears in the transmission, always in mesh, reducing friction loss and preventing shifting or clashing of gears; (10) motor units readily detachable for repair or replacement. Should a number of

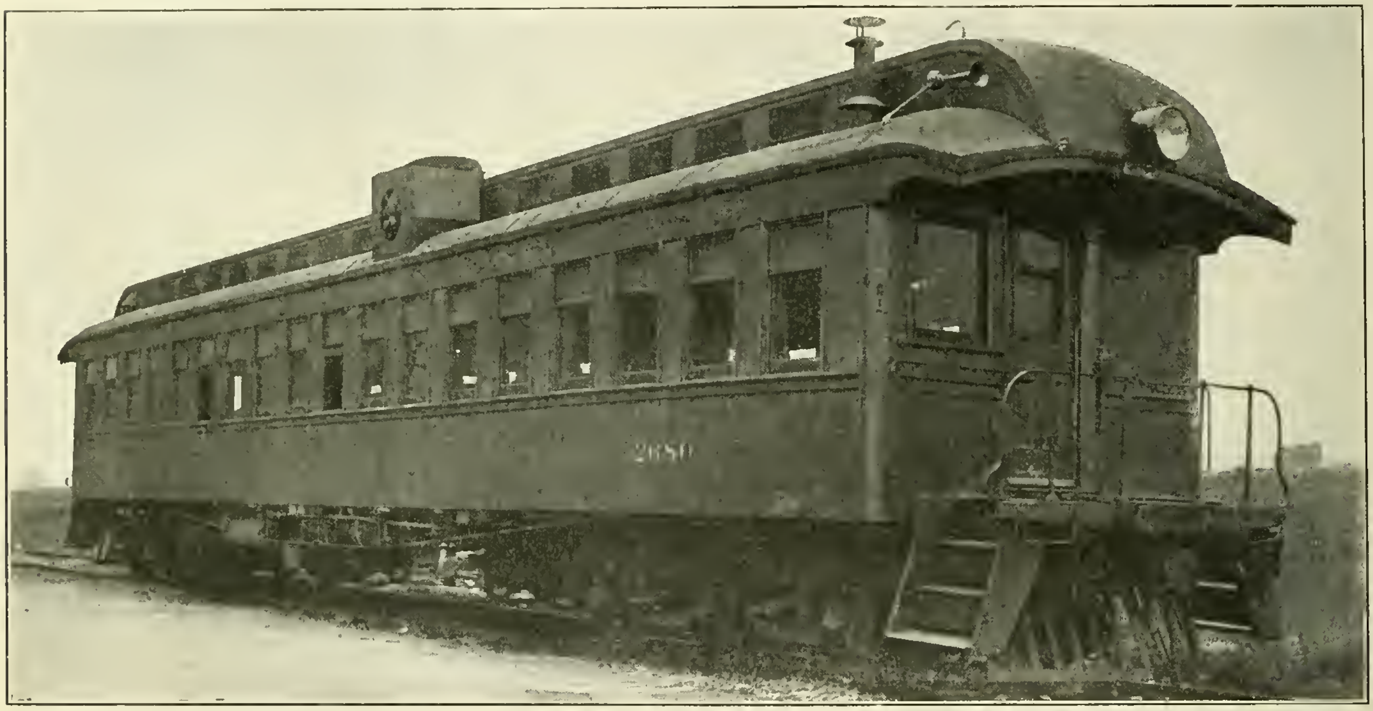


Fig. 1—Motorized Passenger Coach of the Chicago & North Western Ready for Branch Line Service

these cars be placed in branch line service from one terminal, one additional power unit can be repaired and kept in reserve, being quickly applied in case of emergency.

Description of Motor Equipment

The car selected by the Chicago & North Western for the application of Oneida motor equipment was the wooden frame coach No. 2680, equipped with six-wheel trucks, 33-in. cast iron wheels and 4¼-in. by 8-in. journals. This car weighs 62,000 lb. and seats 60 people. Fig. 1 gives the general appearance of the car, the pilot, the easily-detachable headlight, the horn and one radiator on the roof being plainly evident. The arrangement of the driving mechanism and auxiliary units used on the car are plainly shown in Fig. 2.

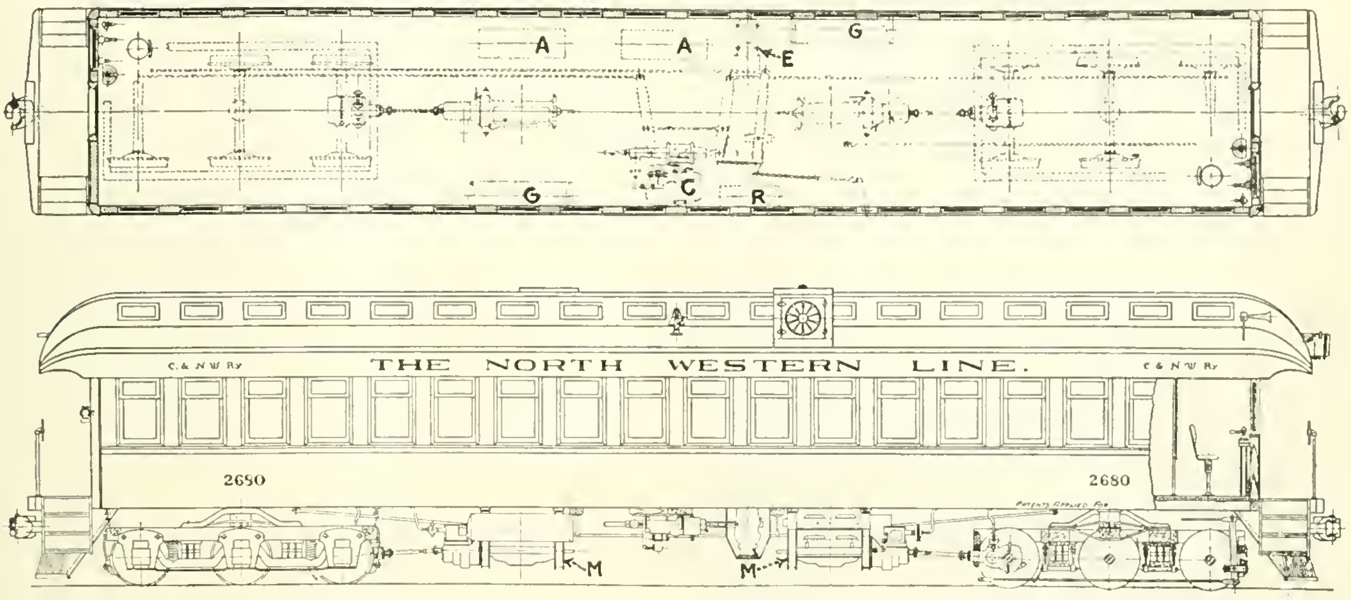


Fig. 2—Plan and Elevation Showing Arrangement for Double Motor Drive and Controls

Practically no change was made in the internal arrangement of the car in applying motor equipment with the exception that the longitudinal seat in each end was removed and replaced by the driver's seat and control apparatus. Referring to Fig. 1, the air reservoirs are shown at *AA*, air compressor at *C*, electric generating plant at *E*, gas tanks at *GG*, auxiliary reservoir at *R* and driving motors at *MM*. The driving motors are Model 6-B, Continental Red Seal, rated at 70 hp. at 2,200 r.p.m. They are of the six cylinder type with 3-3¼-in. bore and 5-in. stroke. The comparative motor and car speeds are shown in the accompanying table.

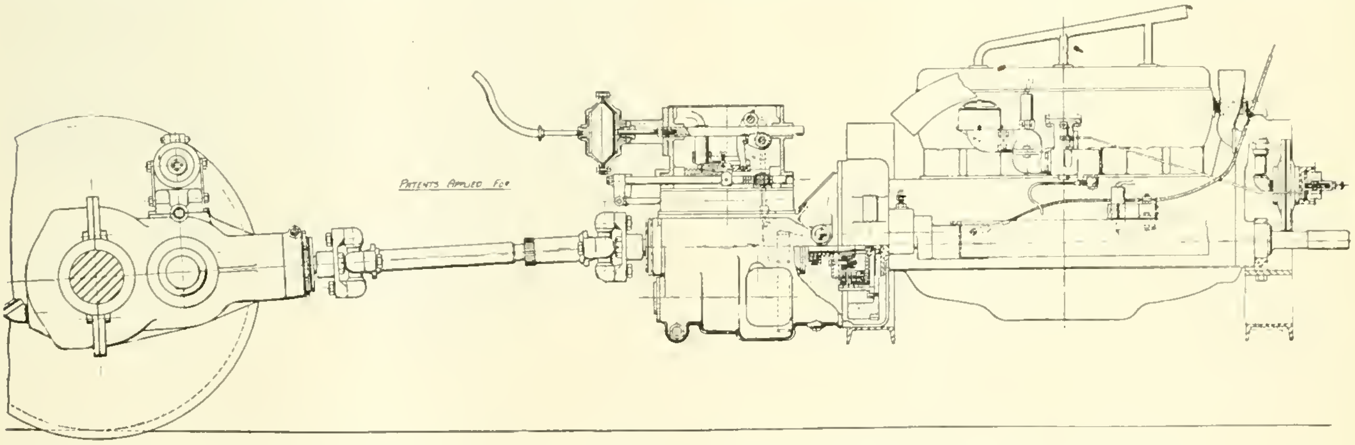


Fig. 3—Elevation Showing One Driving Motor, Universal Joint and Gear Connection to the Axle

A Bosch high tension ignition system is used in conjunction with a bus type generator. Both the starter switch and carburetor choker are of the Oneida remote controy type. Pneumatic speed regulation is provided and a hydrostatic governor gives uniform control from 250 r.p.m. to 2,200 r.p.m., the maximum speed. The air cleaner is of the centrifugal type. A Cotta unit power plant transmission is used, the gears, which are constantly in mesh being provided with sliding clutches. The gear ratios are: Low, 5.2 to 1; second, 2 to 1; high, 1 to 1. Detlaff disc type clutches are used, having nine discs, pneumatically controlled.

Comparative Motor and Car Speeds

	Speed of engine in R. P. M.				
Speed of car in miles per hour	500	1,000	1,500	1,750	2,200
1st speed	1.88	3.76	5.64	6.58	8.3
2nd speed	4.91	9.82	14.73	17.18	21.6
3rd speed	9.82	19.64	29.46	34.37	43.2

Synchronizing is accomplished through the medium of equalized air pressures. The selection of the gears only is accomplished through low voltage solenoid operation, while the work of shifting is performed by air pressure. The hydrostatic governor is directly connected to the water jacket of the motor, the pressure in the water jacket depending on the speed of the motor. The counteracting pressures which regulate the speed of the motor from the operator's control are produced by compressed air. This is the type of construction which makes it practicable to utilize a number of power cars in a train, all of which are controlled from one station by one operator.

The clutch and gear shift mechanism are pneumatically operated in unison. A double reduction gear is used on the axle, arranged for equal speeds in either direction with pneumatic reversing control; the ratio is 5 to 1. The tongue arm is spring-mounted to the truck frame and the suspension is such that the unit can be quickly removed or installed. The gasoline tank capacity is 52 gal. per motor unit.

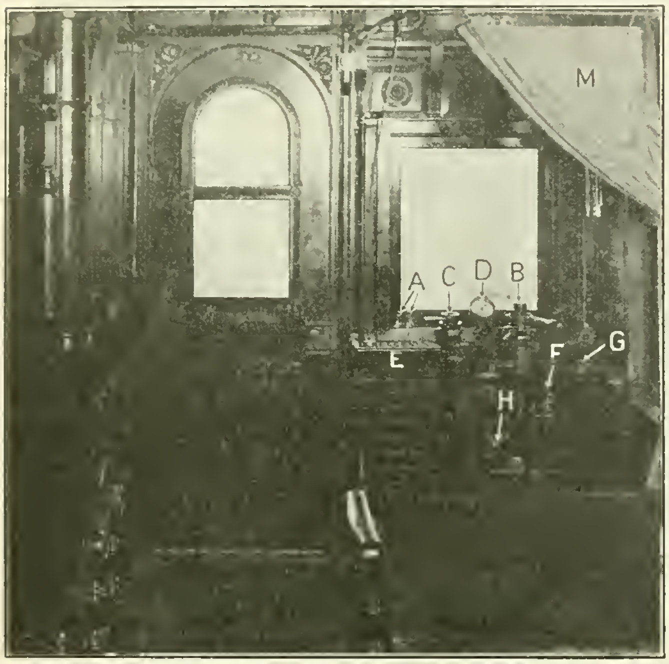


Fig. 4—Duplicate Controls Are Located in Each End of the Car

A Modine-spirex double core radiator for each unit is mounted on the roof. The fan is provided with electric thermostatic control whereby it cuts in at 160 deg. F. and cuts out at 150 deg. F., independent of motor speeds. During the trial run this fan started as soon as the car stopped but while the car was in motion sufficient air passed through the radiator to keep the cooling water temperature below 150 deg. F. A centrifugal pump circulates the water in the cooling system, which has a capacity of 20 gal. Special arrangements are made for operating in low temperatures.

The speed control is pneumatic, operated either by hand lever or foot pedal. The pneumatic gear shift and clutch are also operated by a hand lever. The gear selection, motor start and stop control are operated by hand levers and interlocked with the pneumatic control to make the arrangement positive and fool proof.

The air brake equipment is of the Westinghouse type and consists of a two-cylinder, 10-in. compressor, directly connected to a 1½-hp. 110-volt motor, equipped with the necessary regulating and controlling valves, two 14-in. by 48-in. air reservoirs and a standard controlling valve. On the car illustrated, brake shoes are applied on four wheels of each truck. The brake control system is arranged for both automatic and straight air application.

The car carries a Kohler four-cylinder, 2,500-watt, 110-volt, direct current, generating set which furnishes current for the interior lights, ventilating fan, headlight, radiator cooling fan and air compressor motor. This generating set is automatic in operation. Whenever a switch is turned on the generating set starts. All the accessories are thus separated from the power motors which need not be operated simply to provide air pressure or electricity. Moreover, a uniform speed of the air compressor is secured and there is no need of large storage battery capacity. This car is equipped with one small 24-volt battery. A double air-operated sander, Golmar automatic bell ringer, 250-watt headlight with dimmer and Strombos whistle complete the equipment of the car.

An operator's compartment, located at each end of the car, is enclosed by curtain *M*, Fig. 4. Two tell-tale lights *A* are provided to indicate whether or not both motors are operating; *B* is the air brake valve; *C*, the clutch throw out and gear shift; *D*, the duplex air brake gage; *E*, the electric speed selector; *F*, the sander valve; *G*, the governor valve, and *H*, the air-operated bell valve.

New Lock Lifter for Type D Coupler

Type D Couplers have occasionally given trouble in service on account of the lock lifter working out of the lock causing the coupler to become inoperative. In order to correct this, the Mechanical Division of the American Railway Association has brought out a new design of lock lifter as announced in the following circular issued by the division.

The Committee on Couplers and Draft Gear has had called to its attention recently some trouble with the lock lifts of the D couplers, wedging or sticking when the coupler is in locked position. In extreme cases, the lifter could not be raised sufficiently to unlock the coupler, making it necessary, therefore, to remove the coupler from service.

An investigation of this trouble developed that the lifters of a few of the D couplers were working their way down under the anti-creep ledge as indicated on Fig. 1 which shows this development in a coupler removed from service. This condition is brought about by extreme wear combined with minimum gage parts in the coupler.

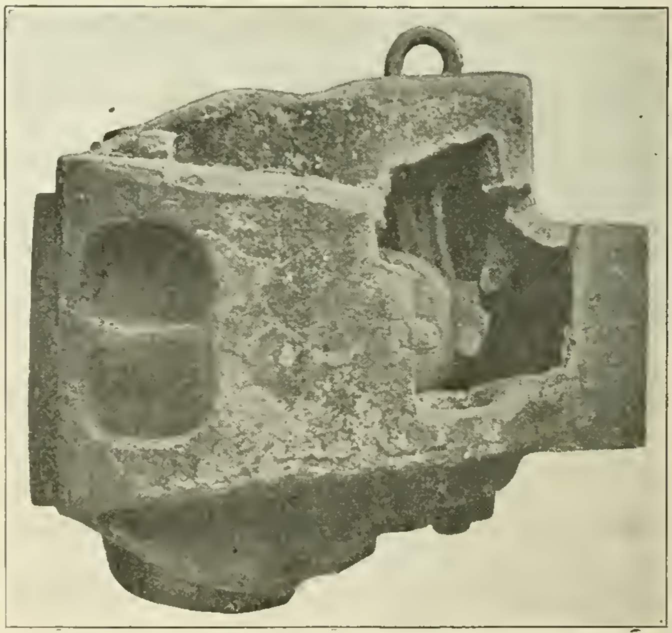


Fig. 1—Lock Lifter Out of Place, Making Coupler Inoperative

In order to overcome this trouble, the design of lifter has been slightly modified to compensate for wear that has developed and application of the modified lifter to couplers giving trouble in service has corrected the same. Fig. 2 shows the relation between the lifter and anti-creep ledge with a modified lifter applied to a coupler that was giving trouble in service. Fig. 3 shows the new and the present design of the lifter and will be of assistance in distinguishing the two designs. The modified lifter is interchangeable with the present design and all lifters manufactured in the future will be of the modified design. This modified design of lock lifter is designed as the D coupler lock lifter No. 2.

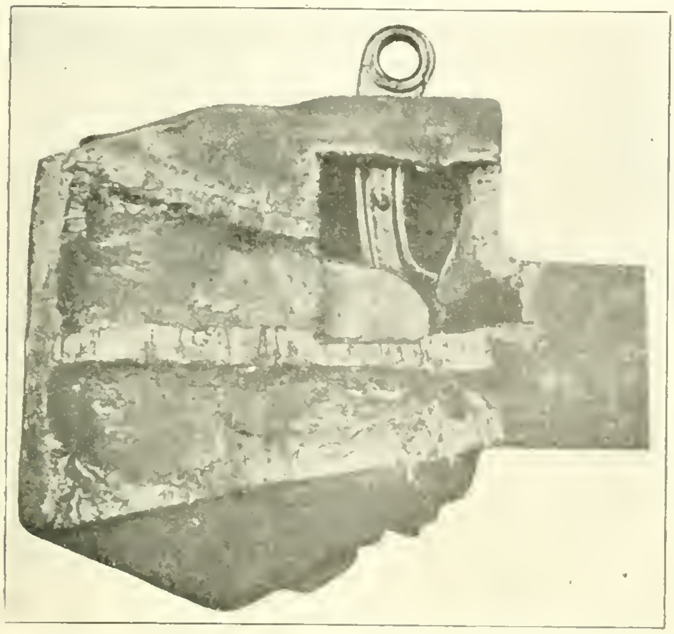


Fig. 2—New Design of Lock Lifter in Type D Coupler

When D couplers are found to be inoperative on account of the lifter wedging, as above indicated, the modified design of lifter should be applied. The coupler manufacturers are in position to make immediate deliveries on the modified design.

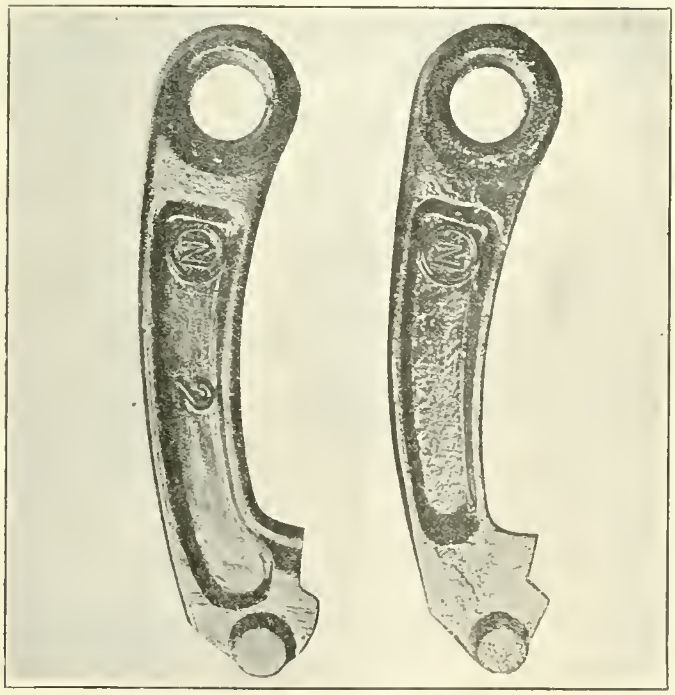


Fig. 3—New Lock Lifter for Type D Coupler (at left) Compared with Former Design (right)

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Failure to Stencil Air Brake Cleaning Date

The Philadelphia & Reading made a repair card showing the cleaning of the cylinder and triple valve of Bessemer & Lake Erie car No. 9560 on January 29, 1921. The New York Central made a repair card dated September 16, 1921, showing the cleaning of the cylinder and triple of the same car, on account of "no date." The car returned to the home line on March 6, 1921. The owner requested the Philadelphia & Reading to cancel its charge for the repairs reported on January 29, on the ground that the repair men had failed to stencil the car, thus giving the New York Central the right to re-stencil and render bill. The Philadelphia & Reading refused to grant this claim on the ground that the New York Central did not make proper effort to locate the stenciling and because the owner failed to secure joint evidence when the car returned home, as required in Rule 13. The Bessemer & Lake Erie maintained that the absence of stenciling upon a car to show when the triple was last cleaned cannot be considered improper repairs, that the absence of the stenciling made the car subject to cleaning at the owner's expense and that no further responsibility rested upon the interchange inspector or any other inspector. This road also pointed out that Rule 90 provides that the billing repair card of an intermediate line shall be final and shall perform the same function as a joint evidence.

The Arbitration Committee decided that: "In a case of this kind car owner cannot be expected to obtain joint evidence on arrival of car home. Rule 90 applies. The contention of the Bessemer & Lake Erie is sustained."—*Case No.* 1251, *Bessemer & Lake Erie vs. Philadelphia & Reading.*

Substitution of Steel Tired for Wrought Steel Wheels, Improper Repairs

The Bessemer & Lake Erie received its car No. 80934, December 5, 1920, with two pairs of steel tired wheels in place of the wrought steel wheels standard to the car. A joint evidence card was obtained and presented to the Northern Pacific, which had applied the wrong wheels on August 31, 1920. The Northern Pacific refused protection because of the extensive use of steel tired wheels and the common practice of substituting one type of wheels for the other in both freight and passenger equipment. The owner contended that the A.R.A. rules did not permit the substitution of steel tired wheels for other wheels, and that no wheel could be substituted for the wheel standard to the car, provided that the wheel standard to the car was an A.R.A. standard. The Northern Pacific stated that "There is no question but that steel tired wheels are a much better and safer class of wheels than the cast steel wheels which are considered to be amply safe for use in freight equipment." The owner maintained that steel tired wheels were only used in locomotive and other special service, and were not considered safe any longer for freight service. On this the Bessemer based its claim that the steel tired wheels should be charged out at normal prices as scrap wheels, and credit allowed for the same amount at the time of removal and scrapping

The Arbitration Committee rendered the following decision: "Wrought steel wheel is A.R.A. standard. Substitution of steel tired wheels constitutes improper repairs, and the road making the repairs is responsible per Rules 16 and 87."—*Case No. 1257, Northern Pacific vs. Bessemer & Lake Erie.*

Net Store Department Costs Applicable on Non-Standard Roof

Northern Pacific box car, No. 43809, underwent heavy repairs at the Louisville, Ky., shops of the Louisville & Nashville. The repairs included the renewal of one complete outside Murphy improved X.L.A. metal roof, for which a charge of $108.47 was assessed, based on actual store department costs. The Louisville & Nashville contended that it was justified in charging the above amount, inasmuch as this was non-A.R.A. material and the repairs as made were authorized. It was also contended that the L. & N. was not aware at the time the repairs were being made, that the car owner's standard was not being maintained, as the roof removed was badly corroded and it was impossible to tell the gage of the iron. The Northern Pacific claimed it had been sufficiently penalized in being required to accept a non-standard roof without the additional penalty of having to pay 100 per cent more than the price of the standard roof; that galvanized iron roofs, which could be purchased at a cost of $57, were standard to this car, and, that the price of the material applied should not exceed the cost of the standard roof. It also thought it necessary to have some kind of restrictions to protect the car owner against the application of expensive specialties.

The Arbitration Committee decided that: The bill of the Louisville & Nashville on basis of their net store department cost is sustained."—*Case No.* 1258, *Louisville & Nashville vs. Northern Pacific.*

Bill for Improper Roof Repairs Confined to Labor

On October 17, 1920, the St. Louis-San Francisco forwarded to the Central of Georgia a joint inspection certificate covering defects requiring the renewal of underframe sills, body posts and braces, and decking and siding to the extent of practically rebuilding the superstructure of the car. The certificate, however, did not specify any roof defects. The estimated cost of repairs was labor, $280; material, $450. Through the oversight of the foreman in rendering the joint inspection statement and subsequent defects found upon dismantling the car, the final cost of repairs amounted to $1,213.72. The Central of Georgia refused to grant the St. Louis-San Francisco authority to bill for the full amount, and held that road to the amount of their original estimate, plus the $50 tolerance allowed by the rule. Among the additional items was the renewal of the roof. Instead of ordering a metal roof from the car owner, the foreman equipped the car with a double-board roof. On arrival of the car home the Central of Georgia claimed improper repairs and a defect card was issued, on which a bill was rendered in the amount of $144.63. The St. Louis-San Francisco claimed that under the rules, the repairing road should be reimbursed for the labor and material expended in making improper repairs and that, upon correction of such repairs, the car owner shall recover on the authority of the defect card.

The decision of the Arbitration Committee stated that the bill of the Central of Georgia for improper repairs should be confined to labor only, according to Rule 88.—*Case No.* 1259, *St. Louis-San Francisco vs. Central of Georgia.*

Cleaning Air Brakes More Than Once Within 60 Days

The Midland Valley was billed for cleaning the air brakes on its car No. 3828 by the Southern Pacific three consecutive times within a period of 40 days. On April 11 the Southern Pacific made repairs to this car at its Sacramento, Cal., shops, a part of which was for cleaning, oiling and testing the cylinder and triple. On May 11, the same road made the same repairs at its Mojave, Cal., shops and again on May 21 at its Tucson, Ariz., shops. The car was in continuous service on the Southern Pacific Lines during this time. Objection was made to the frequency of these charges by the Midland Valley, which contended that if the work had been properly performed in the first instance, the two subsequent cleanings should not have been necessary. The Southern Pacific claimed that while the triple valve may not have been as dirty as it would have been had it been in service several months, it could accumulate enough dirt to render it inoperative; that scale or grit might be blown into the triple from the branch pipe at any time.

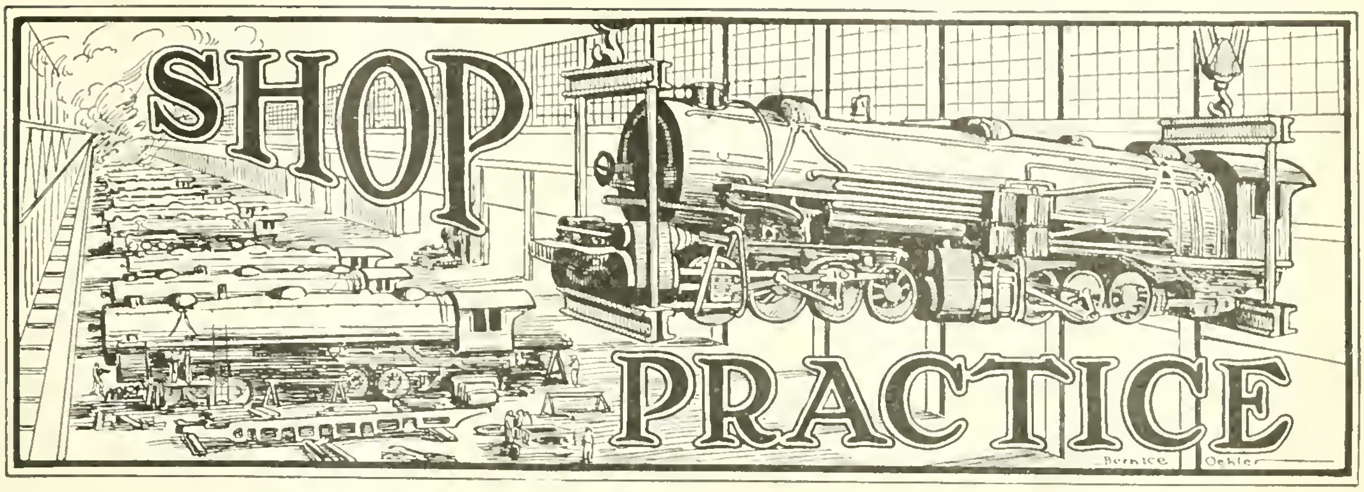
The Arbitration Committee's decision states that: "In such cases where the air brakes have been cleaned more than once on the same road, within 60 days, the expense of such cleaning should be assumed by the handling line. Therefore, charge for cleaning air brakes May 11 and May 21, 1921, should be withdrawn."—*Case No.* 1260, *Midland Valley vs. Southern Pacific.*

Responsibility for Damaged Car Due to Weak Construction

Pere Marquette box car No. 31132, 60,000 lb. capacity, was damaged while being handled in a Lehigh Valley train going up the mountain at Kelly's Run, October 20, 1921. There were 77 cars in the train, this car being the forty-eighth car from the head end. There were two engines ahead and one pusher engine behind, which did not have the air connected to the train. The train parted between the sixth and seventh cars, which caused the air to go into emergency. The body of the Pere Marquette car was crushed, humped in the center and the sides bulged out. After the strain of the train was released, the center of the body of the car dropped down on the track, due to the weight of the load. There were no wheels derailed, neither was the body of the car off center.

The total cost of the repairs was estimated by the Lehigh Valley at $1,221.60. The Pere Marquette objected to this amount, contending that after the train broke in two, the pusher engine, not being affected by the emergency application of the brakes, continued shoving the remaining cars, thereby causing the damage. It maintained that where it is necessary to handle trains in this unusual manner the handling line should be responsible to the owner for damage done to their equipment; that the fact that the body was entirely destroyed and the center of the car crushed and down on the rails, indicated rough handling, and that the owner should not be put to the expense of rebuilding or settling on a salvage basis. The Lehigh Valley stated that examination showed the car had 5-in. by 8-in. center sills to which the emergency draft arms were applied. These sills were apparently the original sills applied when the car was first built. It contended that the destruction of the car was due to its light center sill construction which failed in ordinary handling of the train.

The Arbitration Committee decided that: "The car was damaged as the result of an emergency application of the air brakes, due to parting of the train. There was no evidence of derailment or other unfair usage. Therefore, the damage to the car is the owner's responsibility."—*Case No.* 1261, *Lehigh Valley vs. Pere Marquette.*



Locomotive Scheduling at the Silvis Shops

Part 4—Performance

New Schedule System Designed to Provide Centralized Control of Production and Accurate Cost Data.

By L. C. Bowes,* G. F. Sandstrom † and H. K. Robinson‡

IN the previous articles the complete cycle of centralized production and cost control have been outlined, and the potentialities of that within itself have been indicated. The biggest of all problems now presents itself, namely, that of cutting in and establishing the required functions and routine together with building up and unifying the personnel of the required organization. The problem divides itself into two main divisions—which are:

1. Technical.
2. Morale.

While the technical end is extremely difficult to establish, this difficulty is secondary to the possible difficulties encountered in creating the proper morale which, after all, is the keynote to the success of any endeavor irrespective of any other features that the endeavor may have to recommend it.

High Morale Essential for Successful Operation

Too much stress cannot be laid upon the fact that in the absence of this unified organization and high morale, failure only can attend the endeavor, even though the principles adopted and details established be perfect within themselves.

In order to obtain the necessary morale for the successful operation of any new organization it requires—

1. The complete understanding and faith of everyone connected therewith, not necessarily as to details but as to the principles involved, and the potentialities possible from the standpoint of true management.

2. The complete delegated authority to and co-operation of all officers and division heads connected therewith, together with a hearty and active support of the management as a whole.

While it seems unnecessary to point out that many hardships and discouragements are contended with establishing a re-organization program, the fulfillment of the requirements enumerated above is of vital necessity in order that such hardships and discouragements be surmounted and the program carried to completion in the most successful and harmonious manner.

While it appears that the above is a digression, the object in bringing out these salient and necessary factors is because of the fact that there is always a danger of treating any new endeavor as a mystic and not understandable unique cure-all. There is a proneness in human nature, when the "new" presents itself, to sit on the side lines and clamor for immediate and tangible results. Such cannot be the case, however, as by reading the foregoing articles, it can be very well seen that centralized production and cost control has no mystic power, but consists of nothing more nor less than *Common Sense Systematically Applied.* Further, it may be seen that immediate and tangible results cannot be expected, but the success lies in recognizing the potential possibilities. By the same token, it is most unfair to attempt to measure the success and correctness of principles involved and details established by the immediate returns. This is due to the fact that it is not possible to apply any one complete program at one time, for as it is well known, and by reason of engineering procedure, the real and final program must evolve itself and find its own operating level under the conditions necessary and peculiar to the particular activity. Therefore, the only attempt has been to outline a program which is correct in principle, leaving the measure of actual results and routine to the time when the momentum created will swing itself into its own course.

Maximum Daily Output Obtained under Unit System

The proposed measure of output will be based on the analysis and creation of a capacity measured by average standard unit man-hours, instead of actual number of locomotives as heretofore. Further, instead of making a supreme effort on monthly locomotive output, such effort should be concentrated on a maximum daily production. Thus it is seen, by such a program of maximum daily production, the monthly output will automatically take care of itself, such monthly output being merely a post-mortem reflection of the accumulated daily production. This results in a more uniform flow of output, and eliminates the "end of the month" spasm to meet scheduled output so common in railroad repair shop practice.

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*Production engineer, C. R. I. & P. †Industrial engineer, Roberts-Pettijohn-Wood Corporation. ‡Special accountant C. R. I & P.

However, in order to accomplish the maximum of daily output, the condition forces itself into a balance of the several major progressive operations, which are in the main—

Group 1—Locomotives in process of stripping.

Group 2—Locomotives blocked and in early stage of repair.

Group 3—Locomotive boilers tested o. k. signifying boiler work complete.

Group 4—Locomotives on wheels in final stages of repair.

Group 5—Locomotives breaking in.

The correct balance of all of these groups directly affect—

Group 6—Locomotives o. k. to Transportation Department.

Thus it is very evident that, in order to meet and obtain a true reflection of these conditions, the unit system is the only one that lends itself to correct visualization. By virtue of correct visualization, which presupposes daily rather than monthly blanket scheduling, it makes possible the opening up and immediate remedy of all delays to production. By means of this daily scheduling, certain geometric formations of the red tickets on the master schedule board (See Fig. 1, July issue) indicate without further analysis the balance of the sequence of the several progressive operations. For example; if the formation of the red tickets is that of an inverted triangle, with the lower point of the triangle on the last division of scheduled operations, and the heavy portion of the triangle in the first division of schedule operations, it is reflected immediately that the shop is in a reverse condition and the groups aforementioned are not properly balanced. For proper balance, which means uniform output, the position of this triangular formation should be such that the point is on the first division of the scheduled operations and the heavy portion of the triangle is on the last division.

While it should be remembered that there should be no red tickets, however, this example is merely brought out to show that the latter formation reflects a condition which, no doubt, is possible of immediate remedy, inasmuch as the heaviest work has already been completed.

Another great factor in daily scheduling and subsequent performance is brought out by the fact that the master schedule board is a graphical representation of the paths of progress of the locomotives in the shop, and any interference of these paths, one with another, reflects immediately without further discussion, a physical interference of work in the shop. Such interference could not possibly have been apparent until it actually occurred, unless by some such means of graphical reflection it could have been predetermined.

The reason for laying stress on the connection between performance and daily scheduling is that, *no routine forms* are necessary with the exception of the two already existing forms, namely, production and material tickets which are always necessary in any shop under any system.

Such a system as it has been attempted to describe in its elements and basic features is all very well within itself. It is a means of providing for necessary intensified functions and routine, which, combined with the proper operating policy, permits of a program of maximum production.

Manufacturing Separated from Stripping and Erecting

The general procedure common to a railroad locomotive repair shop is as follows: The locomotive is brought into the shop, stripped and parts stripped distributed to the various departments for replacement or repair. When such activities have been completed, parts are again assembled and placed on locomotive. It can be readily seen that such a procedure is of necessity a direct hindrance to speedy output, in that the locomotive is held out of service until repairs or replacement of parts have been made. This hindrance is a result of failure to open up and intensify on each particular endeavor.

Therefore, the thought presents itself of the possibilities of a radical departure and extreme program, whereby all activities would be opened up, and would be intense within themselves and have no immediate relation with each other but would solve the problem of speedy production. This necessitates primarily the forming of two general and distinct divisions of locomotive repairs, which are—

1. Manufacturing: a—New parts; b—Repairing old parts.
2. Stripping and erecting.

The manufacturing endeavor will be carried on irrespective of locomotives currently in the shop, but will be based upon a blanket program of having necessary parts ready to apply to locomotives when they do reach the shop. Further, the capacity of such manufacturing activity is entirely separate from the locomotive capacity of the repair shop.

By the same token, the locomotive capacity is irrespective of the manufacturing division. Therefore, the output of locomotives under such a program assumes a new and startling aspect, in that the measure of capacity will be governed by the capacity of stripping and erecting only.

Applying this program to a shop built for an output of 60 locomotives per month under the heretofore generally accepted measure of capacity, and remembering that the manufacturing problem becomes a problem of itself, such a shop has a potential capacity of 180 locomotives per month.

For example; it is generally conceded that the time of repairing a locomotive may be divided as follows:

Stripping	10 per cent
Repairing	67 per cent
Erecting	23 per cent
Total	100 per cent

Thus it is very evident from applying this new program that the locomotive production is increased in the ratio of three to one, or that 67 per cent of the time (roughly two-thirds) has been eliminated so far as locomotive capacity is concerned, and has been taken care of by the manufacturing capacity. Such a program presupposes a very careful analysis and an established schedule of shopping which must be strictly adhered to. This program has been exploited at this time in the extreme and any practical application will find its own level as governed by existing conditions.

This article concludes the attempt to bring out the salient and controlling features, as governed by the basic principles of true management, as applied to the repair of locomotives. Constructive criticism is invited with the hope that something tangible will be accomplished in bringing about a solution to a problem which has been paramount for many years.

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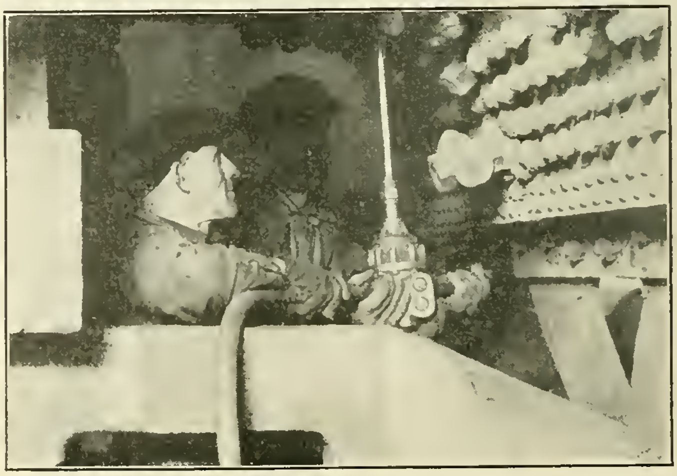

Tapping a Boiler Staybolt Hole in Close Quarters

Setting Valve Gears of the Radial Type*

A Rapid Method of Setting and Adjusting Radial Valve Gears Without Rolling the Wheels Is Described

By S. P. Kennedy

THE quickest method of setting and adjusting the different types of radial valve gears without resorting to rolling the wheels is based on the method in which the gear was originally designed for its particular type of locomotive.

Many methods of setting valves are in use, commonly known as squaring valves, trailing valves and the like, but such methods do not always keep the locomotive from "limping"—a common name for an engine with valves which cut off unequally, such as two large exhausts and generally two small ones.

The average erecting shop man is accustomed to being shown instead of being told. As drawings are the universal language and speak for themselves, seven have been arranged to show clearly each operation in setting the valve to get equal lap and lead and equal cut-off; that is, the cut-off for which the gear was originally designed—say 25 per cent, more or less, according to whichever class of service the locomotive was designed for.

It is a well-known fact that no valve gear can be designed to give an equal cut-off in all its positions, due to angularity of main rod and eccentric rod. That is why it is best to set the valves with equal lap and lead and let the original cut-off design take care of itself, for the engineman does not adjust his reverse lever to any one set cut-off.

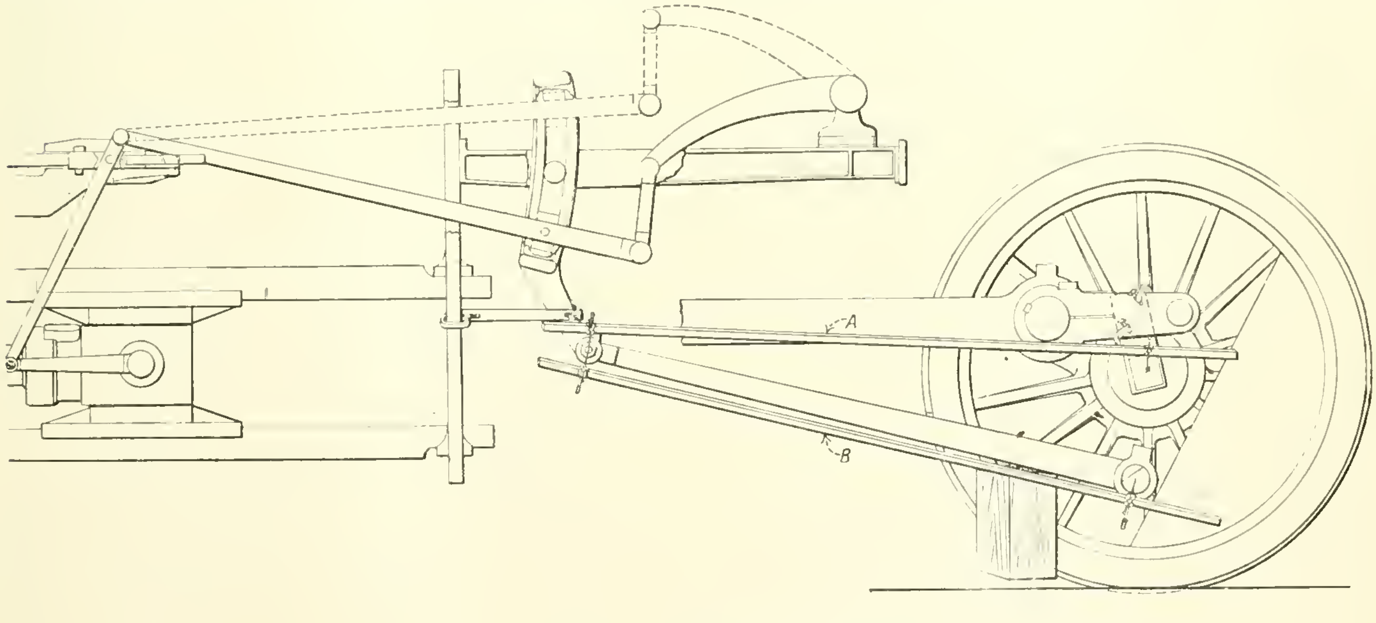

Fig. 1—Setting the Walschaert Valve Gear

Setting Walschaert Valve Gear

Fig. 1 shows the Walschaert gear with a new main crank pin applied and Fig. 3 and Fig. 4 show how the crank is set, drilled, reamed and keyway cut at the machine shop drill press after the wheels have been removed from the wheel press.

Practically all back shops have blue prints of all their different classes of locomotives, but it is best not to rely entirely on blue prints as an occasion may occur at an outlying point, for example, that a strange locomotive is in for a new main crank pin and no blue prints available. Make a sketch on the laying-off table or on a piece of boiler steel or on any flat surface, as shown in Fig. 5, to actual size or to some convenient scale—say ¼ in. to the inch—using a pair of ordinary trammel points commonly used in laying off shoes and wedges. First scribe a circle *C* equal in diameter to the stroke of the piston, for example 32 in. Then draw a horizontal straight line which will be called the center line of motion. Measure from the center of the cylinder or piston rod to the center of the wheels and note if the cylinder is on the center line of motion, or if not, the distance above it. If above the center line of motion, draw a horizontal parallel line the proper distance above it. Next get the measurement of the main rod and scribe its length from the nearest point on the crank pin circle to the point *D* on the center line of the cylinder. Then draw a straight line from the point *D* to the center of the circle and the point *E* where it passes through the crank pin travel circle will be the dead center. Another way to obtain the point *D* is to add one-half the stroke of the cylinder to the length of the main rod and scribe an arc with this radius from the center of the crank pin circle. Next measure from the center of the pin in the bottom of the link, or link foot pin, to determine how far, if any, it extends above the center line of motion. When measuring, it is essential that the link be in the position shown in Fig. 1, known as "still valve position." If the link foot pin is above the center line of motion, scribe off a horizontal line *F* the measured distance above the center line of motion. Then set the trammel points to the length of the old eccentric rod, which is accurate enough for this dimension, and with one point at the center of the crank pin circle scribe the length on the link foot pin line and draw a straight line G through the two points as shown in Fig. 5. From the point where this line passes through the crank pin circle, measure the distance to the center line of motion and then scribe a line H located the same distance back of the quarter or perpendicular line through the same circle, with its other point through the center of the circle. Scribe the length of the crank arm from the point E, which is the intersection of the center line of the main rod, with the crank pin circle through the last scribed line H. The distance measured from this last point I to the center of the crank pin circle will be the radius of the circle J in which the crank arm pin travels. Scribe this same dimension from the crank arm pin center, as shown in Fig. 4, to the piece of sheet iron clamped on the crank arm; also scribe as shown in the same drawing one-half of the crank pin travel or stroke on the same piece of sheet iron. The average mechanic would say it is impractical to measure from the crank pin in the case of an old pin, as the tendency is to wear out of round, so before putting the crank arm on the pin scribe a circle around its outer edge, slightly larger than the diameter of crank pin, in order to act as a proof line as shown in Fig. 4. The point where these two lines scribed on the sheet iron intersect should be directly out from the center of the wheel, as shown in Fig. 3. If not, knock the crank arm to this position and measure out with a square, as shown in Fig. 4. Try the square in all four positions from the wheel center, but before doing so the face on axle should be sand-papered clean.

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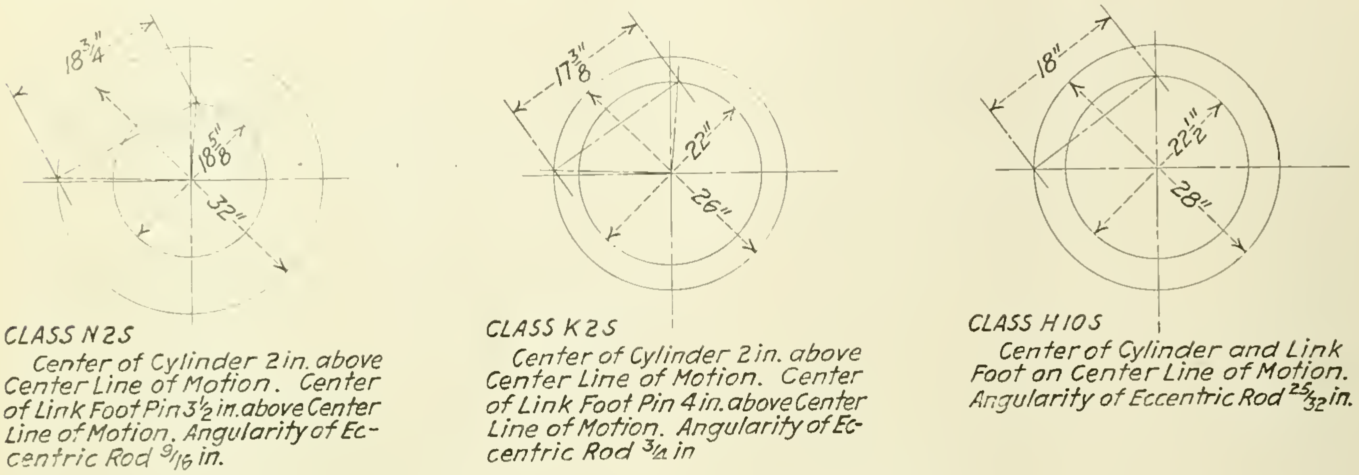
*An article submitted in the Erecting Shop Competition and judged worthy of honorable mention.



CLASS N2S
Center of Cylinder 2 in. above Center Line of Motion. Center of Link Foot Pin 3½ in. above Center Line of Motion. Angularity of Eccentric Rod 9/16 in.

CLASS K2S
Center of Cylinder 2 in. above Center Line of Motion. Center of Link Foot Pin 4 in. above Center Line of Motion. Angularity of Eccentric Rod ¾ in

CLASS H10S
Center of Cylinder and Link Foot on Center Line of Motion. Angularity of Eccentric Rod 25/32 in.

Fig. 2—Charts Giving Data Required for Laying-out Gears May Be Obtained from the Drawing Room

The same method of setting crank arms is applicable also to the Baker, Southern and similar gears.

To get the next important dimension the still valve must be obtained and while obtaining the still valve other parts may be checked at the same time as shown in Fig. 1. Clamp the bottom arm on the link to some stationary point, the guide yoke, for example, and reverse the gear from forward to backward positions. Hold the valve rod tram on the rod to see that there be no motion of the rod. Should the rod move, shift and reclamp the link until it can be reversed without moving the valve. It is important while reversing that the crosshead be on either front or back end of its stroke; that is, the distance from the striking point to the clearance

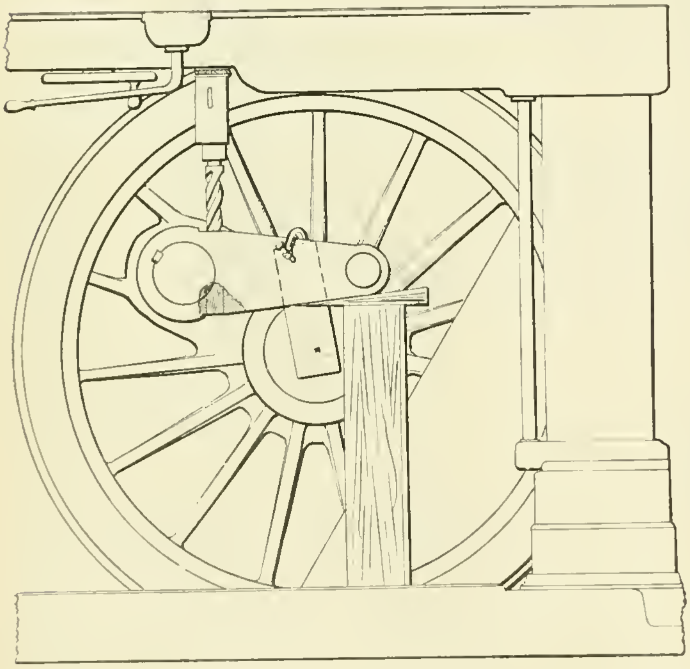


Fig. 3—Locating Crank Arm

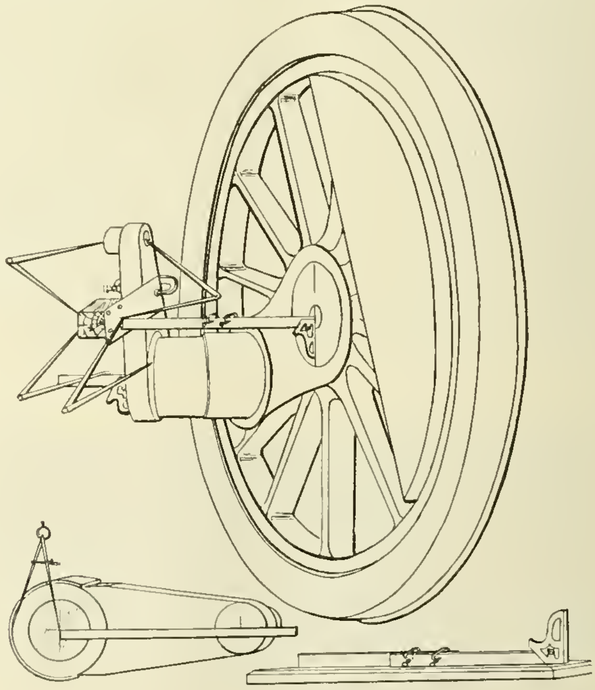


Fig. 4—Locating Centers

line as shown in Fig. 1. With the link clamped in this position, move the crosshead from its forward to back position and scribe the valve rod again. The two points should be at an equal distance on both sides of the port opening marked as shown, but if not, shorten or lengthen as the case may be by applying or removing liners to the valve spool inside the chamber, if the valve rod is too close to shorten. In no case should the length of the radius rod be altered unless it is done to obtain a still valve, as previously described in order to have it the correct radius of the link. With the wheels under the locomotive and the crank arm in place—as shown in Figs. 1, 3 and 4—it will be seen that a small block is screwed to the sheet iron clamped to the crank arm in order to bring it out to the face of the eccentric crank arm pin. The center from the inside of the sheet is transferred to the outside of the block, as shown in Fig. 4. This is the exact center of the wheel. With the eccentric rod attached to the link foot, set the trammel points to the center of the pin in the bottom of the link foot and measure back to the center of the wheel scribed on the block. The way in which the trams are used is shown in Fig. 1. This is not the length of the eccentric rod but the base from which the length is obtained. Use the same manner of laying out as previously used and shown in Fig. 5. With the eccentric crank arm travel scribed as shown, scribe with trams from the center of the circle (actual size) to a point on the link foot center line. From this last scribed point reset the trammels to measure from this point to the top or bottom of the eccentric crank arm travel at the point where it is intersected by the line through the center of the circle, which is perpendicular to the eccentric rod line. Hold the front tram point in its place and scribe from top to bottom of this crank arm circle, starting and ending on the perpendicular line as shown. This set dimension will be the correct length of the eccentric rod, or one may measure from this radius line to the center of the circle and add this to the length of the trams A in Fig. 1, which will also give the exact length of the eccentric rod. With the valve lined up to get equal lead on each side of port opening marks, the cut-off will run at whatever percentage it was originally designed for. To determine if the valve travel will be equal on both sides of the locomotive, place both crossheads in the same position and swing the link backward and forward with the reverse lever in center, or move the reverse lever until there is no motion in the valve. Then try the other side; if the valve is not still when link is swinging, the radius rod hanger must be lengthened or shortened, as the case may be, in order to obtain a motionless valve on both sides with both crossheads in the same position.

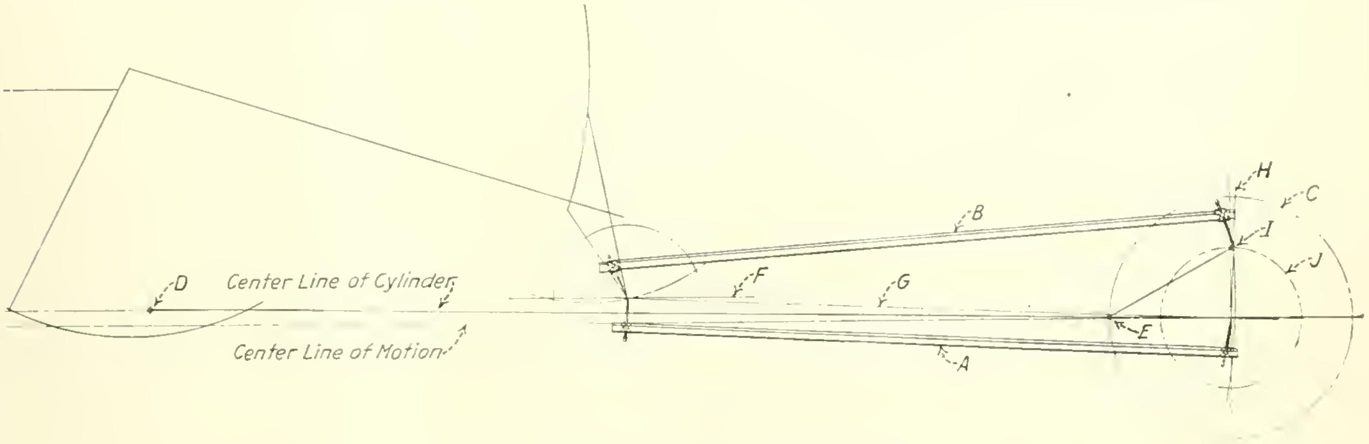


Fig. 5—Laying-out Walschaert Gear When No Drawings Are Available

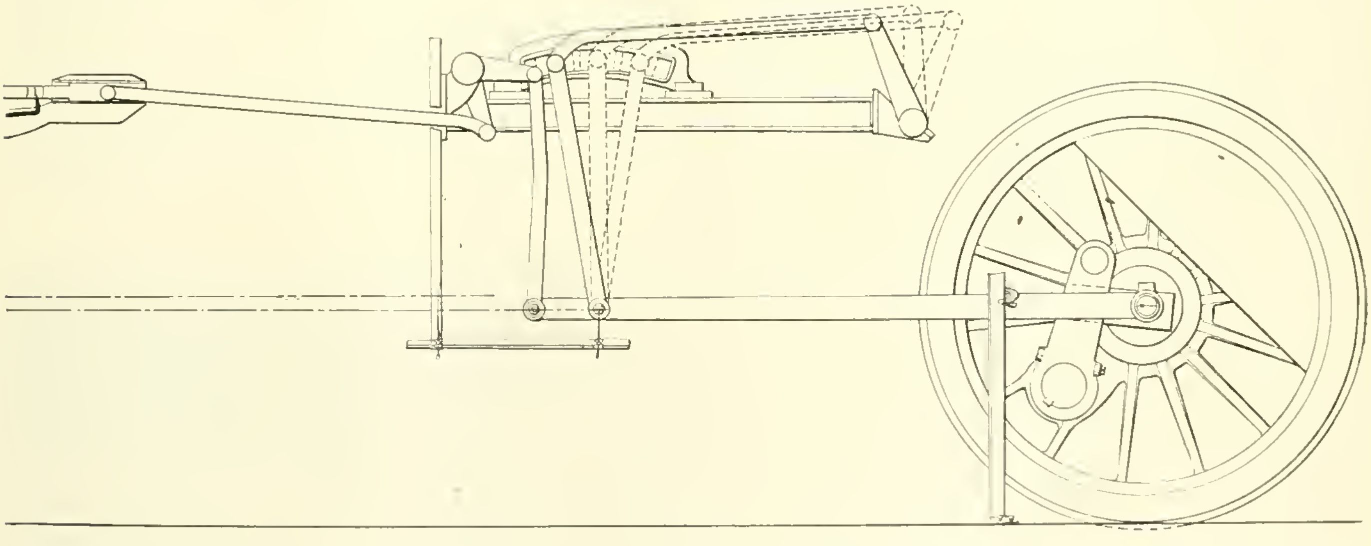


Fig. 6—Setting the Southern Valve Gear

If blue prints are available, no laying off will be necessary to obtain the different dimensions. A chart can then be made like Fig. 2 showing all the dimensions that are necessary to adjust the valve gears correctly. These may be obtained from the head draftsman as well as the angularity of the eccentric rod for different classes, which is important.

Setting Baker Valve Gear

The instructions for setting the Baker valve gear are based on a ratio, as the reversing gear is standard for all types of locomotives. The method described for setting Walschaert gear may also be used to set correctly and adjust the Baker gear. When doing so, no precaution need be used to have the crosshead in any one position when obtaining a still valve or when equalizing the valve travel on right and left sides of the engine.

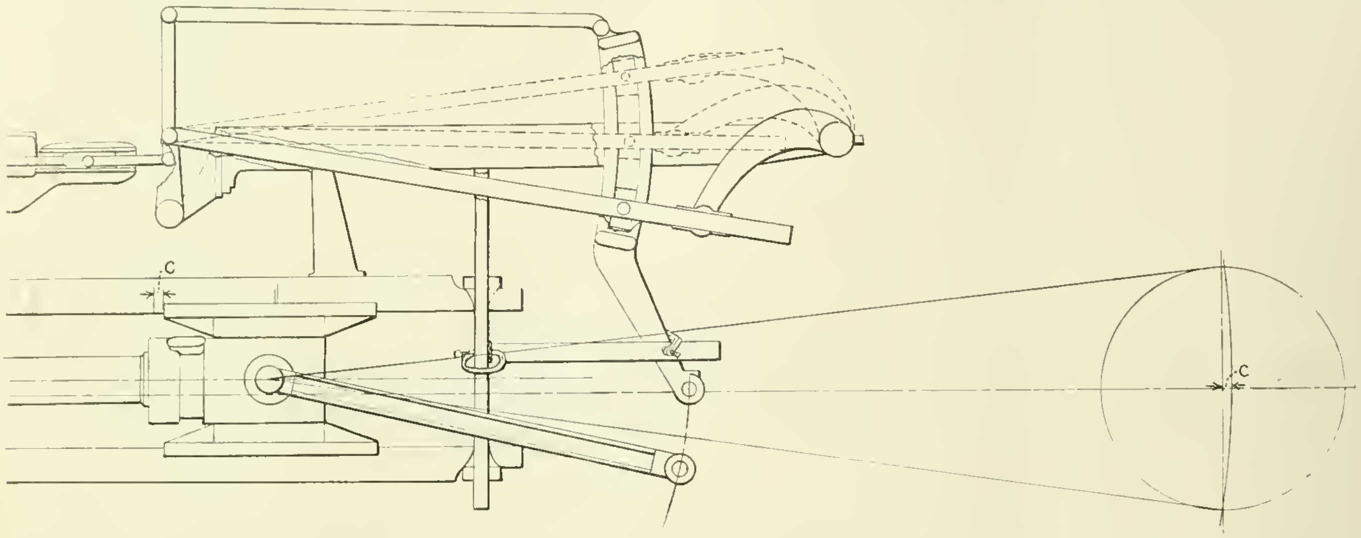


Fig. 7—Setting the Young Valve Gear

Setting Southern Valve Gear

Fig. 6 shows how the Southern valve gear is adjusted correctly by the same principle. The center of the wheel is transferred out onto the sheet iron plate clamped to the crank arm in the usual manner. The gear is connected up as shown in the drawing and clamped to a bar spiked to the floor. The center of the back eccentric rod bushing is raised up to the center line as shown, or preferably ⅜ in. to ½ in. above the center of the wheel to allow for the drop of the locomotive when filled with water and in running order. Next, reverse the gear backward and forward until a still valve is found by moving the radius hanger rod backward or forward, as the case may require. When the still valve is found, with the back of the eccentric rod above the center of the wheel to allow for settling, scribe the valve rod with the valve rod trams. This scribe mark should be exactly in the center between the front and back port opening marks. Also tram from the pin in the bottom of the radius hanger rod to some stationary point, such as the guide yoke. This is to be used later in order to get the correct length of the eccentric rod. Next unclamp the eccentric rod and lower to the floor and move it and the bottom of the radius hanger rod pin until the tram points scribed on the guide yoke measure the same distance to the radius rod pin as before. This is known as the still valve. Hold the radius hanger rod in this position and measure from the bottom pin in the radius hanger rod to the center of the wheel and add the angular correction of the eccentric rod to this, which will be the correct length of the eccentric rod. The angular correction is obtained in the same manner as with the Walschaert gear. By the eccentric rod length we mean the distance from the bottom pin in the radius hanger rod back to the eccentric crank pin and the length in front of the radius rod will be called lap and lead extension, which is checked with blue print or by laying off. Equal travel on right and left sides may be obtained by adjusting the adjustable auxiliary reach rod on both sides.

Setting Young Valve Gear

Fig. 7 shows how the Young valve gear may be set correctly. Proceed as with the Walschaert gear until getting the length of the union link—the rod from the crosshead to the bottom link foot pin. To obtain this rod's length scribe on the guide, the center or middle of the crosshead's travel or center of the striking points and measure back the distance *C* from this center and scribe the angularity of the main rod. Place the crosshead in this last scribed position with the union link connected to it and with the link clamped in still valve position. The union link should then couple up to link foot pin. If it is not the right length, shorten or lengthen to suit. Should the difference be slight, 1/32 in. or so, the main rod can be lined to make up for it. The angularity of the main rod is found in the same manner as the angle of the eccentric rod, or as shown in Fig. 7. With the links in the still valve position on right and left sides, the valve rod tram should scribe a line in the middle or center of the space between the front and back port opening marks, as shown in the drawing.

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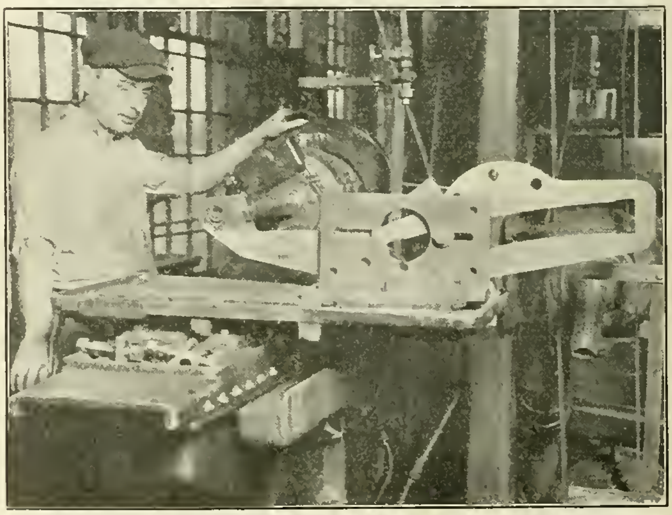

Truing Hole in Link Foot on Planetary Internal Grinder

Standard Tool Gages*

By R. D. Fletcher

OWING to the fact that the average cost of locomotive repairs is about 70 per cent for labor and only 30 per cent for material, it behooves us to watch the time consumed in stripping, routing work through the machine shop and especially the time that is required to machine each particular piece of work. It is the writer's opinion that the machine side is one of the leading factors in railroad shop output, consequently more time should be devoted to supervision regarding the proper cuts, feeds and speeds required for the various classes of work to be done.

The average machine foreman is kept busy routing work and endeavoring to keep up with the erecting shop, and many times while doing this he overlooks individual operators. Frequently he does not know whether the proper cut, feed and speed are used so as to complete each job in the required length of time.

Machine Tool Demonstrator Aids Standardization

Each large shop should have a machine tool demonstrator to regulate the shape and size of tools, also the cut, feed and speed of each individual machine. This man should be in a position to know the ability of each operator as well as the class of work done on each machine. Standard tools are required somewhat like the ones used in large manufacturing plants today and all tools should be delivered to the tool room. One or more men can grind them and keep them always in good condition ready for service. The man in charge of the grinding should be furnished with a complete set of models and blueprints, giving the proper degree of rake, side slope and clearance required for the various kinds of work that each tool is designed to do.

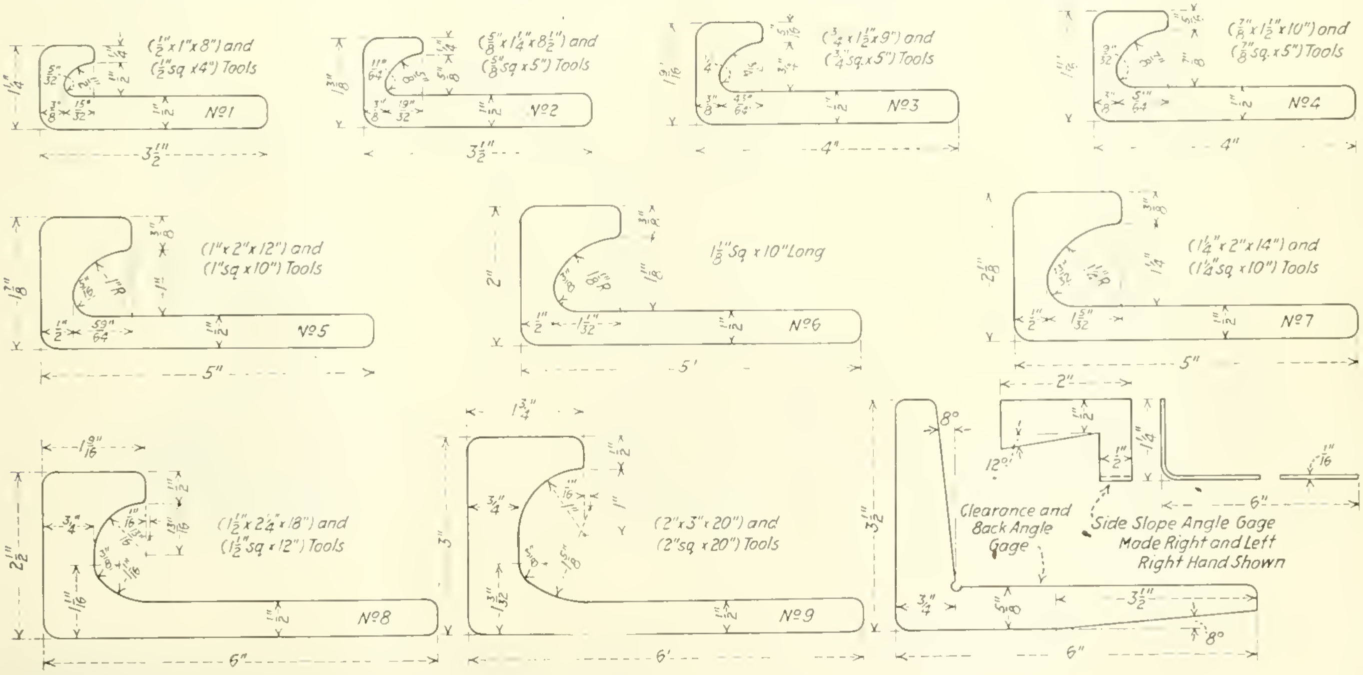
($\frac{1}{2}$"x1"x8") and ($\frac{1}{2}$"sq x4") Tools
No1
3$\frac{1}{2}$"
($\frac{5}{8}$"x1$\frac{1}{4}$"x8$\frac{1}{2}$") and ($\frac{5}{8}$"sq x5") Tools
No2
3$\frac{1}{2}$"
($\frac{3}{4}$"x1$\frac{1}{2}$"x9") and ($\frac{3}{4}$"sq x5") Tools
No3
4"
($\frac{7}{8}$"x1$\frac{1}{2}$"x10") and ($\frac{7}{8}$"sq x5") Tools
No4
4"
(1"x2"x12") and (1"sq x10") Tools
No5
5"
1$\frac{1}{8}$"Sq x10"Long
No6
5"
(1$\frac{1}{4}$"x2"x14") and (1$\frac{1}{4}$"sq x10") Tools
No7
5"
(1$\frac{1}{2}$"x2$\frac{1}{4}$"x18") and (1$\frac{1}{2}$"sq x12") Tools
No8
6"
(2"x3"x20") and (2"sq x20") Tools
No9
6"
8°
12°
Clearance and Back Angle Gage
Side Slope Angle Gage Made Right and Left Right Hand Shown
6"
3$\frac{1}{2}$"
8°
6"

Fig. 1—Gages for Standard Lathe, Planer and Shaper Tools

Idle machines decrease shop output. To offset this, standard shaped tools for all classes of work should be on hand, and an ample supply ready for service. The machine operator can then replace a dull tool with the least possible loss of time.

Method of Grinding Highly Important

The grinding of tools is very important. "More tools are ruined in every machine shop through the overheating in grinding than from any other cause." There is a general idea prevalent that the heat generated in grinding does not affect the temper of high speed steel. This opinion is reached because cutting tools made of this material will stand up and maintain their cutting edge under a red heat which would render carbon tool steel useless. The fact is that high speed steel can be ruined as easily by grinding as the ordinary carbon tool steels. High speed tool steel is easily ruined by checks and cracks if great care is not observed. This is possible with both wet and dry grinding, but it occurs more frequently with dry grinding. Most operators cause their tools to check by pressing them against the grinding wheel hard enough to draw a color and occasionally dipping the tool in a pail of water. In wet grinding, the operator must remember that the presence of water alone is not a preventive to the burning, checking, or cracking of a tool. It is necessary to use the same ordinary care in the grinding of high speed tool steel that is observed in the every-day operation of the common machine tools.

More attention should be given to the loading and glazing of grinding wheels, causing the cutting or grinding surfaces to become smooth. No grinding can be done under these conditions and the additional pressure against the wheel only serves to increase the friction and generally ruins the tool. When ordering grinding wheels for high speed machine tools, it is very important to specify the proper grit, grade and bond; they should be kept true and running at 5,000 peripheral feed per minute.

Referring to the cuts, feeds and speeds of machine tools for regular shop practice, the data given later in the paper has been found very practical. Of course, there are times when it is up to the operator to increase or decrease the speed and feed of a machine according to the class of work that he is doing, but generally a heavy feed is worked to a greater advantage than a fast speed, especially on rough turning and planing. The shapes of tools, illustrated in Fig. 1, pertain to roughing tools only, and the angles used for the several classes of ordinary shop work are as follows: Cast iron, 8 deg. clearance, 3 deg. rake and 10 to 15 deg. side slope; soft steel, 8 deg. clearance, 8 deg. rake and 15 to 20 deg. side slope; tire steel on wheel lathes, 5 deg. clearance, 5 deg. rake and 5 to 10 deg. side slope. Planer and shaper tools require only 5 deg. clearance, while the rake and side slope remain the same as for turning tools. The side slope on these tools is greater than the rake, and the relatively steep side slope allows the tools to be more frequently ground without weakening. The chips also slide off in a line avoiding a tool post or holder. Moreover, the tendency of the tool to deflect to the side is largely corrected by throwing the pressure line within the base of the tool and reducing the feed pressure.

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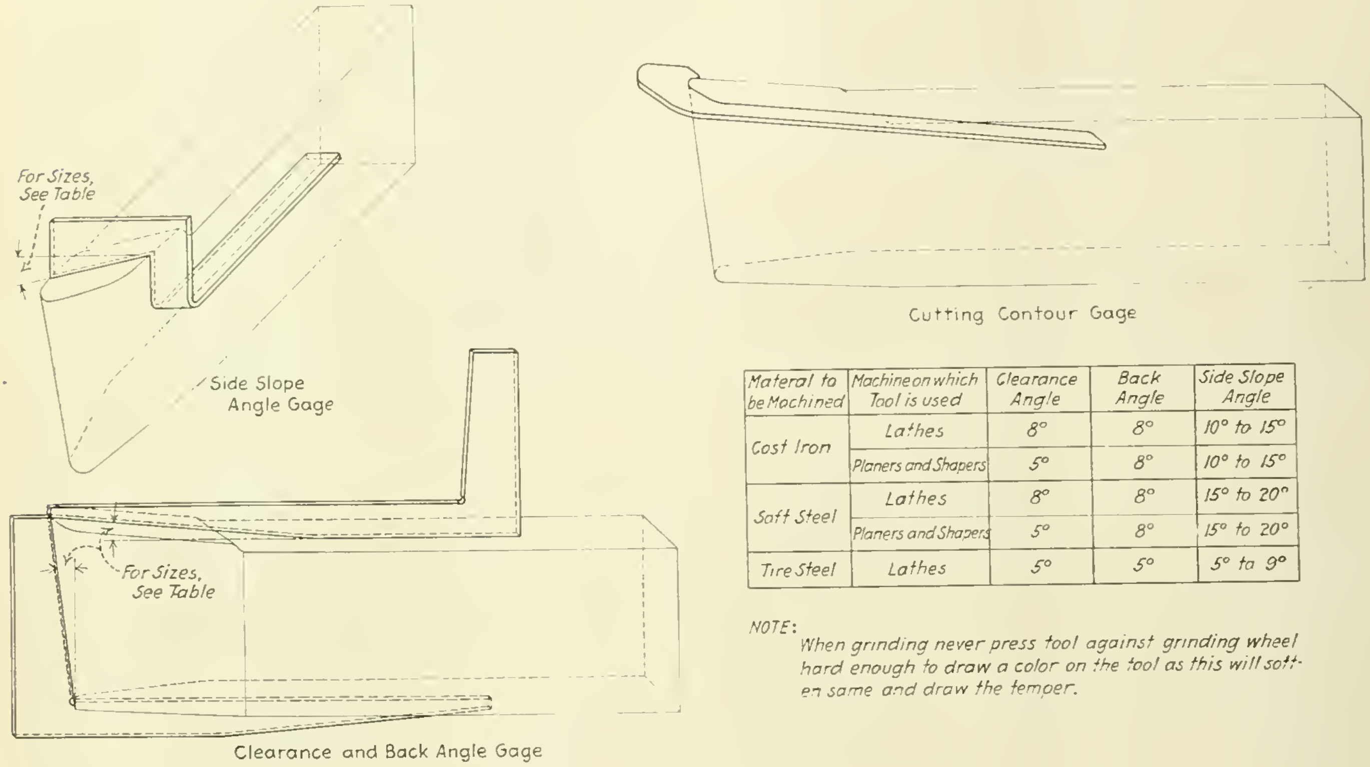
* Abstract of a paper read before the 1923 Convention of the International Association of Railway Tool Foremen by R. D. Fletcher, retiring secretary. The gages described have been adopted as standard by some of the leading railroads, notably the Atchison, Topeka & Santa Fe. The author desires to give credit for much of the data presented to F. W. Taylor's book "The Art of Cutting Metal."



Materal to be Machined	Machine on which Tool is used	Clearance Angle	Back Angle	Side Slope Angle
Cast Iron	Lathes	8°	8°	10° to 15°
	Planers and Shapers	5°	8°	10° to 15°
Soft Steel	Lathes	8°	8°	15° to 20°
	Planers and Shapers	5°	8°	15° to 20°
Tire Steel	Lathes	5°	5°	5° to 9°

NOTE:
When grinding never press tool against grinding wheel hard enough to draw a color on the tool as this will soften same and draw the temper.

Fig. 2—Method of Using Gages Shown in Fig. 1

Gage No. 1 to No. 7, inclusive (Fig. 1) are for lathe, planer and shaper tools. Gage No. 8 and No. 9 are for wheel lathe tools only. Fig. 2 shows the method of using these gages.

All roughing tools should be forged and ground as near the width of the steel as possible thereby allowing a greater feed pressure against the side of the tool, greater strength for the chip pressure on the top of the tool and a greater area for heat radiation. The proper radius of the cutting edge for each size of tool is about one-third of the thickness of the tool. For example, a ¾-in. by 1½-in. tool would require a ¼-in. radius for the cutting edge. To maintain this radius, grinding gages can be used to great advantage.

Data on Feeds and Speeds

With a ¾-in. by 1½-in. tool cutting soft steel, such as bolts and similar work, using a 1/16-in. cut and 1/16-in. feed, an average of 65 ft. per min. should be made. With a 1¼-in. by 2¼-in. tool turning crank pins, piston rods, axles and similar work, using a ⅛-in. cut and 3/16-in. feed, an average of 40 ft. per min. should be made. With a 1¼-in. square tool on a boring mill turning or boring gray iron castings, using a ⅛-in. cut and 3/16-in. feed, an average of 40 ft. per min. should be made. With a 1½-in. by 2½-in. tool planing cast iron or soft steel, using a ⅛-in. cut and 3/16-in. feed, an average of 35 ft. per min. should be made. With a 1½-in. square tool, using a square nose for boring out tires with a 1/16-in. cut and ¼-in. feed, an average of 20 ft. per min. should be made. With a 1½-in. by 3-in. tool turning locomotive tires, with a ⅜-in. cut and ⅜-in. feed, an average of 13 ft. per min. should be made. For every additional ⅛-in. depth of cut used, reduce the speed about 15 per cent. Every shop has its own local conditions to meet and the above data is only a base from which to work, taking machine and shop conditions on the average.

The greatest amount of time is consumed in getting the work finished on the machine side, partly due to the fact that the machines are not properly grouped together. Insufficient crane service also often delays the work. In conclusion, it is the writer's opinion that more time and study should be given the machine side regarding the proper grouping of machines and work to avoid delay in machine output. Work can thereby be returned to the erecting shop in a shorter time and locomotive out of service time reduced.

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Worn Piston Heads Reclaimed and Made as Good as New by Brazing

General Foremen's Convention at Chicago

Problems of Personnel Receive First Consideration—Address by Director General of Railroads

It was both significant and encouraging to note the attention given to methods of training and securing the co-operation of shop employees at the seventeenth annual convention of the International Railway General Foremens' Association. This convention was held at the Hotel Sherman, Chicago, September 4 to 7, inclusive, and in view of the fact that business and labor conditions prevented holding a convention during the past two years the officers were much pleased with the attendance and interest shown.

President Wright's Address

In his opening address, J. B. Wright, president of the association, spoke in part as follows:

The International Railway General Foremen's Association will find its efforts valuable largely in the extent to which it can induce mechanical department supervisory officers to co-operate with officers in other branches of railroad service. We must feel our common responsibility in relation to the one thing that railroads have to sell—transportation. There is no doubt that our responsibilities are greater and our daily problems more complex than they were previous to the labor trouble of last year, and the fact that equipment in general on the majority of railroads is in better condition today than it was previous to the strike would indicate that these problems are being solved. I do not believe there is any one thing more important to the successful operation of the mechanical department of the railroads than that of proper and efficient supervision. In selecting subordinate supervisors, careful and serious consideration must be given to their ability. To be a successful foreman at the present time requires many qualifications which were given little consideration a few years ago. One of the most important of the general foremen's tasks is the proper training of subordinate foremen. Being responsible for the output and efficient operation of railroad repair shops requires a man capable of surmounting any obstacle no matter what it may be. Due to direct contact with employees, the foreman's attitude toward them must be such that he will not only gain but retain their absolute confidence. To the employees, the attitude of the company is reflected through the shop foremen and if foremen practice unfairness in dealing with them, the loyalty which is needed most on the railroads today will be lost. Fairness and firmness will win and hold the respect of most men we may come in contact with. The railway executives are asking for more mileage, and an improvement of the bad order cars and locomotive situation which necessitates speeding up in every department. Much has been accomplished along these lines by stirring up real enthusiasm throughout the entire railroad organization. The real problem now is to see that this enthusiasm does not die down but that every railroad employee is spurred on to greater activity.

J. B. Wright (Hocking Valley)
President

G. H. Logan (C. & N. W.)
First Vice-President

H. E. Warner (N. Y. C.)
Second Vice-President

Address by James C. Davis

On the second day of the convention an address was delivered by James C. Davis, Director-General of Railroads, on the subject of "the Responsibilities of American Citizenship," of which the following is an abstract:

The United States today has the most efficient rail transportation system in the world. Even at present rates, persons and commodities are transported for less compensation than in any other civilized country on the globe. This vast system has been largely constructed within the memory of many men and women now living. In 1870, five years after the close of the Civil War, there were some 50,000 miles of railroad in existence. Since that date, covering a period of a little more than fifty years, more than 200,000 miles of railroad with necessary equipments and terminals, have been constructed.

The money necessary to create this wonderful system has, all except for comparatively small donations by various states and national government, been furnished by private individuals, who invested their private funds in this great and necessary improvement, which has been the controlling factor in the country's growth and development. The value of this property, resulting from the construction of this vast plant, as fixed by the tribunal created by law, is now in excess of $19,000,000,000.

It is quite accurately estimated that the stock and bond holders of the American railroads aggregate over two million. It is a matter of note that small investors make up the great aggregate; investors who have ordinarily paid full value for their holdings, under laws recognizing such carrier obligations as private property. Persons who have purchased these securities have a private ownership in them, just as a man has who owns a home, an automobile, or a farm, and so long as we have a constitution and courts to adminster the law of the land, this private ownership will be recognized and protected.

Every one concedes that an adequate system of transportation, highly maintained and efficiently operated, is absolutely essential to any sort of national prosperity and progress. Railroads cannot be efficiently operated unless their income is sufficient to pay operating expenses, fixed charges and a reasonable return on the investment. Men will not work unless their wages are paid; coal and materials must be paid for; capital will not invest unless promised a fair return. The income must be sufficient to pay these charges and to properly maintain the plant or the railroads cannot be operated as privately owned property and the only alternative will be public ownership and public operation.

The remedy proposed is to cut the value of the property in two, on the alleged theory that outstanding railroad stock represents eight or ten billion dollars of water. This charge is made without any sort of consideration of the undisputed facts and would destroy the entire value of all of the outstanding stock. It would violate every provision found in our national and state constitutions protecting the rights of private property.

If by an act of Congress or the legislature you can destroy one-half of the value of the railroads, why stop at one-half? Why not destroy it all? If you can reduce or destroy the value of railroad property owned by private individuals by a legislative act, why not apply the same rules to water, gas, electric light and street railway property, and thus reduce the charges which the public pay for these services? If this step is taken, by the same logic the government could either destroy the value or make a common ownership of farms, homes, factories and all sorts of tangible property. In none of these suggested cases from the railroads down can this be done so long as we have a government functioning under a constitution protected by courts that respect the rights of private property.

Before our present form of government is destroyed, should there not be presented a better and a definite plan as a substitute? Has not our existing form of government been a success? Is there a government or a land in the whole wide world where the people as a whole have such opportunities to enjoy life, where men can so effectively enjoy the fruits of their own labor, where advancement and promotion wait only on efficiency and industry?

Efficient transportation is essential to any sort of national prosperity and some degree of patience should be exercised to enable the carriers, under the existing detailed governmental supervision, to work out as nearly as possible an ideal transportation system.

T. J. Mullin (L. E. & W.)
Third Vice-President

C. A. Barnes (Belt Ry. of Chicago)
Fourth Vice-President

William Hall (C. & N. W.)
Secretary-Treasurer

Locomotive and Car Shop Efficiency

Competent and adequate supervision is a great factor in maintaining shop efficiency. A modern shop with up-to-date improved machinery and with an unlimited pay roll, if supervised by incompetent foremen, cannot compete with an old shop lacking in modern tools, but where the supervision is of the best. Competent supervision makes for competent workmen. A combination of executive and mechanical ability makes an ideal supervisor.

A good supervisor must be a student of human nature, quick to discern men's qualifications and capabilities, assigning men to that class of work to which they are best adapted. A competent supervisor will gain and hold the respect and confidence of his men by a firm but quiet insistence of the recognition and performance of rules of the shop and by his daily habits and actions.

Satisfied men are efficient men; therefore they should be made to feel that their efforts are appreciated. In handling men today and getting the output for your companies that can be reasonably expected, it means one of personal and close contact with the men themselves. Make that one of your important duties.

The grouping of machinery making for one continuous movement is a very great factor in the efficiency of the shop, and should receive due thought and deliberation. Every machine should be worked to its fullest capacity, and it is the duty of the supervisor to see that this is done. He therefore should be a competent judge of the machines' capabilities.

No supervisor should be expected to do work that a clerk can do; the cost is too high and the penalty paid too great. He should not be expected to leave his department to look up material from the store house.

The increasing demands made each year on the American railroads, due largely to maintenance requirements enlarging more rapidly than the shop facilities, bring the problems of increased output per man hour and costs into a prominent place in the affairs of railway shop supervisors.

Training and Developing Apprentices

Apprentice training on railroads in general was neglected to some extent during the war period but it is apparent to those who are familiar with the situation that interest is now being revived in this direction and that it is being recognized that the best hope of the future is to carry on a recruiting system that will provide the force of competent men which is necessary for successful results.

The apprentice training plan should provide for shop instructors who follow up the apprentice on the job to see that he is given instructions in the best methods of performing the work to which he has been assigned. The duties of the instructor are not supervisory but educational. He does not assign work but follows up the boy to see that he is moved in accordance with the established schedule of shop work for apprenticeship training.

The theory of shop practice has proved to be a more interesting subject to the average apprentice than the other classes of study. This is undoubtedly due to the fact that they can more readily see the direct application of the instruction to the shop work. Unit text books, each containing one shop practice subject, and questions pertaining thereto, should be provided for instruction during the first two years of the course.

The success of the apprentice school depends largely upon the energy and enthusiasm of the school instructor. Best results can be obtained if the school is in the charge of one who undertakes the job for the love of educational work and who is practical mechanic enough to demand the respect of the shopmen. He must possess the ability to find and touch the chord in the boy's nature that will stimulate enthusiasm for his studies when it is apparent that his interest is lagging. He must keep the instruction abreast with the shop work by incorporating new lessons as new equipment is adopted by the shops. This will require that he make frequent visits to the shop and keep in touch with latest shop methods. Ambitious apprentices, like all other enterprising railroad people, have a fondness for "digging into" new equipment.

The instructor should be aided in every way so that the enthusiasm in the courses can be kept up. He must be given assistance in the lecture work by men in the shops who have the ability to impart their experience to others. This has the effect of giving a practical touch to the school work and enlarges the circle of persons who are interested in the apprentices.

A good plan is to have the representatives of the various supply houses give the apprentices lectures along their line on their regular visits to the shops. This gives the apprentices the advantage of hearing an expert along any particular line.

Shop Supervisors and Employees

The man in charge of the shop must have a vision of what can be accomplished and not be satisfied with what was done last month or last year. In increasing the efficiency of shop supervisors and employees it is necessary to hold foremen's meetings periodically.

The foremen and employees should be encouraged in suggesting and being given an opportunity to try out new methods of doing work. All employees should be encouraged to take some mechanical paper that treats on their particular line of work so that they can keep posted on all improvements and developments that are brought out in other shops.

Mistakes or improper practices should be taken up with the departmental foremen, gang foremen and employees doing the work in such a manner that it will be considered as educational, for the betterment of the service and in no case should be let go without the proper investigation and each one concerned having his particular attention called to the mistake and the better way of taking care of the work in the future.

There should be close relationship between the shop and the store department and some sort of system inaugurated whereby the shop foreman will be notified within one hour of any material which it is impossible for the store department to deliver him on a written order. This is very essential in order that the foremen and employees are advised in the shortest possible time so that he may provide a substitute and not hold up the output.

Increased Output per Man Hour—Cost

The general foreman or superintendent of shops should make out a schedule of engines out of shop, taking into consideration the number of fire box sheets, flues, general and light repairs that will be required for the desired output for the month, and advise the master mechanic or superintendent of motive power the number of each class of repairs to book in. It is very essential that the shops be given the class of repairs asked for, as the output of locomotive repair shops has been held back more by not having the proper class of repairs booked in than any other one cause. In other words, you must get an *in put* to get an *out put*.

A schedule of pit days each class of power you will have to shop will require should be made up, taking into consideration the size of locomotives and any special design that may affect the time necessary to repair.

After determining the number of days an engine will be in the shop for any classified repair, there should be a schedule made and followed out by each department, showing the number of days they will have on the more important items.

One of the most helpful ways to get efficient work from supervisors is to keep them informed regarding what they are doing and what it is costing. This should be done by comparison with previous months and years and where possible with other points doing the same class of work. This also helps where the employees know what they are doing, as compared to past records, keeping up the feeling that they should try to beat the past record.

Shop output is regulated by the condition of machinery, crowded shops, cleanliness and comfort of workmen, systematic attention to education, special knowledge, experience, morality, temperance, tact, resources, reliance, foresight, memory, energy, initiative, persistence, promptness, accuracy, system, executive ability of employees and foremen.

Increased output can be obtained by seeing that ample and the correct kind of material is furnished. Facilities for doing the work are provided such as riveting machines, straightening and bending machines, punches, shears. Increased output can be obtained by closer supervision, head work, adequate tools, new devices and specializing on certain well defined jobs.

This report was signed for the part pertaining to locomotive shops by H. E. Warner (N. Y. C.), Wm. Hall (C. & N. W.), F. M. A'Hearn (B. & L. E.); for car shops by C. F. Baumann (C. & N. W.) and C. E. Strain (Hocking Valley).

Discussion

In discussing this report, G. H. Logan (C. & N. W.) said that the human element is the most important factor in shop output with which the general foreman has to deal. More or less general unrest in the ranks of labor throughout the country is manifest and the shop supervisors must change this attitude, if possible. Good results cannot be expected from antagonistic men and railroad general foremen should exercise every talent in interpreting the constructive policies of the railroad managements to the shop employees. M. R. Benson (M. C.), said that shop supervisors should give workmen a fair opportunity to hang up production records by providing (1) full information regarding work to be done, (2) comparative records with past production, (3) tools, jigs and special tools needed for the particular work in hand. In addition, a fine opportunity is presented to foremen to secure the co-operation of their men by listening carefully to all suggestions made by them and at least trying all ideas which have a fair chance of success.

Another member commented on the mistaken idea which some general foremen have that they ought to take cases requiring disciplinary action out of the hands of the gang foremen. Gang foremen should never be slighted, and, as long as they are foremen, should be allowed to run their gangs without interference. The possibility of considerable increases in shop output through friendly rivalry of various departments or gangs was favorably commented on.

The discussion of shop efficiency also brought out some strong comments on the necessity of co-operating with the stores department in ordering material in advance of the need and preventing excessive investments in material which is either obsolete or infrequently used. Another point mentioned was the need of modern machinery in most railroad shops on account of high labor costs. Foremen should constantly question if present machine methods are most economical and satisfactory. Manufacturing methods are also needed in railroad shops to a greater extent than now employed, large economies being possible by making and assembling interchangeable parts in advance of shopping. This reduces the cost of manufacture and enables cars and locomotives to be returned to service more promptly.

Considerable time was given to a discussion of apprenticeship courses, J. W. Gibbons (A. T. & S. F.), answering questions regarding the Santa Fe practice and C. W. Cross (N. Y. C.) explaining New York Central methods of dealing with this important subject.*

Maintaining Valves and Valve Gears

After the valve gear is removed it is thoroughly cleaned, given a coat of whiting and a hammer test, in order to find any defects. It is then checked up to proper blue print lengths, in order to keep these parts standard, with the exception of blades, which are altered after valves are set to suit conditions.

When applying a new main axle on an engine with Stephenson link motion, the quarter lines are placed on the axle before removing it from the lathe centers; keyways milled; eccentrics and strap applied and completed before the engine is wheeled. We find this method a practical way which has proven very satisfactory. With the Walshaert gear we have solid gages which are used to locate the position of the eccentric crank.

Valve Ring Bushing Record

Engine 40 (B. & O.) made 200,000 miles with one set of piston valve rings and bushings and the bushings were worn just about 1/32 in. These bushings were made out of Hunt-Spiller gun iron.

We rebore valve bushings when worn out of round 1/16 in. and apply a new one when worn 3/16 in. larger than the original size.

In removing valve bushings from cylinders we use the following method: First burn them out with the carbon electrode or with the acetylene torch and at other times use the air hammer. I think one of the best ways to apply bushings in a cylinder is to heat the cylinder with a charcoal fire and make the bushings a snug fit in the cylinder and apply the cap screws. In this way it appears to be able to do away with the leaky or loose piston valve bushings.

One of the most serious causes for cut piston valve rings and bushings is the lack of lubrication. Should some of the railroads that are being troubled with this fault adopt the practice of having the engineer use a little more oil a considerable amount of savings will result.

The report was signed by F. J. Spangenberger (Ulster & Delaware) and W. C. Clugston (Baltimore & Ohio).

Discussion

Several of the members seriously questioned the advisability of allowing valve chamber bushings to run until they were 1/16 in. out of round. Also the practice of applying valve chamber bushings by heating the cylinders was disapproved. Several of the roads have limits of 1/32 in. wear out of round for valve chamber bushings and apply them by screw action, thus preventing any chance of cylinders cracking due to expansion and contraction strains bound to occur when cylinders heat and cool off.

The relation of adequate lubrication to valve ring and bushing life was strongly emphasized, the members advocating three pints of oil per 100 miles, depending on operating conditions and type of locomotive. There was some question as to the best point of application of the lubricant, quite a few members maintaining that the best results are secured when oil is delivered to the valve chamber only and not to both valve chamber and cylinder, as is the practice on some roads.

Repairing and Maintaining Duplex Stokers

Duplex stokers used on the Grand Trunk Western are removed every time the engine comes to the shop for class three repairs, taken to the repair department, and tested. Thorough repairs are made at a cost as shown in the following table:

Approximate Cost of Repairing Stoker

	Hr.	Min.	Rate
Stripping conveyor reverse unit	2	30	.34½
Welding body on main drive shaft	3	..	.77
Turning after weld	1	30	.70
Grinding	..	15	.70
Bushing conveyor pawl casing cover	1	..	.70
Fitting up conveyor reverse unit	2	..	.70
Welding pawl shifter	..	30	.77
Turning after weld	..	30	.70
Fitting sealing ring caps in hopper	1	..	.70
Stripping elevator screws and shafts	2	..	1.04½
Turning elevator screws for weld	2	..	.34½
Turning sleeves	..	30	.34½
Welding sleeves	3	..	.77
Turning after weld	3	..	.70
Fitting and laying off sealing ring caps	1	..	.70
Drilling and tapping elevator screws	2	..	.70
Fitting sealing caps on screws	1	30	.70
Applying new gears on elevator shafts	1	..	1.04½
Electric weld elevator shafts	2	..	.77
Turn after weld	2	..	.34½
Applying shaft screws and head on elevator	4	..	1.04½
Stripping and repairing main cylinder head	5	..	.70
Electric weld main drive rack	..	30	.77
Plane after weld	1	..	.70
Grinding piston rod	..	30	.70
Electric weld piston rod when loose	..	30	.77
Turn and thread	1	..	.70
Bore packing	..	15	.70
Slotting front drive rack	..	30	.70
Fitting up piston and rack	1	30	.70
Fitting up cylinder, applying rack and piston to hopper	4	..	.70
Repairing distributor tubes	1	..	.70
Bushing universal joint	1	..	.70
Bushing universal slip joint	1	..	.70
Testing stoker	2	..	.70

Fire Doors

Firing a locomotive with air fire door, requires with each scoop of coal, 10 less body movements than are required with a hand fire door. This is because reaching for the chain on a hand door leaves the body in an awkward, unnatural position for shoveling. With air fire doors, all a fireman has to do is shovel. Each ton of coal averages 115 scoopfulls. Ten tons are used on an average run, or 1,150 scoopfulls. The air door saves 11,500 body movements on an average run.

Accidents are prevented through automatic closing of the fire door. Burst flues cannot injure the man in the cab. The force of the explosion is directed through the grates and front end, instead of into the cab.

This report was signed by W. S. Buntain (Grand Trunk).

Railroad Shop Kinks

Micrometer Tire Gage

A gage designed to simplify the method of determining the correct thickness of shims necessary to use in setting of tires to conform to M. M. standard shrinkage allowance is shown in Fig. 1.

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*Both the Santa Fe and New York Central systems of apprentice training are commented on at some length in an article beginning on page 497 of the July, 1923, *Railway Mechanical Engineer*.

The body of the tool has its periphery marked with 125 graduations and as the hub is tapped eight threads to the inch, one graduation indicates .001.

The indicator which screws into the hub of the body must point at lines marked "125 and 250" when screwed up to the shoulder in the body.

As many shrinkage allowance shims should be made as is necessary to care for variations in driving wheel diameters. The method of using the gage is as follows, assuming the wheels on which the tires are to be set are 68 in. in diameter:

Caliper the wheel center; then assemble the tire gage with the stem marked "68" and insert the shrinkage allowance shim marked "68" between the shoulder on the indicator and the top of the body and screw the indicator down on the shim. If the shim has been properly made, the indicator point will show at .088 which is the M. M. shrinkage allowance for 68 in. wheel centers as shown on the chart under figure "A," and opposite the wheel diameter 68 in. The tire gage is then set to the calipers as in ordinary practice, adjustment being made by screwing the stem in or out, and when properly set, the stem is locked by tightening the knurled lock nut. The gage is then set to the exact diameter of the wheel center. Now screw off the indicator enough to remove the allowance shim and then screw the indicator tight to the body again and in doing this, you have made the gage .088 smaller than the wheel center. Then try the gage in the tire which is to be applied and we will assume it slips in or that the tire is larger than the gage. Adjustment is now made by screwing out the indicator until the gage is set with the indicator point at .070 and therefore it will be necessary to use a shim of ½ this thickness or a shim .035 thick which would be No. 20 gage.

Reference to developed view of graduations on drawing show the various gages of iron stamped in line with graduations which indicate twice the thickness of the various gages in thousandths. This is necessary by reason of the shim going entirely around the wheel center and it must of course be only one-half the thickness of thousandths indicated.

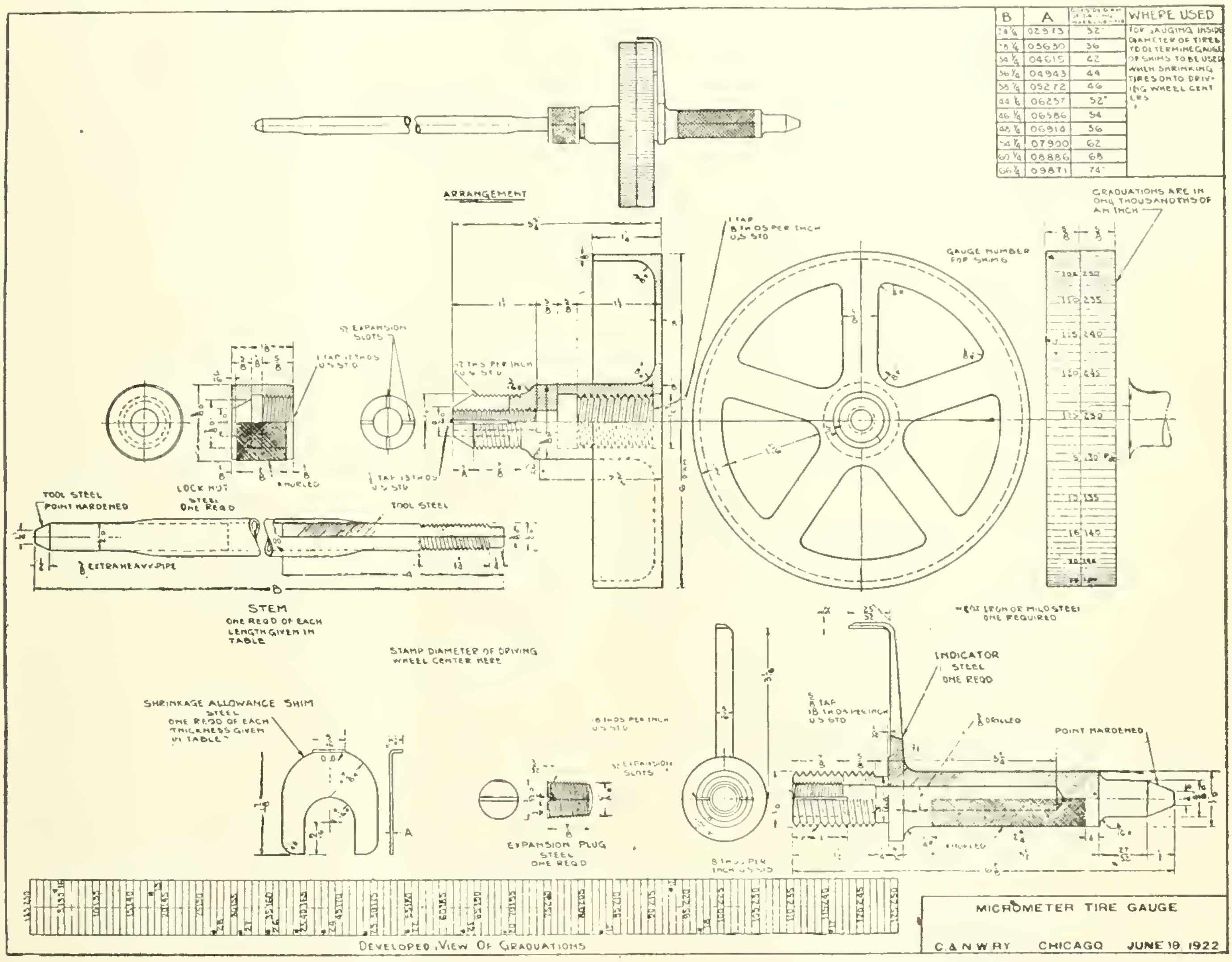

B
A
WHERE USED
24¼ 02913 32
28¼ 03630 36
34¼ 04615 42
36¼ 04943 44
38¼ 05272 46
44¼ 06257 52
46¼ 06586 54
48¼ 06914 56
54¼ 07900 62
60¼ 08886 68
66¼ 09871 74
FOR GAUGING INSIDE DIAMETER OF TIRES TO DETERMINE GAUGE OF SHIMS TO BE USED WHEN SHRINKING TIRES ONTO DRIVING WHEEL CENTERS
ARRANGEMENT
GRADUATIONS ARE IN ONE THOUSANDTHS OF AN INCH
GAUGE NUMBER FOR SHIMS
EXPANSION SLOTS
LOCK NUT STEEL ONE REQD
KNURLED
TOOL STEEL POINT HARDENED
EXTRA HEAVY PIPE
TOOL STEEL
STEM ONE REQD OF EACH LENGTH GIVEN IN TABLE
STAMP DIAMETER OF DRIVING WHEEL CENTER HERE
WROT IRON OR MILD STEEL ONE REQUIRED
INDICATOR STEEL ONE REQD
DRILLED
POINT HARDENED
SHRINKAGE ALLOWANCE SHIM STEEL ONE REQD OF EACH THICKNESS GIVEN IN TABLE
EXPANSION PLUG STEEL ONE REQD
DEVELOPED VIEW OF GRADUATIONS
MICROMETER TIRE GAUGE
C.&N.W.RY CHICAGO JUNE 19 1922

Fig. 1—Tire Gage for Determining Correct Shim Thickness Needed in Setting Tires

It can now be seen that if a man setting tires can caliper and will apply proper allowance shim to gage and remove it as instructed, when the tire is gaged the indicator will show the gage number of the shim he must use.

In connection with this tool, a standard wire gage should be used to insure the correct size of shim indicated being applied.

Lathe Dog or Driver for Crosshead Pins

This tool, illustrated in Fig. 2, was designed to eliminate the necessity of removing a tail or screw dog from the wrist pin each time it was necessary to try the pin in the crosshead. It is merely a block of iron tongued to fit a slot in the face plate of suitable height to go between the head of the pin when on a live lathe center and face plate, with a pin in hole and spring back of pin to allow for variation in size of center holes in wrist pins.

To use the device, it is necessary to drill a hole in the head of the wrist pin slightly larger than the driving pin and these holes should be drilled at the same radius from the center on all pins.

The driver is set on the face plate so that the pin engages a hole in the head of the wrist pin and its advantage over a dog which must be removed is quite evident. In addition it permits a lathe hand to machine a pin in a handier way. With the old method of dog on screw or small end of pin the operator really works backward. With a smaller tool of this kind, rod knuckle pins and other headless two-fit taper pins may be more quickly machined.

The tool can be simplified by the elimination of dowel and grooves for driving pin, as a slight shoulder on the pin and an enlarged opening for the spring would be a better and cheaper way to make it.

Turning Ball Crank Pin Bushings

This device, shown in Fig. 3, can be used on any lathe that has a compound carriage attached. The center of the bottom of compound carriage must be in the center of lathe in line with the lathe centers. The carriage is reversed so that the feed handle on the compound carriage is at the back of the lathe instead of at the front. An arm is clamped to the tail stock spindle; also a connecting arm is attached from the arm on the tail stock spindle to compound carriage. These arms can be of any size or length to suit the condition and size of lathe. The ball bushing is held by means of a mandrel screw on the spindle of the lathe and held by a nut. The bushing is turned and the contour made by feeding the tail stock-spindle. After the first bushing is turned to size a gage should be made to set the tool by so that all bushings should be the same size.

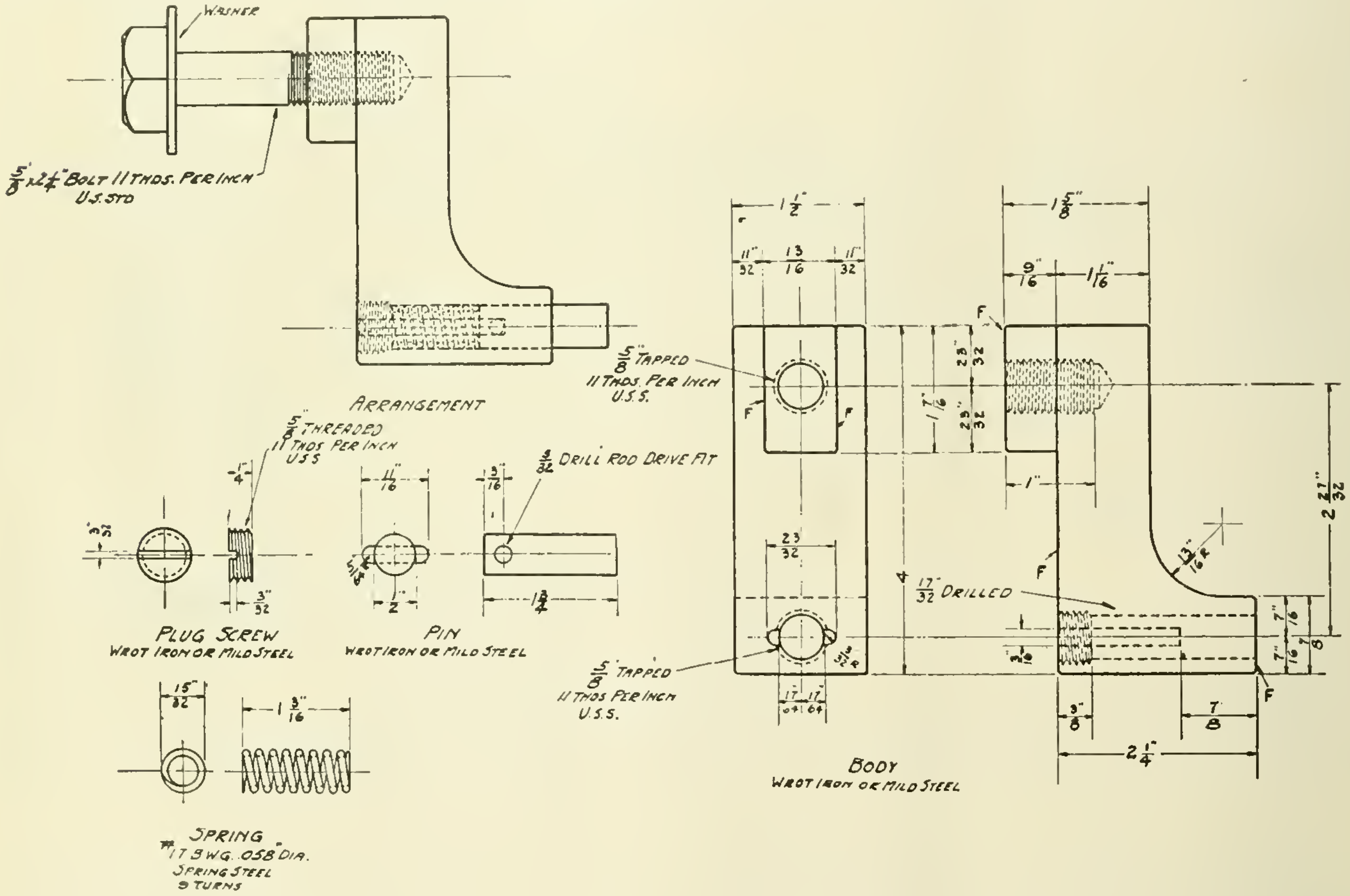

WASHER
5/8" x 2 1/4" BOLT 11 THDS. PER INCH U.S. STD
ARRANGEMENT
5/8" THREADED 11 THDS PER INCH USS
1/4"
3/32"
PLUG SCREW WROT IRON OR MILD STEEL
11/16"
3/16"
3/32 DRILL ROD DRIVE FIT
1 3/4"
PIN WROT IRON OR MILD STEEL
15/32"
1 3/16"
SPRING 17 B.W.G. .058 DIA. SPRING STEEL 9 TURNS
5/8" TAPPED 11 THDS. PER INCH U.S.S.
1 1/2"
11/32"
13/16
11/32"
1 5/8"
9/16"
1 1/16"
F
23/32
1 7/16
4
17/32 DRILLED
1"
2 27/32"
3/8"
7/8
2 1/4"
BODY WROT IRON OR MILD STEEL

Fig. 2—Lathe Dog or Driver for Crosshead Pins

This report was signed by G. H. Logan (C. & N. W.), M. J. Fahey (N. Y., N. H. & H.), J. M. Horn (M. & S. L.) and B. F. Harris.

Welding Driving Tire Flanges

On the subject of welding flanges on driving tires, we are advised that the restoring of worn flanges to their original thickness and contour is being successfully accomplished on some of the railroads of the country by both the electric and acetylene (gas) processes. On one of the important systems the following report is furnished your committee: For electric welding, a 3/16-in. coated carbon steel wire of 60 to 75 point carbon content is employed as an electrode to obtain a degree of hardness as near that of the original tire as possible, consistent with safety from failure. In application the initial metal is applied, starting on one side of the tire at a point corresponding with the horizontal center line and welding in an upward direction to the center line at the top. This is then repeated by starting on the opposite side and welding upward to the top, finishing half of the wheel, after which the engine is moved to allow finishing the opposite half in the same manner.

In starting, an initial deposit on the shoulder is formed by moving the electrode back and forth across the flange, in this way applying a triangular sloped deposit in one layer. The cost of building up a 63-in. tire under shop conditions is approximately as follows:

18 lb. welding wire @ 15 cents a lb.	$2.70
45 kw. hours power @ 2 cents a kw. hour	.90
6 hours labor @ 75 cents an hour	4.50
Total	$8.10

The cost will vary slightly depending upon size of tire, skill of operator, amount of material, etc., but this figure will represent average conditions.

We have also built up tires with acetylene. This makes a smoother job as we do not finish these tires off on a machine after they are built up, but the acetylene job costs more, due to the price of the acetylene and oxygen used. Gas for welding a 63-in. tire averages around $9.00 a tire. Labor and material used is practically the same for both gas and electric but there is a difference in favor of the electric welding of about $8.00 per tire.

Advice from another road is to the effect that on engines with 72-in. wheel centers, the welder with the oxy-acetylene process takes from 6 to 7 hours to complete one tire, using,

10 to 15 lb. of steel at 27 cents a lb.	$2.70
425 cu. ft. of oxygen @ $1.78 a 100 ft.	7.56
400 cu ft. of acetylene @ $2.60 a 100 ft.	10.40
Total	$20.66

An equivalent for 63-in. tire would be $16.80.

We have no data giving the relative life of flanges built up with the two processes except the statement that when flanges are built up by oxy-acetylene process they give a longer life than the original. The apparent greater cost of the gas process may be materially reduced when the life is taken into consideration.

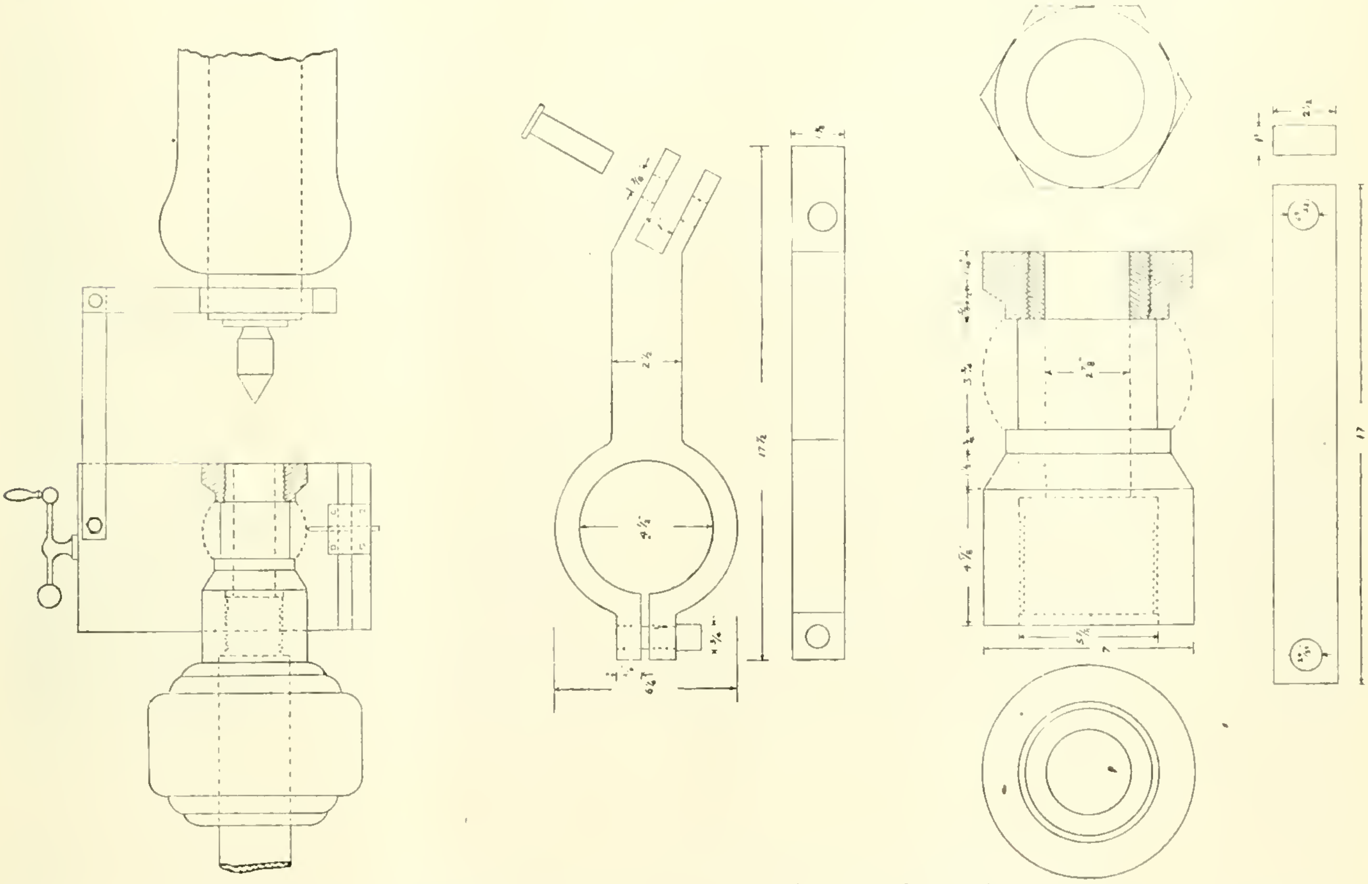


Fig. 3—Device for Turning Ball Bushings for Front Crank Pins

Taking the cost of building up tires by the cheaper of the two processes, you will note that you may effect a considerable saving in the cost of tire maintenance, and a rough estimate of a greater mileage between tire turnings. The life of tire will be increased from 1/3 to ½ on the initial cost.

Your committee is therefore of the opinion that the railroads should give this practice very careful consideration as a source of economical operation.

This report was signed by H. T. Cromwell (B. & O.).

Discussion of Sharp Flanges

F. M. A'Hearn (B. & L. E.) stated in connection with this subject that the best practice is to anticipate the cause of sharp flanges rather than attempt to "lock the stable door after the horse has been stolen." J. M. Horne (M. & S. L.) said that from his experience it was dangerous to attempt to build up sharp driving wheel flanges by welding without removing the tires from the wheel centers, owing to internal stresses set up and the resultant danger of loosening and breaking tires in service. The members of the association were almost equally divided as to the advisability of building up sharp tires by welding. A large number of roads have had success with this method over a period of years and almost as many more roads have strict rules against any welding on tires. Several roads follow the practice of welding tires on switchers and slow freight locomotives, removing these tires for the welding operation and subsequently reapplying them. These roads do not weld tires on locomotives in fast passenger and freight service, however.

There was an extensive discussion of the best methods of preventing sharp flanges with particular emphasis on the need of squaring the frames properly and laying out the driving boxes, shoes and wedges so that the one wheel will not be ahead of the other. Improper spring equalization also sometimes causes cutting on the front driving wheels and the same result is caused by engine trucks and trailer trucks not being properly centered.

Election of Officers

The following officers were elected for the ensuing year: President, G. H. Logan (Chicago & North Western); first vice-president, H. E. Warner (New York Central); second vice-president, C. A. Barnes (Belt Railway of Chicago); third vice-president, B. L. Davis (Chesapeake & Ohio); fourth vice-president, F. M. A'Hearn (Bessemer & Lake Erie); secretary-treasurer, William Hall (Chicago & North Western). The following were elected members of the Executive Committee: C. F. Baumann (Chicago & North Western), M. H. Westbrook (Grand Trunk), M. R. Benson (Michigan Central), William Mulcahy (Baltimore & Ohio), and W. F. Lauer (Chesapeake & Ohio).

Progressive Repair System for Locomotive Shops

The Straight Line Method Used in Modern Industrial Plants Applied to Classified Repairs

By Lawrence Richardson
The Whiting Corporation

"STRAIGHT LINE" methods of production, the foundation of all successful low-cost manufacturing, have recently been applied to heavy freight car repairs with gratifying results. These installations have shown marked savings, at least one of them passing the half-million mark annually. Their success has suggested the further application of the same principles to classified locomotive repairs. With an annual back shop repair bill for labor alone of more than $125,000,000, it will readily be appreciated that even a small percentage of saving will warrant their adoption.

Usual Shop Procedure Not Economical

When a locomotive is taken in a back shop for classified repairs the usual procedure is to place it on a certain track, where it remains until the repairs are completed. This means that all parts removed for repairs must be cleaned, usually including a trip to the lye vats, and trucked to their respective repair points. After being repaired, they are trucked back to the locomotive for assembly. Some of the larger back shops use two or three gangs on this trucking. Since all repair jobs start and end at a particular locomotive, the path traced by any particular part is a closed loop. "Backtracks" are common. This counter-movement always means a loss in productive effort, and gives rise to confusion.

To minimize this trucking and overlapping movement a "Straight Line" system of back shop operation has been devised. With this system all movements are continuous and onward, with no conflicting or backward movements. The principal feature of this system is the division of the repair work into stages. The locomotive is received at one end of a shop, where it is unwheeled on a hoist. The wheels, boxes, valve motion parts, rods, etc., are removed, cleaned and started moving in "Straight Line" through the repairs to the final stage. The locomotive is then placed on trucks and moved to an intermediate track, where the repairs are continued. When the locomotive is ready for wheeling, it is moved to the far end of the shop and wheeled on a second hoist. The rods, wheels, boxes and valve parts meet it at this point. The repairs are completed here, all of the movements leading to this point without any crossing or retracing.

Straight Line Shop Layout Simplifies Movements

An application of the straight line principles to a locomotive repair shop is shown in Fig. 1. The arrows on the "IN" and "OUT" tracks and on the transfer table denote the movements of the locomotive proper, while other lines denote the movements of wheels, boxes, rods and valve gear parts.

The locomotive enters the shop at the point "IN" and passes through the stripping and unwheeling operations. The wheels are moved out of the shop and first pass the tire heating pits, where the necessary tire changes and renewals are made. If the locomotive is in for firebox or heavy boiler repairs, its wheels are moved to the wheel storage to prevent congestion; at the proper time, they are again placed in line so as to meet the locomotive when it is ready for wheeling. In this second stage, they move past the wheel and journal truing lathes onto the track leading to the wheeling jack. This track is so arranged that the machine bay crane can transfer the wheels to the hoist track. As there is space for 15 drivers under this crane, variations in the outbound schedule can be handled. A locomotive can be moved ahead or back without appreciably affecting the system of operation.

Meanwhile, the rods, valves, boxes and other parts are moved to the lye vats or to the sand-blast room. After cleaning, the parts move over a small industrial railway just outside the shop wall, the valves, rods and boxes being distributed as shown by the arrows.

Machine Shop Divisions

In the "box" area are located a press, lathe, boring mill and planer. It will be noted that the "box" area lies in the angle made by the wheel movement. This permits the boxes to be swung onto the wheels as they pass.

The "rod" area is located immediately adjacent to the position occupied by the locomotive after moving off the wheeling jacks. The average movement of the rods from bench to locomotive is only 28 ft. No time or effort is wasted in moving them about the shop, as the work is always done at the same station. Gooseneck cranes are utilized in hanging rods, thus releasing the overhead crane for other service.

The "valve" area is located to give an average movement of 97 ft. from the bench to the locomotive. In the case of Stephenson links and other inside hung valve gear requiring assembly before wheeling, this space is centrally located with respect to the tracks in the main bay of the erecting shop. The average distance to the erecting shop tracks is only 195 ft.

The rest of the machinery is grouped to the best advantage. The heavy repairs are concentrated in the far end of the erecting shop, the large machines usually involved in this work being placed adjacent this area.

Separate Hoists for Unwheeling and Wheeling

After the locomotive is stripped, it is moved onto the hoist and unwheeled. It may then be moved to a final stripping pit. This pit is only used as a relief, as the regular organization ordinarily should finish the stripping on the first pit. After stripping and unwheeling, the locomotive is moved on trucks onto the transfer table and shifted to a track in the main bay of the erecting shop. The variation in the time required for repairs is taken care of here, the time depending on the class of repairs. Class 5 repairs should move through the main bay in a day.

When ready for wheeling, the locomotive is again transferred. not back to the "IN" track, but onward to the far end of the shop, where it is wheeled on a wheeling hoist and is then moved onward. The rods are hung, the valves set and the locomotive turned out as shown on the diagram. A number of outbound stages may be consolidated.

Advantages

The principal advantages of this system are the elimination of expensive overhead heavy-duty cranes and the utilization of lower buildings of much lighter construction, thus materially decreasing the investment and reducing the direct labor charges.

The layout shown is an adaptation of this scheme, and can be modified to meet existing shops and property limitations with no essential change.

Shops may be built as outlined in the sketch between the "IN" and "OUT" tracks, inclusive, this distance being a minimum for efficient handling. As more facilities are demanded, the heavy repair bay can be added without changing the system of operation.

Comparative Capital Investment

The accompanying figures are based on a transverse erecting shop served by a transfer table, as shown in Fig. 1, which is a typical layout, representative of American back-shops. The usual equipment today would be a 200-ton crane, with a 10-ton crane operating on a lower runway.

With "Straight Line" operation, the unwheeling is done by a hoist at one end of the shop and the wheeling by a second hoist at the other end of the shop. The locomotives are handled from stage to stage on trucks. Necessary lifting in the main bay of the erecting shop is handled by a 10-ton crane.

Equipment for 20-Track Shop

Equipment for 20-Track Shop

Present Operation		"Straight Line" Operation	
Cranes, 1-200 ton	$45,000	2 200-ton hoists	$24,000
Cranes, 4-10 ton	28,000	4 10-ton cranes	28,000
Transfer table, 1-250 tons	12,000	40 trucks @ $400 each	16,000
Extra cost of crane runway @ $200 per ft	88,000	1 250-ton table	12,000
	$173,000		$80,000

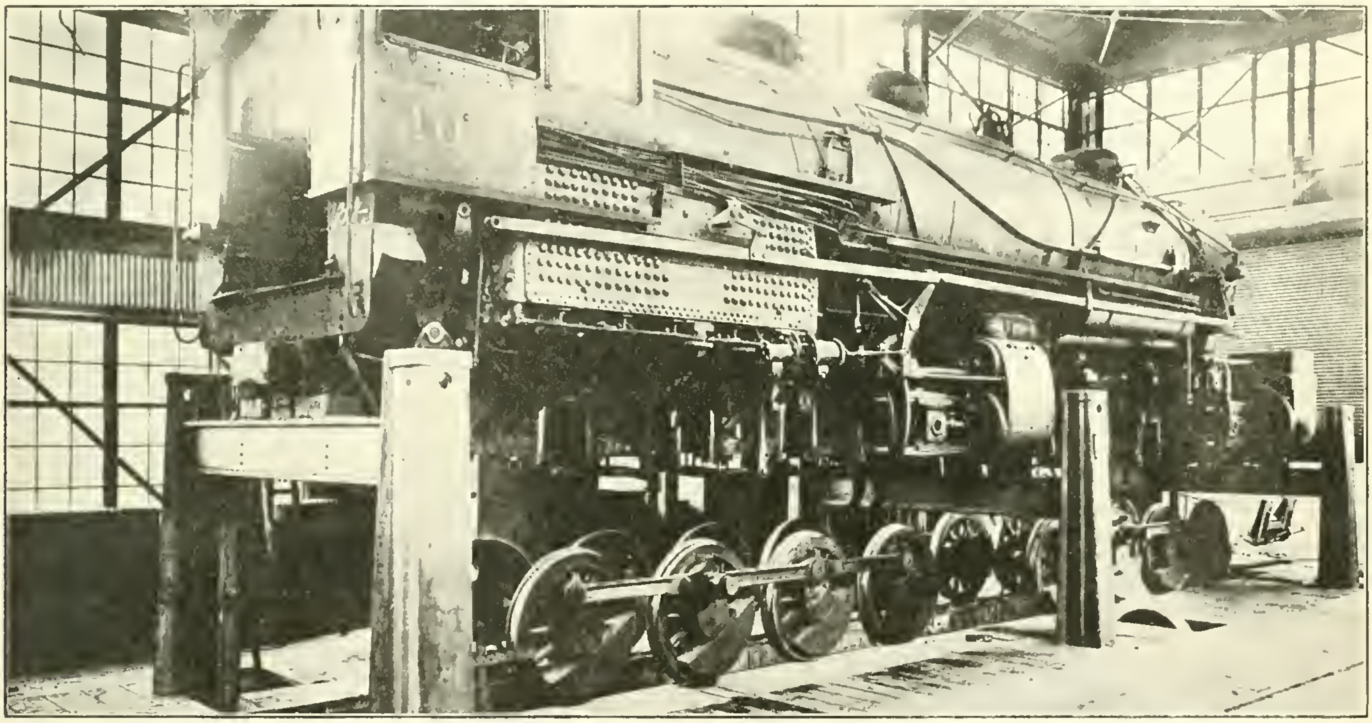
Saving in favor of "Straight Line"		$93,000
Interest, depreciation, taxes and repairs @ 10 per cent, Present Operation	$17,300	
Interest, depreciation, taxes and repairs @ 10 per cent, "Straight Line" Operation	8,000	
Saving per year in fixed charges in favor of "Straight Line"		$9,300
Additional cost of transferring locomotives in "Straight Line" system		900
Net saving per year (exclusive of direct labor)		$8,400

In this estimate, a transfer table has been charged against the present type of back shop. The carrying charge, however, is small compared with the advantages gained. This was strikingly brought out on a recent visit to a shop not so equipped. The heavy overhead crane was out of service for some 30 days, completely tying up repair operations. Had the shop been equipped with a transfer table, they would have managed to operate with but a slight inconvenience. The loss in production exceeded $100,000.

It will be further noted that no allowance has been made in the statement for the additional maintenance and operating cost of the heavy overhead cranes. This is an appreciable item and will make the net saving even more attractive.

Straight Line Operation Used for Car Repairs

"Straight Line" operation has recently been put into effect at the Beech Grove car shops of the C. C. C. & St. L. The cars are moved from one end of the shop layout to the other by stages; stripping, fitting, riveting, brakes and safety appliances, inspection and painting following in the order named. The outstanding result was an increase in the daily output of heavy repairs from six to 15 cars per day. A similar system has been put in effect at the Readville shops on the N. Y., N. H. & H., which was described in the August issue of the *Railway Mechanical Engineer.*



Under the "Straight Line" System Unwheeling and Stripping Are Separated from Wheeling and Assembly

A division of labor makes for increased output. The Chicago & North Western, Atchison, Topeka & Santa Fe and Grand Trunk have separated the locomotive stripping operation with good results. Repetition results in the development of methods and shop kinks, materially reducing the unit times.

In the "Straight Line" shop, the stripping and assembly mechanics are separated. The assembly mechanics are divided between rods, boxes and valve gear. Constant valve setting, for example, soon enables the mechanic to do the operation faster and better by an appreciable percentage. Furthermore, these mechanics do their work at one point instead of all over the shop, which minimizes the walking so that at least 25 per cent unproductive time is utilized. This stationing gives them no excuse to wander about the shop. All their tools are placed where needed.

As many of the operations are only performed by one gang, there is no occasion for "borrowing" parts, as no gang borrows from itself. The permanent location of the rod and valve gangs results in all such parts moving to their particu-

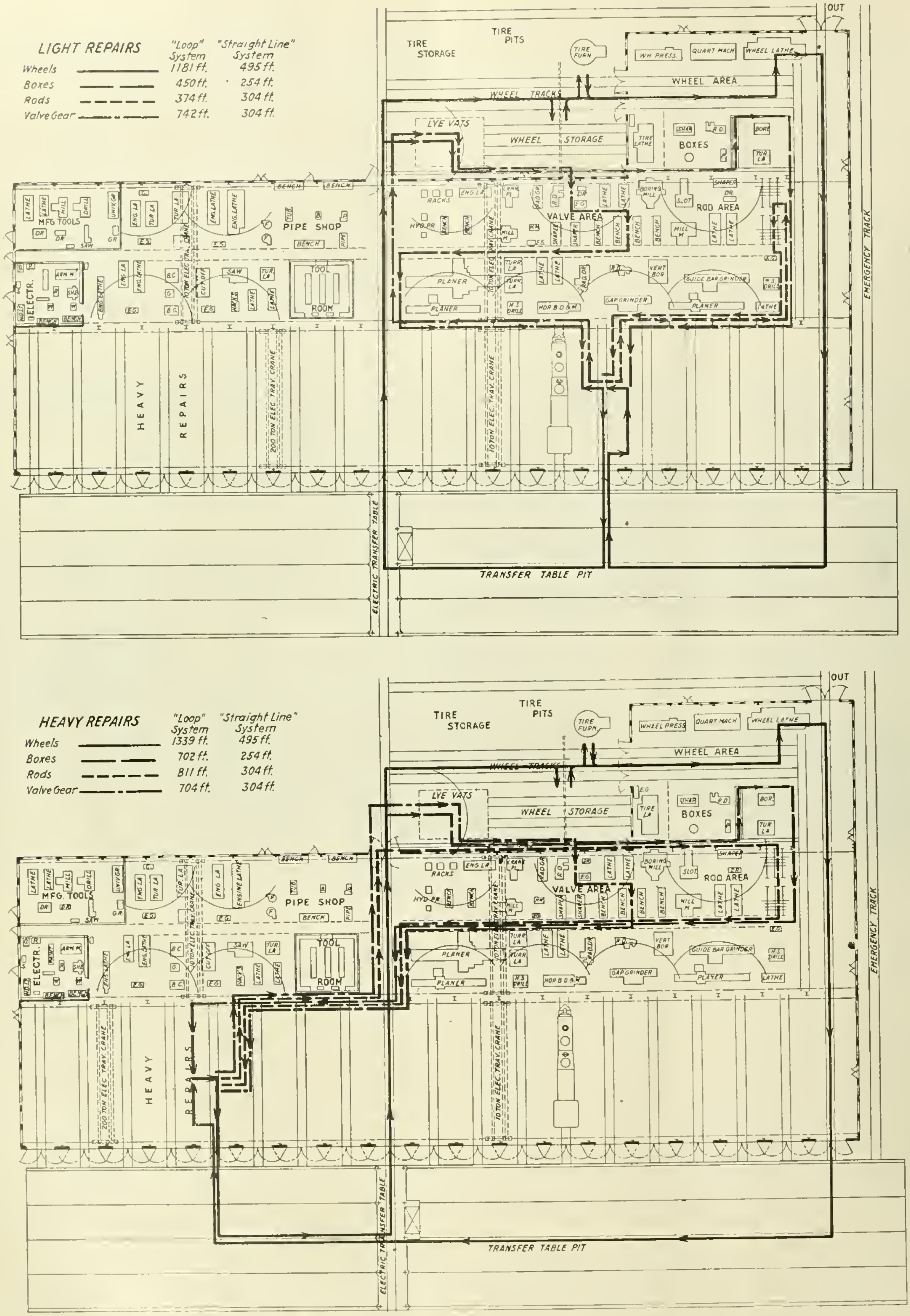


Fig. 1—Chart Showing Movements in Shop Operated Under Ordinary Loop System

lar location on the outbound track. Each member moves to one definite destination.

Minimum Hauling by Separating Operations

When locomotives are stripped throughout a shop, most of the parts must be hauled to lye vats or cleaning points. With this operation confined to one point, the lye vats are located only 25 ft. away from the hoist. The assembling is also done to a large extent at one point. Since both stripping and assembly are concentrated, lines for movement of repair parts between the two points are laid out so as to require a minimum amount of hauling and no lines embody a back haul. Fig. 2 and Fig. 3 show the movements in the shop under the usual system of operation, where each part makes a "loop." The average length of haul for "Straight Line" operation is less than half as much as for operation under the ordinary "Loop" system.

A higher degree of skill and a different type of ability is required for assembly than for stripping. Division of the two enables the foreman to separate his best mechanics and use them in assembly work where they are most needed. Not only does he use them where they are most needed but he uses them as skilled mechanics all the time.

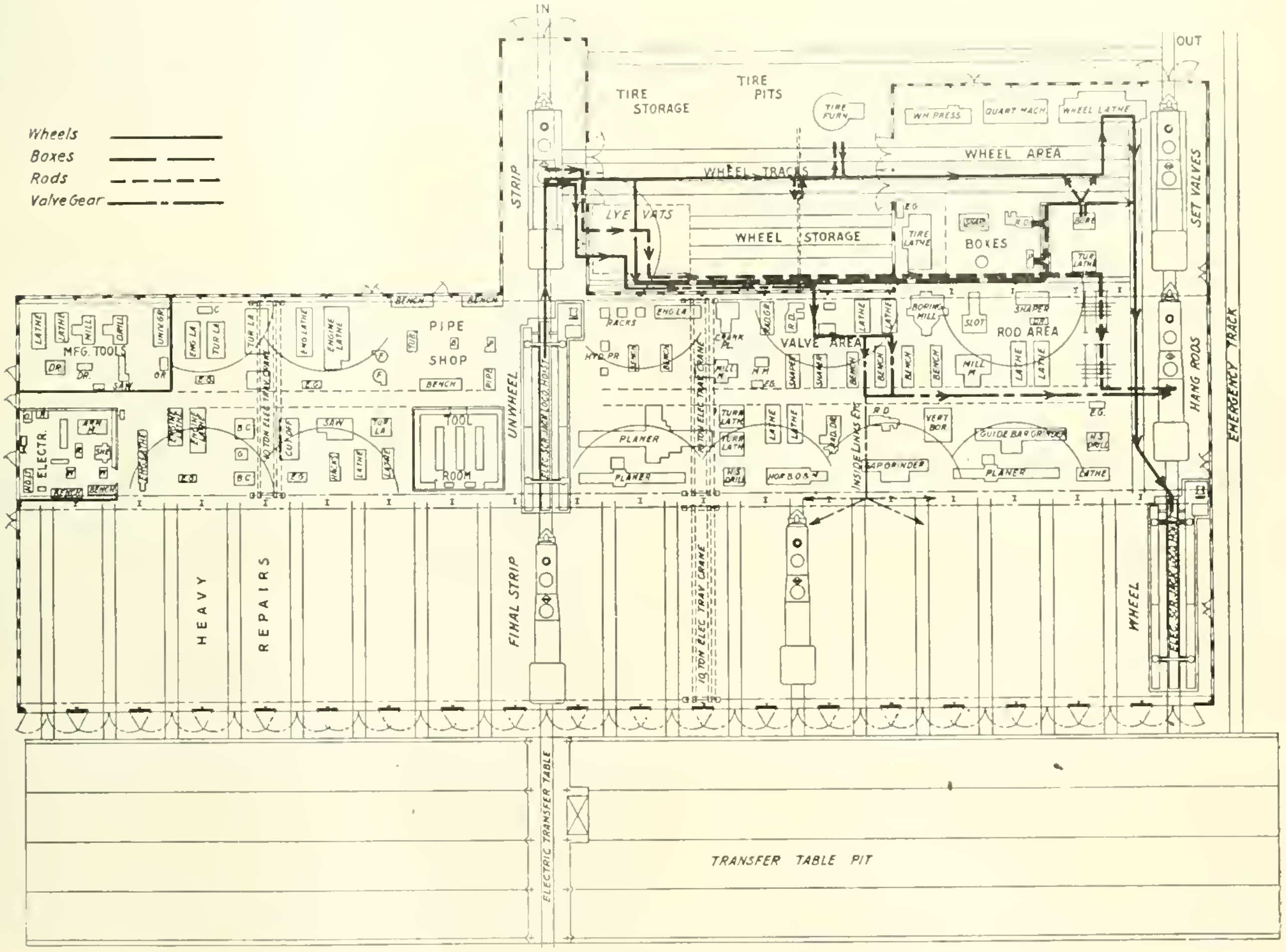


Fig. 2—Chart Showing Movements in Shop Operated Under the "Straight Line" System

Straight Line Shops Are Clean

Under the "Straight Line" scheme, all the greasy work is concentrated around the stripping pits and lye vats, the rest of the shop enjoying comparatively clean work—95 per cent of the shop is devoted to clean work. This absence of greasy parts in the main shop and assembly space results in better work, and more of it. Even roundhouse mechanics appreciate clean pits. A business man reacts favorably to good clothes and a mechanic to clean overalls.

The Work Is Brought to the Man

Many shops make a practice of assigning valve motion, links and other special work to certain men. Ordinarily they spend about half their time traveling around a shop from job to job, etc. Under the "Straight Line" method they do the bulk of their work in one place. This permits of a more permanent location, with adequate bench facilities. Instead of hunting most of their work, they get it as it moves past them.

Advantages are enjoyed by the stripping layout, as well as by the assembly. The lye vats are located within 25 feet of the stripping pits, eliminating the dumping of greasy parts about the shop and the hauling from different points. Special containers are placed near the locomotives from which point they are dumped into lye by one man provided with proper facilities.

It will be noted in the layout shown that the wheels are kept out of the main shop. It is not unusual to find a back shop with the main aisles blocked with wheels. They take up valuable space under heavy capacity cranes. It is much more economical to get them out of the main shop and under low head room and low capacity cranes. In many shops the space between pits is used for the wheels. Running the wheels around the erecting shop frees the workman of this hindrance.

Since all the parts are stripped on the "IN" track, the inspector who determines the repairs is located there. Being at one point, instead of hunting his work all through the shop, he can also supervise the men doing the stripping. This relieves the foreman so that he can be stationed near the outbound track and can direct the final stages. He is also relieved of the necessity of supervising heavy crane service, as all of this is done on the hoists. This gives him additional time to devote to the rest of the shop.

Better Scheduling and Many Other Advantages Result from System

By moving in stages it is possible to schedule production as is done in car-building shops and automobile factories. When a locomotive stays in one place from the time it is received until it is finished, a schedule is more or less vague. It takes a lot of the time of a good foreman to size up a shop and check up a schedule under such operation. But actual movement from stage to stage is on a standard schedule. If one stage lags, the work backs up and tends to hurry up the laggards. It is much better for the spirit of a shop to have the pace set thus rather than require the foreman to drive. The self-respect of a mechanic requires that he "hold up his end of a job." Good results have always been obtained by playing gang against gang, the best results being obtained with the shortest unit time. This is effected by dividing general repairs in stages.

There are many shops that were built to handle the smaller locomotives. Many roads have been unable to benefit by larger power on account of shop limitations. Such shops can be salvaged by an adaptation of the "Straight Line" system, in that heavy cranes and excessive overhead clearances are not necessary. The older cranes of limited capacity used for lifting the lighter locomotives will be found strong enough to take care of necessary lifts of parts of the larger locomotives, the heavy lifting in wheeling and unwheeling being done by the hoists. The original cranes perform a service corresponding to that rendered by 10- and 20-ton cranes located on runways under the heavy crane runways in back shops. An expenditure of $30,000 should salvage an obsolete back shop and make it capable of handling the heaviest power.

The movement of locomotives to and from the intermediate points on trucks is the safest way. Handling heavy locomotives over the heads of workmen has always been recognized as dangerous.

In case of emergency, the operation of either the wheeling or unwheeling group may be reversed until the occasion passes. This emergency capacity has a large potential value.

Review of the capital charge of statement shows the "Straight Line" system warranted on that basis alone. All of the benefits derived from "Straight Line" operation add to the net saving. Pacemaking, as a substitute for hard driving, works for better relations between the employees and the supervisory forces. "Straight Line" operation is not a radical departure; it is merely the application of a well proved principle to a new field. It is a logical development.

Making Cylinder Cock Valves

ONE of the interesting jobs done in the locomotive blacksmith department of the Boston & Maine repair shops at North Billerica, Mass., under the direction of Charles Nutter, blacksmith foreman, is the forging of cylinder cock valves in one heat and four operations. The dies are illustrated in Fig. 1, with valves in various stages of completion resting on top of the dies. Round stock is used, the blank after the first operation being shown at *M*; after the second and third operations, at *N*; and after the fourth operation, at *P*. For convenience, *M* and *N* have been formed on the ends of a single piece of stock although this is not usually the practice. The dies are set up in a 3-in. forging machine.

The first operation after heating the stock is to insert it in recess *A*, which forms the valve, nicked to the proper length and with the flash attached, as shown at *M*. In the second operation the valve is inserted at *B* which removes the flash and trims the valve. Any flash that remains is swedged down at *C*, when the valve looks as shown at *N*. The fourth and final operation consists of punching out the slide rod slot, which is done with the valve held upside down in recess *D*. The valve is gripped between the dies, when operation of the forging machine ram with a punch of the proper size forms the rectangular slot in the valve, shown at *P* and also *B* in Fig. 2. These operations are all performed quickly in one heat at a cost of 0.5 cents a piece for labor for forging. The total cost of these valves, including material and labor in forging, is 11 cents.

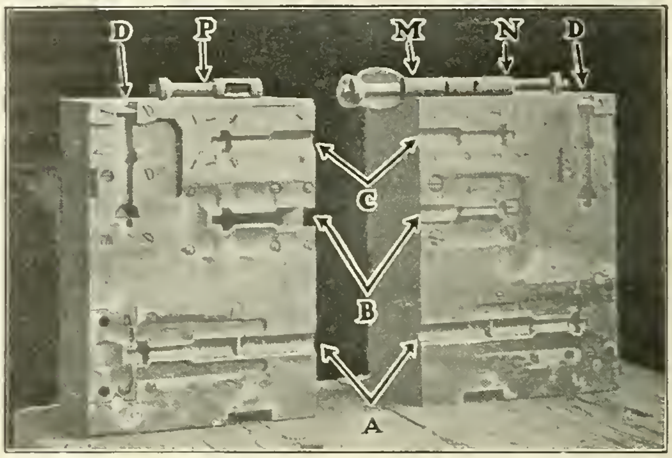


Fig. 1—Dies Used in Forging Cylinder Cock Valves

Machining Operations

The method of machining cylinder cock valves may be of interest, two operations only being required. Referring to Fig. 2 which shows the turret lathe used to perform the final cutting-off operation, a finished valve is shown at *B* on the cross slide. The only machining necessary on this valve is to turn the outside diameter of the body and form the seat, both operations being performed at one time by a special box tool. The valve stem is then cut off to the required length as shown in Fig. 2, being held in a Barker wrenchless chuck which is particularly adopted for repetition chucking work. By means of lever *H*, the universal jaws of this chuck can be set up or released while the chuck is in motion, the work being centered accurately and quickly by a single pull on lever *H*. This chuck is a time-saver since the jaws can be set approximately to the required size, one pull on the lever tightening them on the work which is thereby centered.

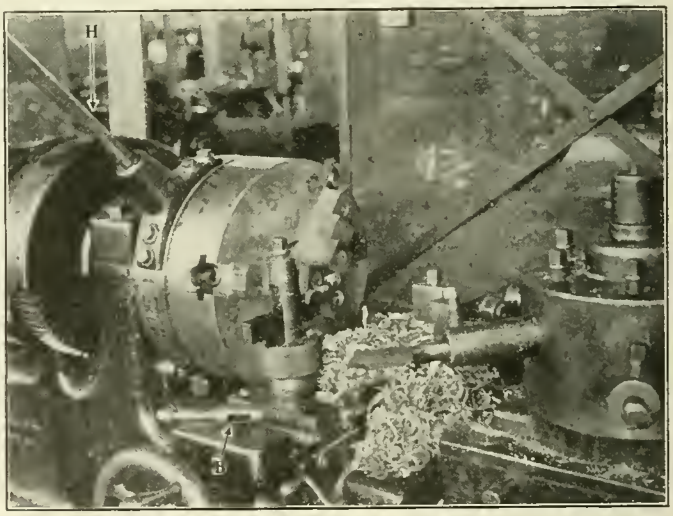
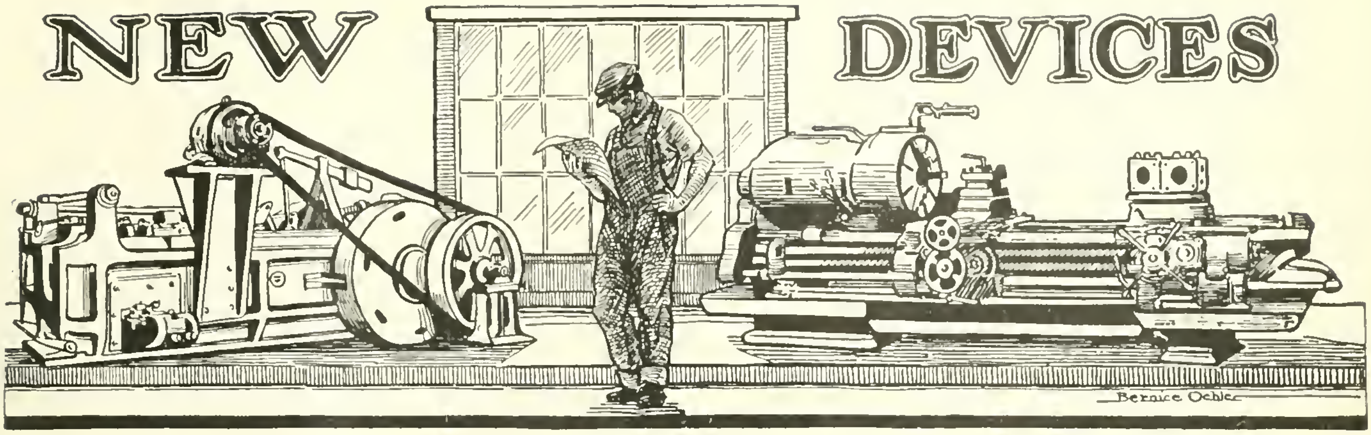


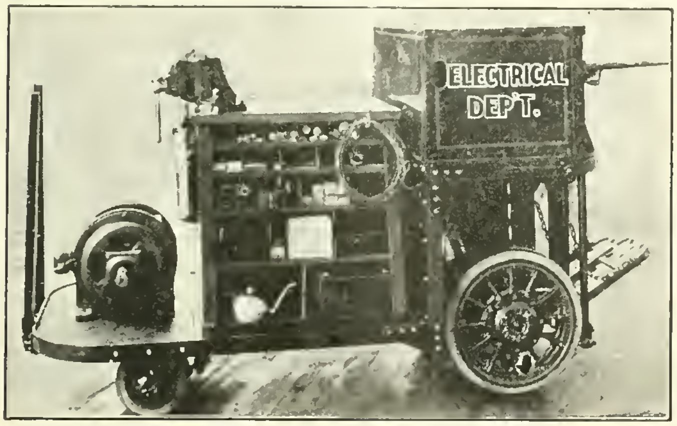
Fig. 2—Barker Wrenchless Chuck Holding Valve for Final Cutting Off Operation

NEW DEVICES



Electric Truck for Shop Emergency Service

A TRUCK designed to meet the needs of millwrights or electricians in the performance of emergency service around shops and factories has recently been developed by the Elwell-Parker Electric Company, Cleveland, Ohio. It provides handy working facilities for the electrician or pipe fitter, whose work is, of necessity, performed in various parts of the shop.



Shop Truck for Emergency Use

The truck is in reality a small, mobile repair shop. It is equipped with a steel and wood case that occupies about two-thirds of the platform, while the balance is reserved for a motor and tool kit. The truck may be driven at three times walking speed and provision has been made for one or two men to ride. A pipe vise is mounted on the partitioned rack to accommodate the usual emergency equipment.

The truck is driven by a battery carried in a large compartment over large rubber-tired driving wheels. The operator stands on a small platform consisting of two pedals. The truck cannot be started unless the operator is on the pedals, and it will stop within its own length if he steps off.

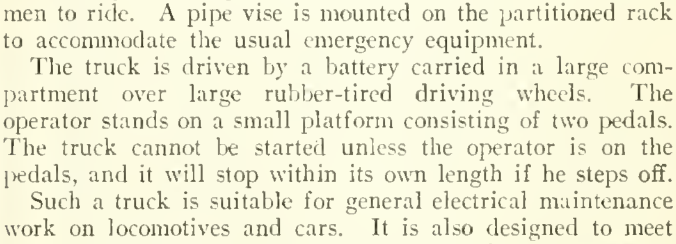
Such a truck is suitable for general electrical maintenance work on locomotives and cars. It is also designed to meet the requirements of a pipe-fitter's gang whose work takes them to all parts of the shop. This truck is capable of transporting the men, tools and material from place to place throughout a shop with little time lost in transit and also provides working facilities after arriving on the job.

Simple and Rugged Electric Drill

THE electric drill illustrated, which weighs less than five pounds, has been placed on the market recently by the Argyle Railway Supply Company, Chicago. This tool will drill holes up to 3/8 in. in diameter and is said to be practically non-stallable. It is well adapted for many drilling operations in railroad shops, including stay bolt tell-tale holes, miscellaneous drilling in car repair work and battery work. A special Westinghouse motor is used which will operate on either alternating or direct current, the motor running at high speed on light loads and slowing down to the required amount when drilling larger holes. The free speed is 2,000 r.p.m. and the full load speed 850 r.p.m., which is approximately the proper cutting speed for a 3/8-in. drill.

The field windings are coated with a special compound and baked 90 hours, resulting in a field coil of one solid mass with practically no possibility of the wires becoming loosened from each other. This adds to the insulation properties, making the armature practically indestructible except from accidental mechanical abrasion. The armature is not injured by immersion either in oils or in water except as this might corrode the metal parts.

The ventilation of the drill brings the cool air into the back both in the upper and lower branches of the handle, assuring that the handle grip will always remain cool and that the incoming air will be distributed to all parts of the motor. The motor field is held away from the housing by ribs which permit the air to pass around that and also around the armature to cool these parts in the most effective manner. The air is discharged in the front of the housing, tending to



The Titan Electric Drill is Convenient to Handle and Operate blow away from the drill any dirt or particles which might be raised in drilling operations.

The Titan drill runs only when the operator is actually gripping it and drilling. The position and operation of the switch is natural and the ease of release without shifting the hand makes it possible to stop the motor without shifting the position of the drill, a frequent cause of breakage. This switch was developed for the Titan drill by the Cutler-Hammer Manufacturing Company. The drill is steel armored, designed to be non-breakable, and all parts are riveted together so that there is no danger of the contacts becoming loosened or the plug becoming broken. A durable cord is used which does not lead into the motor itself and can therefore be replaced without the services of an experienced electrician.

A simple and effective lubricating system is used, the two armature bearings and the drill chuck bearings having bronze bushings and spring oilers which retain a considerable amount of lubricant. If the drill is thoroughly oiled for the first few hours of operation it is said to require lubrication only occasionally thereafter.

The thrust in drilling is taken up on a ball-bearing, working between two hardened and ground steel surfaces. The gears are packed in grease. The pinion is of steel, cut directly on the armature shaft and meshing with a bronze gear. The teeth are cut helical, adding to the strength and smoothness of operation. The gear ratio is 7-5½ to 1. This odd number is chosen purposely to prevent the same pair of teeth on the gear and pinion always meeting. The chuck is of the Goodell-Pratt keyless type requiring no tool to open or close it. To prevent the armature from turning when opening or closing the chuck, it is only necessary to press the spring stop into the slot in the end of the armature shaft, this locks the shaft, and the chuck may then be turned without difficulty.

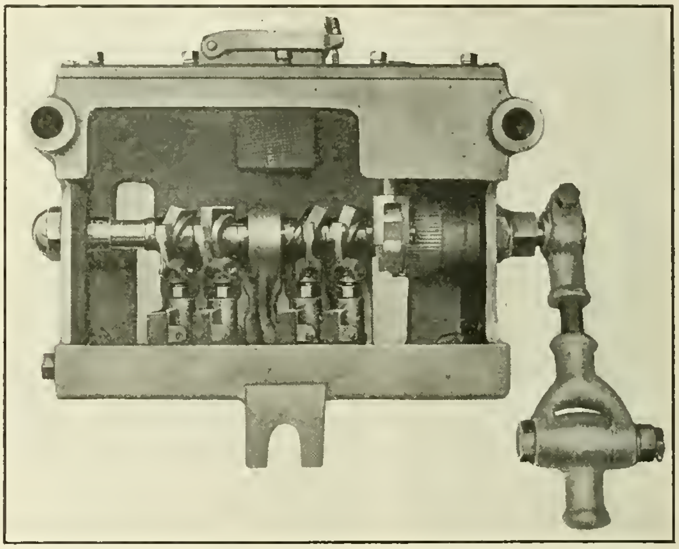
A Valveless Force-Feed Locomotive Lubricator

ONE of the force-feed lubricators for supplying oil to locomotive valve chambers and cylinders now coming into considerable use is shown in the illustration. This is the valveless type of the Madison-Kipp Corporation, Madison, Wis., which has been applied in stationary practice for about 25 years.

The illustration shows the locomotive type lubricator with one side of the oil reservoir cut away to disclose the operating mechanism. It will be seen that the eccentric which gives the oil plungers their vertical motion are provided with bearings the plane of which is inclined so that it is oblique with respect to the center line of the shaft. The plungers are thus given a turning movement so that suitable openings in the plungers register with the inlet and outlet ports, respectively, at the end of the suction and discharge strokes. This movement makes it possible to dispense with valves.

One of the other features of this lubricator is the broad face of the ratchet wheel, which, running in oil, is said to show negligible wear after years of service. The lubricator also contains a special adjusting arrangement which permits the adjustment of the pump feed independently of the range of the driving stroke. This permits a wide variation in the length of the drive arm without making it difficult to adjust the lubricator for the proper oil feed.

Installations of this type of lubricator are now in service on more than 20 railroads and a number of the lubricators have been in constant service for more than two years.



Madison-Kipp Valveless Lubricator with Side Cut Away to Show Operating Mechanism

"Fire Armor" Treatment of High-Speed Steel

A METHOD of treating high speed steel, known as the Fire Armor method has been developed by the Chrobaltic Tool Co., Chicago. It is based upon the principle of obtaining a thorough carbide transformation at the lowest possible temperature. This method, briefly stated, consists of heating the tool in a protected atmosphere to a predetermined temperature a predetermined length of time, which results in the full development of the cutting structure throughout the entire piece at the lowest possible temperature.

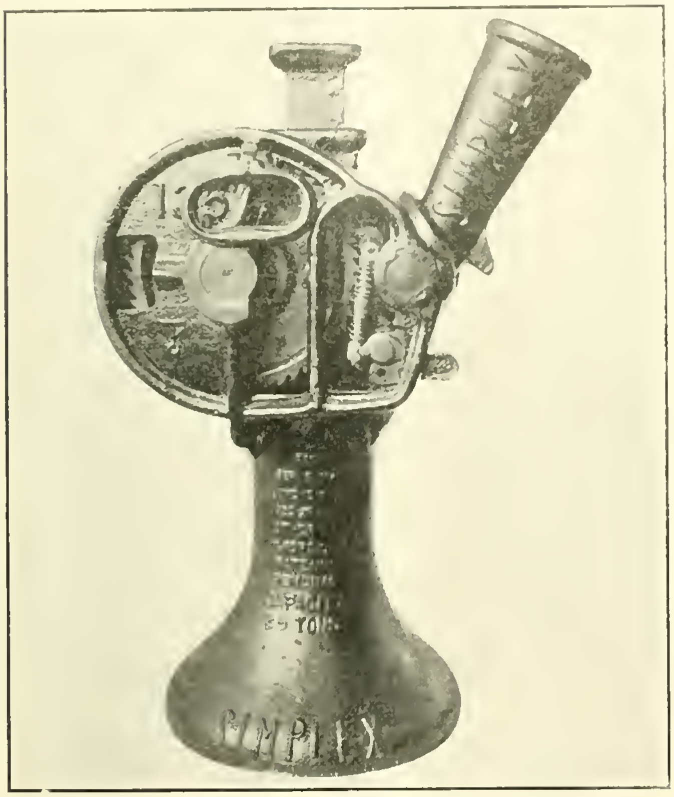
It has been determined by carefully conducted experiment that the complete carbide transformation is obtained in the standard modern high speed steel at between 2200 and 2210 deg. F. when held accurately between those temperatures in a protected atmosphere a sufficient length of time to complete the change. The length of time depends upon the volume of the piece, but in no case will it be less than approximately 45 min. after the temperature has been reached. It has been proven that continuing to hold at this temperature for a period of two to three hours does not alter the structure. The releasing of occluded gases occurs at temperatures slightly higher or approximately 2240 deg. F. and that pitting and other surface defects result from the action of these gases being released.

Fire Armor, therefore, gives a fully developed cutting structure throughout without affecting the surface. Resultant tools are stronger physically and are said to have proved, in many cases, several times as efficient for cutting as the average high speed tool. The method provides against overheating the cutter, tool, or part, and the protected atmosphere assures the material being hard up to the very surface; it also corrects materials which are somewhat out of balance and consequently have a prolonged "lag." In a word, this method is designed to overcome most of the irregularities found in high speed steels.

Fire Armor containers for carrying out this method are obtainable in any size or dimension within reasonable limits. While the highest temperature required for the method is 2215 deg. F., the containers themselves are not affected by temperatures up to 2350 deg. F. and are being used in large quantities daily up to the latter temperature.

Twenty-Five and Thirty-Five Ton Geared Jacks

EFFICIENT utilization of man power, ruggedness and simplicity of design are features of the improved Simplex geared jack No. 135 (35 tons capacity) illustrated. This jack, manufactured by Templeton, Kenly & Company, Ltd., Chicago, is also made in a smaller size, No. 125 (25 tons capacity).



Simplex No. 135 Geared Jack

In considering mechanical efficiency, the basic question is:—How much work will the tool perform per unit of time, under standard working conditions? This jack is designed to develop the maximum power under heavy loads, the geared construction giving it the desired power without sacrificing speed. It is said to require only 16 lb. dead weight to lift one ton with the Simplex No. 125 jack, the dead weight being applied at the end of an operating lever six ft. long. A 160 lb. man using this jack and a six ft. oval pole will develop 3,450 ft. lb. per min. In other words, he can lift with the jack a 10-ton load at the rate of about two inches per minute.

The entire working mechanism of this jack is contained in a single unit, the spring link. This spring link as shown in the illustration consists of three steel drop forgings and two steel piano wire springs. In shop tests, these springs are said to have been expanded and contracted over 80,000 times without lubrication. The construction is simple and when repairs are necessary, they can be made with the least possible loss of time. When badly worn, a spring link can be replaced by any mechanic in two minutes or the entire working mechanism, socket, pawls and spring link can be taken apart and reassembled in six minutes.

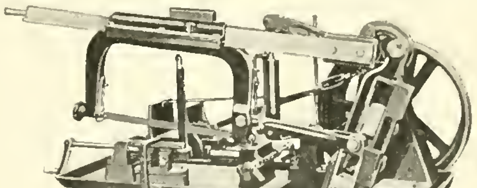
The pinions and ratchet wheels are keyed as shown in the illustration. The strain that is put on these parts in a jack of this type made it impractical to use any of the ordinary forms of keying and the Simplex integral keying was devised. The pawls and the rack bars and pinions are of chrome nickel steel, the ratchet wheels being 40-50 point carbon steel. All parts are carefully heat treated. The lever sockets are constructed without fulcrum pins, the fulcrum being steel trunnions cast integral with the socket. These trunnions after heat treatment, are said to be unbreakable under service loads.

Jacks are frequently put out of service because of a lost part, but in this jack, expansion rivets are provided which cannot loosen under the severest shop service. The side plates are also riveted in position. The arched construction of the standard with its broad, substantial base affords a strong foundation and is another contribution to the cause of safety.

Power Hack Saw with Automatically-Adjusted Stroke

A HACK saw machine, featured by an automatically adjusted stroke and known as the No. 18 Kwik-Kut machine, has been placed on the market by E. C. Atkins & Co., Indianapolis, Ind. This machine has a solid cabinet base which contains the settling tank, compound reservoir and plunger pump. The general construction throughout is heavy so as to make a sturdy machine, practically eliminating vibration and reducing wear to a minimum. A few of the features of this machine are mentioned below.

The stroke, is automatically adjusted according to the size of the material in the vise providing a greater blade travel per minute and consequently a higher cutting speed. Practically none of the hack saw blade is wasted. The machine cuts straight because the saw frame travels on a T-bar, the frame being kept in adjustment by means of screws so that it will always travel in a straight line. The blade holder has a gage, showing whether or not the blade is adjusted perpendicularly to the bottom of the vise, and to the side of the vise. In addition, the blade guide rides on top of the blade, preventing the latter from running side-wise in the cut.

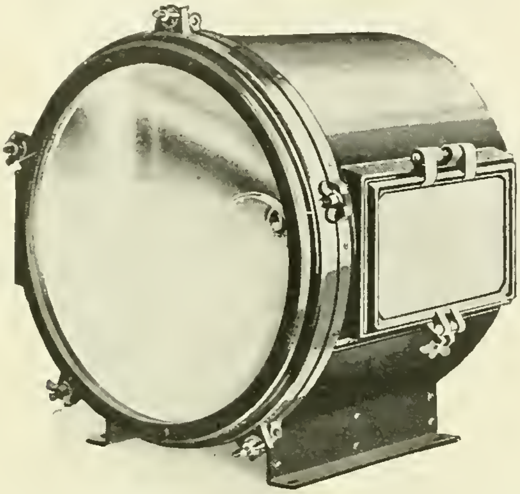


Kwik-Kut Power Hack Saw

The Kwik-Kut hack saw machine is carefully balanced to reduce vibration and wear. Oil cups are placed where a large amount of oil is required, and oil holes are provided to lubricate other moving parts. The link blocks are made of bronze as these blocks must withstand almost continuous wear. The feed of the machine is controlled by a hydraulic dash pot, and a greater or less feed can be secured by simply turning a by-pass cock. Where a constant feed is required, the by-pass cock can be set for the proper feed. This hydraulic dash pot also acts as a cushion to the raising device so that the blade is lowered into the cut without jar.

Locomotive Headlight With Sealed Metal Reflector

A LOCOMOTIVE headlight case with a hermetically sealed silver-plated copper reflector has been developed by the Pyle National Company, Chicago, Ill. A standard 18-in. by 9-in. parabolic reflector is used which is spun from heavy gage sheet copper, the inside surface being prepared for the quadruple silver plating by a grinding and polishing operation. After plating, the silver surface is burnished and lacquered.


Pyle-National Headlight No. 20-C-320-N Having Illuminated Numeral Display Frames with Parallel Sides

The focusing device is attached to the back of the reflector and is designed to maintain the seal at all times. Use of the device is necessary only in making the focal adjustment for the initial lamp application, unless, on renewal, a lamp is applied which does not conform to specifications. The reflector assembly is held tightly against a gasketed joint in the door frame casting by bronze screws.

The case is fabricated from 16 gage copper-bearing steel or Armco iron. The case is protected on the outside by two coats of flexible black baking enamel and on the inside by the application of an aluminizing preparation. A machine finished cast aluminum-alloy door frame forms the front of the case and a slot-hinged door ring which is also a machine finished aluminum-alloy casting is sealed against a heavy gasket by the tightening of five wing nuts on hinged bolts. When the door is open it swings freely on the hinge, but when it is closed the hinge does not interfere with the action of the bolts and wing nuts. The front glass is made of clear, convex, heat resisting glass, and is held and sealed against the door ring gasket by means of bronze clamp screws.

Lamp replacements are made by loosening the bronze ring nuts and swinging open the front door. This construction makes the fitting of front glasses convenient and avoids the necessity of breaking electrical connection or disturbing the focal adjustments for renewing lamps. The headlight is made in four case styles to comply with requirements for numerical display frames.

Redesigned Vertical Drilling Machine

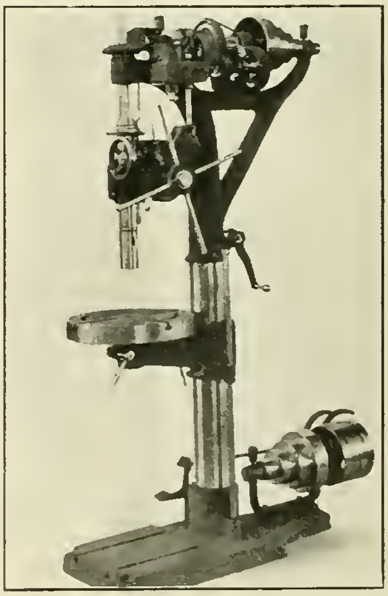
THE 20-in. vertical drilling machine illustrated has been recently redesigned by the Superior Machine Tool Company, Kokomo, Ind., to include bronze bushings, back gears, geared feed and wheel and pilot feeds. Flexibility is secured by the new design and with the unit method of assembly with all parts made on an interchangeable system, the machine may be converted or reassembled to meet varying requirements.

The feed box is provided with steel gears heat treated, reduction being obtained by a bronze worm and gear running in oil. Three feeds are obtainable by shifting a key in the feed box and three additional feeds by a sliding gear on the top shaft.

The column is well proportioned as shown in the illustration, being reinforced at sections subject to heavy strains. The drive provides for a 2-in. belt and pulley and 2¾-in. belt on the counter pulley, which gives all necessary power for drilling within the capacity of the machine. Ample provision for lubrication is afforded for all working bearings.

As shown in the illustration this machine is belt driven; however it can be adapted for motor drive with motor speeds varying from 750 to 1,800 r.p.m.

The height of the machine to the top of the pulley is 74 in., the spindle being 41½ in. above the base. The distance from the table to the spindle is 26 in., the traverse of the spindle sleeve being 8½ in. and the traverse of the table 23¼ in. This machine drills to the center of a 20¼-in. circle. Six spindle feeds from .005 to .018 in. per revolution


Superior 20-Inch Vertical Drilling Machine

are available. When belt driven, a driving pulley 9 in. by 3 in. running at a speed of 450 r.p.m. is used. This gives four direct spindle speeds from 971 to 875 r.p.m. and, with the back gears in, four additional speeds from 25 to 226 r.p.m. can be obtained. A one horsepower motor is required if the machine is to be motor driven.

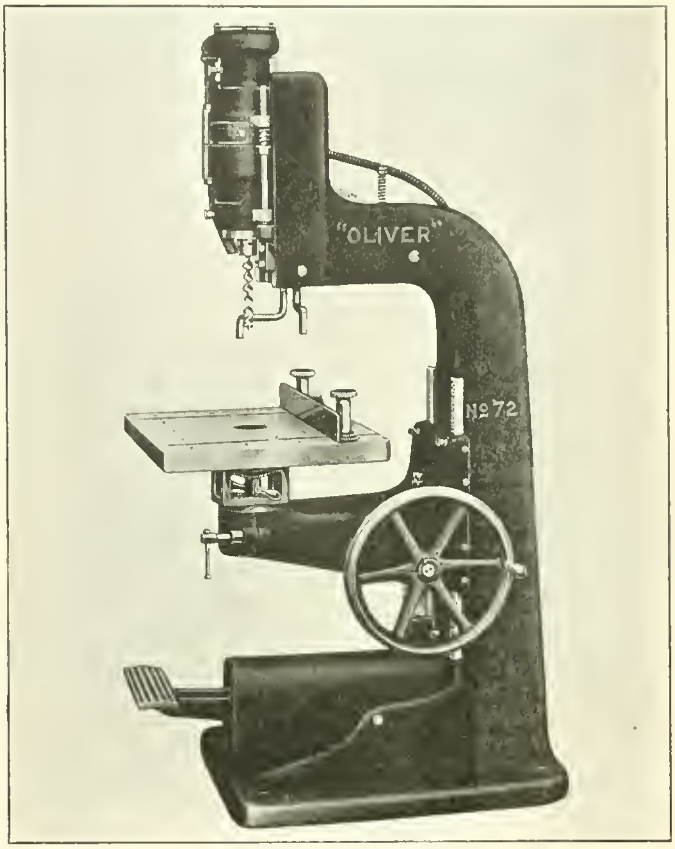
Single-Spindle Boring Machine for Pattern Shops

A VERTICAL, single-spindle boring machine with the rotor of the motor mounted directly on the spindle has been designed by the Oliver Machinery Company, Grand Rapids, Mich. It is known as the Oliver No. 72. This method of providing power for the machine eliminates all belting, countershafts, pulleys and most of the bearings, thereby decreasing the power required and making it a more simple machine. There is a self-contained pressure blower fan mounted directly on the spindle at the top of the machine, to blow the dust and borings away from the work, and also cools the boring bits.

The machine has an adjustable table that can be tilted in any direction up to 45 deg. and is equipped with a scale and pointer to indicate the angle of tilt. It is drilled for wood screws so that a wood table can be fastened to it when desired. Vertical adjustment of the table is controlled by a large hand wheel on the right hand side of the machine, allowing ample room in front of the machine for the operator's knee. All moving parts are carefully counterbalanced, causing less fatigue to the operator.

The maximum stroke of the motor head is 6½ in. Holes up to 2 in. diameter and up to 6 in. deep can be bored with one stroke, to the center of 36 in. The motor housing consists of two halves securely clamped by two large bolts, forming a unit, with planed, dovetailed ways at the rear. The motor itself has no bearings. The rotor, which is keyed to the spindle, runs in ball bearings at the outer ends of the two halves. The motor used is 1½ hp. and can be either 2 or 3 phase, 60 cycle, 220 or 440 volt a.c., 3,600 r.p.m.

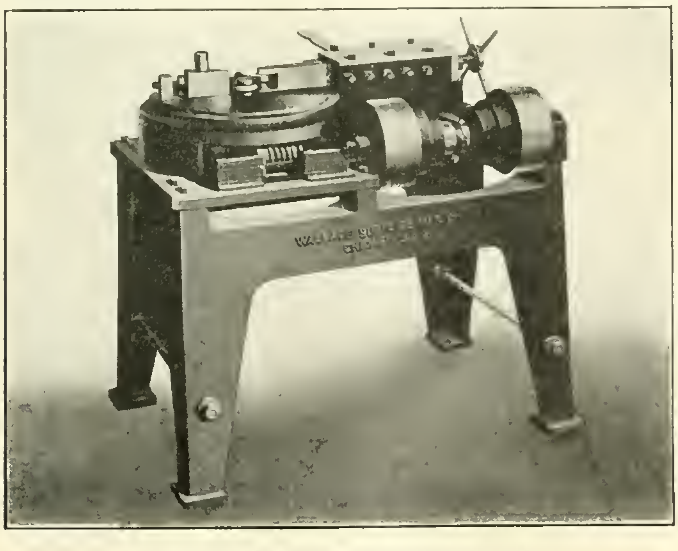
This machine is especially suited to pattern shops because of the great distance, 18 in., from the center of the spindle to the foot of the column. This permits the handling of large or irregular shaped patterns.



Oliver Motor-in-Head Vertical Single Spindle Borer

Strongly Made Bar-Bending Machine

A BAR-BENDING machine featured among other things by its rugged construction has been placed on the market by the Wallis Supply Manufacturing Company, Chicago. This machine is used for bending cold metal bars one inch in diameter, or one inch square, flat shapes ⅜ in. by 2 in. (on edge or flatwise), and angles 2 in. by 2 in. by ¼ in. On hot bending work, 1½-in. squares, or rounds; also flat shapes ¾ in. by 2 in. and angles 2½ in. by 2½ in. by 5/16 in. can be bent.



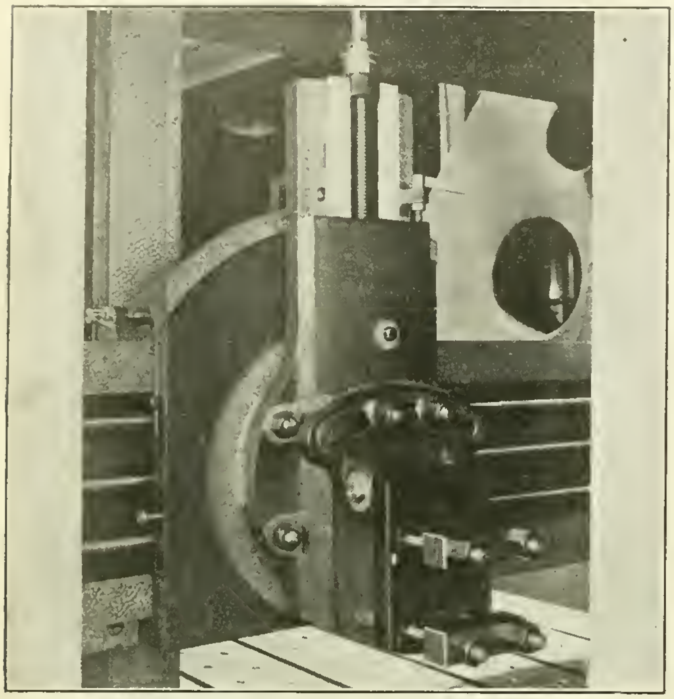
No. 15 Wallace Bar Bending Machine

On the under side of the machine there is an adjustable stop mechanism which provides means for automatically stopping the rotating table at any predetermined point so that materials can be bent identically to any desired number of degrees.

The speed of the rotating table is six revolutions per minute, the production varying according to the number of degrees that the material has to be bent; the length and kind of stock; also the size of the section, etc. The forming of materials on the edge or bending of angles consumes more time than does ordinary rod or bar work on account of the greater difficulty in handling and adjusting. A fair average production estimate for ordinary cold bending to 180 deg. is 150 pieces per hr., based on rounds, squares and flats bent flatwise. The bending of flat stock on edge, or angle iron to more than 180 deg. necessitates the use of a "split form" so that the upper part of the form can be lifted after each bend has been made to allow the removal of the finished part from the machine. For this class of work the average production is about 60 pieces an hour. Three horsepower is required to operate this machine.

Large Size Maximum Service Planers

The 60-in. and 72-in. planers recently announced by the G. A. Gray Company, Cincinnati, Ohio, complete the line of maximum service planers described on page 777 of the December, 1921, *Railway Mechanical Engineer.* In general the same time and effort-saving features are incorporated with one important addition, namely the Twin-Purpose gibs.



A View of Rail Head Showing Twin-Purpose Gibs

The grouping of the planer controls at the operator's end of the rail eliminates a great deal of walking about hitherto necessary. The operator pushes up the stirrup which hangs at his end of the rail, and thus gives him control of the movement of the rail without leaving the position from which he can see the work and the tools. The rail stops without drifting, so that it may be set at a line. It is then clamped by a few turns of the clamping screw located at the right-hand end of the rail. Having located the rail, the operator can move a rail head into position by simply shifting one lever at his end of rail. Similarly, in spite of the great size and weight of these new planer heads, the slides may be rapidly raised or lowered without effort by using the middle traverse lever at the end of the rail. In other words, these large planers can be handled as quickly as a 36-in. planer.

To set the feed, the same Cantslip feed which has been standardized on the smaller sizes of planers is employed. Any feed between zero and one inch can be had in steps of .01 in. The feed is positive and is not driven through a friction. The oiling of the planer has been most carefully worked out. The gears, which are helical throughout, run in a bath of oil. From the oil pan under the gears oil is taken through a strainer and pumped through a filter to each of the shaft bearings and to the center of each vee.

A close-up view of the rail head, as illustrated, shows the Twin-Purpose gibs provided between slide and harp. A turn of the handle in one direction positively adjusts the gib to the operating position, while a turn in the other direction rigidly locks the slide to the harp. Similar gibs also are provided between saddle and rail. Furthermore, a clamp is provided which clamps the harp to the top of the saddle. These methods of clamping lock the various parts of the head so rigidly together that relative motion, even under the heaviest cutting, is eliminated.

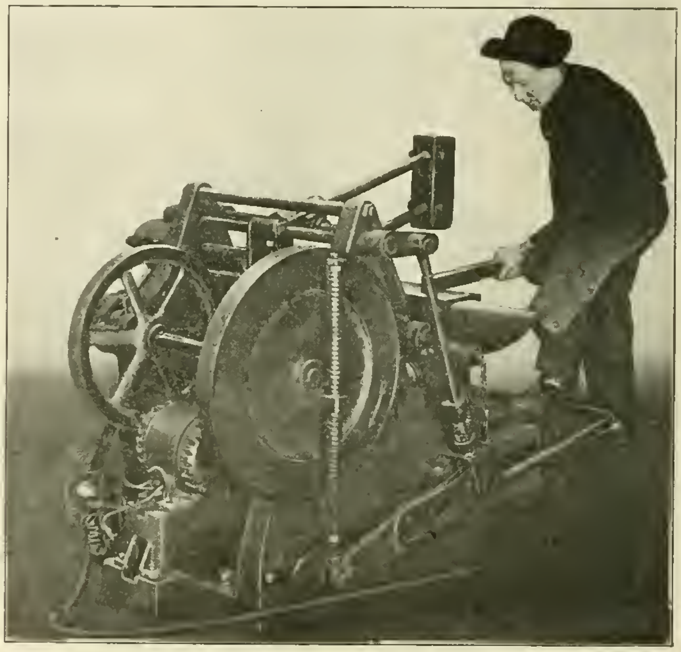
Supplementing these production features, the parts have been built with unusually heavy sections, the cast-iron being distributed in such a manner as to insure the greatest possible rigidity under heavy cutting strains.

General Utility Power Smithing Hammer

A POWER-DRIVEN hammer intended particularly for use on forging work ordinarily performed under hand-swung sledges and too small to be done under steam hammers, is shown in the accompanying illustration. The hammer is termed a "mechanical helper," since it replaces one or two men employed as strikers at each anvil. The same hand tools that the smith ordinarily employs are used with the hammer, without the need of special tools and dies. The hammer, which is stated to greatly increase the capacity and the output per anvil, has recently been placed on the market by the Blacker Engineering Co., Inc., Grand Central Terminal, New York.

The machine is rated to handle material up to 2½ in. thick, although even larger sizes can be cared for. The hammer itself is under the control of the smith, so that either a light or heavy blow can be struck. The force of the blow varies directly with the depression of the treadle extending around the anvil. It is stated that the maximum blow is about four times as heavy as that delivered by a human striker, and that the machine attains a rate of 140 blows per minute. This higher rate of speed and power is important in smith-shop production.

An important feature of the hammer is the lateral traverse motion that can be given to the hammer itself. This motion is controlled by a winged foot lever located at the right of



Power Hammer for Light Forging Work

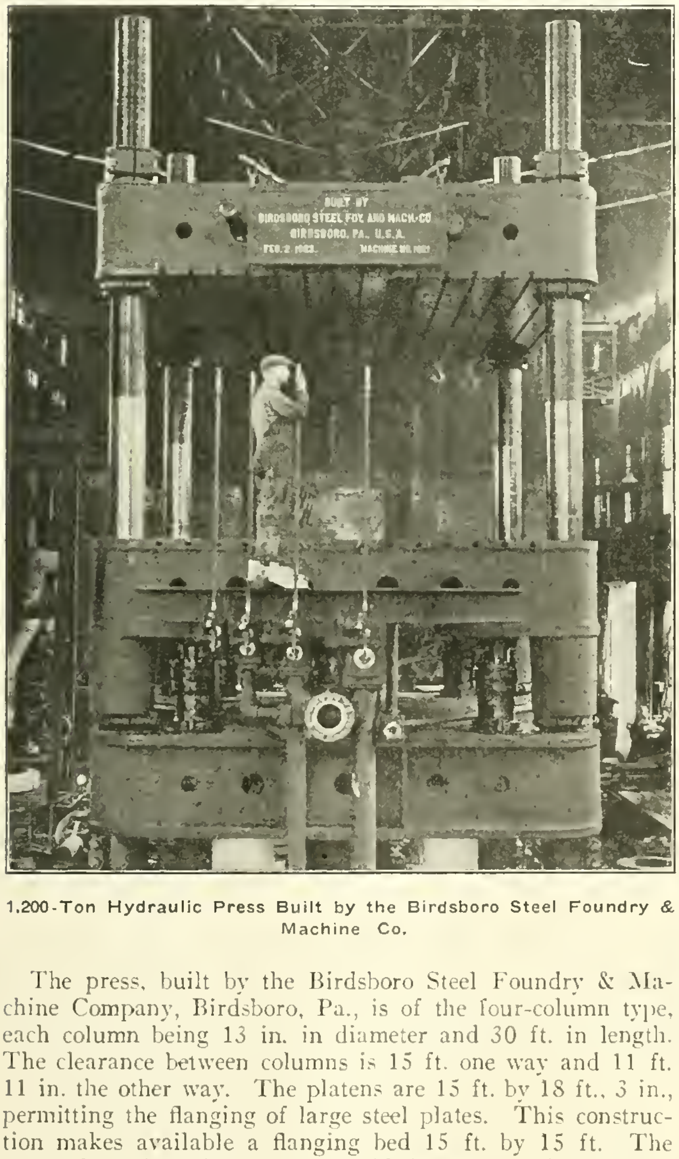
the anvil and enabling the head to be traveled along the face of the anvil to the desired point.

An anvil and a block of special design to suit the hammer are furnished. The base of the anvil is planed and adjusting screws are provided on the stand, to enable the anvil to be moved forward or backward to get in proper position.

The hammer requires only one horsepower to drive it. It can be run by means of a belt from a lineshaft, being furnished with tight and loose pulleys 15 in. in diameter for this work. A more compact unit is the one driven by an individual motor, as illustrated. The motor is mounted on a small stand on the base and geared to a large driving gear placed on the main shaft. The hammer alone weighs 1,300 lb., the anvil 560 lb., and the stand 336 lb.

Large Flanging Press for Boiler Shop

A FLANGING press, said to be the largest ever built, has recently been constructed for use in a railway shop. It uses an accumulator pressure of 1,500 lb. per sq. in., making a capacity of 1,200 tons. The machine is of the moving-up type, equipped with modern labor and power saving devices and safety appliances. A foundation pit, 8 ft. wide, 25 ft. long and 18 ft. deep, is required as the floor level in which the press is placed comes slightly below the face of the middle platen, which is the moving member.



1,200-Ton Hydraulic Press Built by the Birdsboro Steel Foundry & Machine Co.

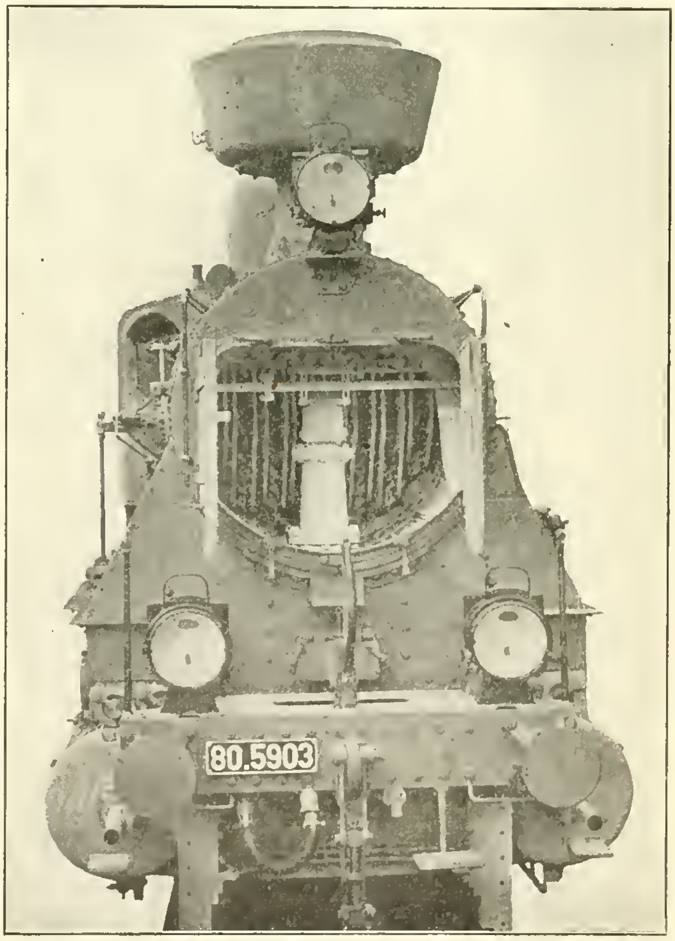
The press, built by the Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., is of the four-column type, each column being 13 in. in diameter and 30 ft. in length. The clearance between columns is 15 ft. one way and 11 ft. 11 in. the other way. The platens are 15 ft. by 18 ft., 3 in., permitting the flanging of large steel plates. This construction makes available a flanging bed 15 ft. by 15 ft. The top and moving platens are provided with a multiplicity of longitudinal T-slots to accommodate bolts for fastening dies.

The columns have long threads on the upper ends, thereby providing an adjustment between the top and moving platens of from 12 ft. maximum to 5 ft. minimum. The inner nuts supporting the upper platen are made in halves, and the outer nuts are split on one side to permit the use of a wedge for slackening while they are being raised or lowered in adjusting the clearances.

Six ranges of power may be exerted by the press, which has three main cylinders and plungers 26 in. in diameter each with a lift of 6 ft. By admitting 1,500 lb. accumulator pressure to the center cylinder, only 400 tons will be exerted. When pressure is admitted to the other two 26-in. cylinders simultaneously, a pressure of 800 tons will be obtained, and by applying pressure to the three cylinders, 1,200 tons will be obtained.

It is possible to exert three additional pressures by using the four jack rams in conjunction with either of the above three combinations. These rams are 9 in. in diameter and also are used for raising and controlling the motion of the moving platen while running up to the work. The press is cast steel construction throughout, with the exception of the plungers, which are of chilled iron, ground and polished, and the tension bolts, which are of steel forged from metal cast ingots. The total weight of the press is over 300 tons.

* * *



An Austrian 0-10-0 Equipped with Lentz Feed-Water Heater and Schmidt Superheater

GENERAL NEWS

Decisions of Labor Board

The third annual edition of the decisions of the United States Railroad Labor Board has been published and is being distributed. In this edition certain miscellaneous subjects heretofore included have been left out. A separate volume is to be issued containing the cumulative index digest which will contain reference to all the decisions issued by the board. In all other respects the subjects included in this volume are the same as in previous editions and the general arrangement is maintained. The volume contains 904 decisions handed down during 1922.

Injunction Against Great Northern "Company" Union

A temporary injunction restraining the Associated Organization of Shopcraft Employees of the Great Northern from interfering with members of the Federated Shopcrafts has been granted to the latter organization by United States District Judge John B. Sanborn at St. Paul, Minn. Since the formation of the "company" union in July of last year the national shopcrafts' organization claims that its members returning to work have been denied membership in the local union. B. M. Jewell, president of the federated shopcrafts, is quoted as saying that there is no intention to seek such injunctions in other sections.

Bonuses at C. & A. Storehouse

Since installing a bonus system at the general storehouse of the Chicago & Alton as an inducement to fill requisitions promptly, the average number of requisitions being held has been reduced one-half as compared with those held in January, while the average number of days required to fill them has been reduced from 43 to 16. The bonus consists of two days off or two days added to the summer vacation and is given to the stock man making the best record in filling requisitions. A committee of stock men decides the winner of the bonus. On January 1 the number of unfilled department requisitions at the general storehouse for all sections totaled 299, and on June 18 this number had been reduced to 119.

Wage Increases

Shopmen on the Cincinnati Northern, including machinists, boilermakers, blacksmiths, sheet metal workers, electrical workers, carmen, helpers and apprentices, have been granted an increase in wages of three cents an hour. This increase is retroactive to August 1.

Mechanical department employees on the Maine Central and the Portland Terminal have been granted wage increases amounting to $58,000 annually. Machinists, boilermakers, blacksmiths, electricians, sheet metal workers, carmen and helpers with over one year of service have received an increase of three cents an hour, helpers with less than one year of service, one cent an hour and car cleaners, 1½ cents an hour.

The Cleveland, Cincinnati, Chicago & St. Louis, following negotiations with representatives of the federated shopcraft unions, has made a general advance of three cents an hour in the wages of shopmen; said to number 4,000 individuals.

P. R. R. Abandons Mount Vernon Shops

Orders have been issued by the Pennsylvania Railroad permanently closing the shops of the Akron Division located at Mount Vernon, Ohio, which have been in continuous operation for 50 years. It is said that the decision to abandon the shops was on account of Mount Vernon being located at a considerable distance from the division terminals and also the shop facilities being inadequate to handle the locomotives now used by the Pennsylvania. Over a year ago a portion of the shops was damaged, entailing a loss of $100,000. Reconstruction work was started but never completed. Over 300 men now employed at the Mount Vernon shops will be sent to other shops on the Pennsylvania. These men will be given their preference as to the plan of employment and will retain their seniority rights.

Wage Statistics for June

The total number of employees reported by Class 1 railroads for the month of June, 1923, was 1,933,929, which exceeds the number reported for any month since November, 1920, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. Compared with the returns for the same month last year, the total shows an increase of 248,515, or 14.7 per cent. The largest increase appears in the maintenance of equipment group and is accompanied by a substantial increase in the number of hours worked per employee. Compared with those for May, 1923, the returns for June, 1923, indicate an increase of 37,710 in the total number of employees, or 2 per cent. The compensation, however, shows a decrease of 0.2 per cent, which is explained by a decrease in the total hours worked. Due to a fire which destroyed certain records of the Erie and subsidiaries, only partial returns were furnished by these roads; data covering 7,712 employees and $1,017,915 compensation have been omitted.

Canadian Union President Attacks Labor Board

The Railway Labor Board was denounced as a "tool of the employers" in an address by A. R. Mosher, president, at the convention of the Canadian Brotherhood of Railway Employees at Calgary, Alta., on September 17. Mr. Mosher also declared the strike to be "too powerful a weapon" for workers engaged in an essential public service to employ. In referring to the Labor Board, Mr. Mosher said, "It is a greater menace to railway employees than any other combination of individuals on the North American continent." He accused the board of aiding railway managements "in their attacks upon the pay envelopes of workers" and referred to it as a "United States Government tribunal which has made itself ridiculous in the eyes of every right thinking person on this continent by declaring that a living wage for workers is impracticable and impossible." He said further that except where the workers directly block the practice, Canadian railways apply the decisions of the board so that employees in the Dominion are as much affected by its judgment as are their fellow craftsmen in the United States, although the Labor Board is not supposed to have jurisdiction on the Canadian side.

Locomotive Shipments

Department of Commerce reports based on returns from the principal manufacturing plants show that the builders made shipments in August of 272 locomotives as compared with 239 in July. In the first eight months of 1923, shipments totaled 1,916 as compared with 641 in the corresponding period of last year. At the end of August unfilled orders totaled 1,497 as compared with 1,738 at the end of July. The detailed figures showing the proportion of foreign and domestic business and giving comparisons with preceding periods follow:

	August, 1923	July, 1923	August 1922	Eight months' total January to August 1923	Eight months' total January to August 1922
Shipments:					
Domestic	259	211	130	1,802	472
Foreign	13	28	21	114	169
Total	272	239	151	1,916	641
Unfilled orders: (end of month):					
Domestic	1,406	1,652	926	....	....
Foreign	91	86	109	....	....
Total	1,497	1,738	1,035	....	....

The Fastest Train in Great Britain

The train which has the fastest schedule of any in Great Britain is operated by the Great Western Railway from Cheltenham to Paddington (London) and covers the distance from Swindon to Paddington, 77¼ miles, in 75 min.—or at the rate of 61.8 miles per hour.

Miles Distant from Paddington		Schedule time p. m.	Actual time p. m.
77.3	Swindon	3:45	3.45
53.1	Didcot	4:09	4:09½
36	Reading	4:25	4:24
24.1	Maidenhead	4:35½	4:33½
18.5	Slough	4:40½	4:38½
9.1	Southall	4.49	4:47
...	Paddington	5:00	4:57

On the first run the train gained on its schedule so that the Swindon-Paddington run was made at an average speed slightly in excess of 64¼ miles per hour. The schedule time and actual time on the initial run are shown in the accompanying table. At one time a speed of 83 miles per hour was reached.

The locomotive is of the two-cylinder, 4-6-0 type. It has 18½-in. by 30-in. cylinders, drivers 80½ in., a heating surface of 2,124.8 sq. ft. and has a working pressure of 225 lb.

The locomotive is green in color and the cars chocolate and cream, according to Great Western standards. The usual train weighs 250 long tons.

New Boiler Law in Pennsylvania

Two laws pertaining to the collection of fees for services rendered by the Department of Labor and Industry, Commonwealth of Pennsylvania, in the administration of the rules and regulations of the department covering boilers and elevators, were passed at the last session of the legislature.

The boiler law provides for the inspection of boilers by representatives of insurance companies and by salaried employees of the Department of Labor and Industry. Owners and users of boilers will be required to forward to the Department of Labor and Industry a fee of one dollar before the annual certificate of operation for the boiler will be issued. When boilers are inspected by representatives of the Department of Labor and Industry a fee of six dollars and fifty cents ($6.50) will be collected for each external and internal inspection made while the boiler is not under pressure, and two dollars and fifty cents ($2.50) for external inspection made when the boiler is under pressure.

Persons desiring to take examination for boiler inspector are required to pay a fee of ten dollars ($10.00) at the time of making application for examination. If the applicant is successful in passing the examination a certificate of competency and a commission card will be issued without further charge. It is the plan of the Department to put this law into effect as soon as the necessary forms can be printed.

New Equipment for Long Island

The Long Island Railroad has authorized the purchase of new equipment to cost about $2,863,000, consisting of 60 steel motor passenger cars for electric service, 5 large passenger locomotives for heavy express trains, 5 heavy freight locomotives, and 200 gondola cars or open-top cars for general use, such as the hauling of stone and gravel for road building and other traffic requiring this character of equipment. Contracts for this equipment are to be let not later than October 15. This is about two months sooner than the 1923 car and locomotive program was made up, and assures delivery of all the new equipment covered by the above appropriation, in ample time for the 1924 summer traffic. There are still 40 steel motor passenger cars, 10 steel passenger coaches for steam service, and two steel mail cars due for delivery under the 1923 contracts. This means that when the summer rush of 1924 comes, the road will actually have 110 passenger cars more than the equipment available for the season of 1923. These 110 additional cars will provide seating capacity for 8,380 passengers, and make it possible for the Long Island to adequately care for the normal increase in traffic, which averages from 5,000 to 8,000 passengers per day, compared with the previous year. On December 31, 1922, the equipment register of the Long Island showed that the company owned 1,210 passenger train cars, of which 310 were of wooden and 900 of steel construction. With the 92 additional steel passenger cars ordered for 1923 delivery, and the 60 now to be placed on order, and deducting 80 wooden cars of the older type that have been retired, the passenger equipment will total 1,282 cars at the end of 1924, of which 1,052 will be of steel, and 230 of wooden construction. Of the wooden cars, only 160 will be utilized for carrying passengers, the balance for the handling of express, baggage and mail traffic.

MEETINGS AND CONVENTIONS

Dixie Railway Club Organized at Mobile

The Dixie Railway Club has been organized at Mobile, Ala., for the purpose of advancing the science of railroading, and bringing into closer relationship railroaders, railway supply men and employees of water transportation lines. The associate membership also includes traffic managers of chambers of commerce and industries. The club has about 200 members. G. P. Brock is president, J. H. Cassidy and R. G. Lauten are vice-presidents, R. C. Schley is secretary and G. M. White is treasurer.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners' Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical. V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.- Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—W. C. Stephenson, Atlantic Coast Line.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Convention October 8-12, Ballroom William Penn Hotel, Pittsburgh, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Meeting October 9. Paper will be read on Crossing Accidents; Their Cause and Prevention, by George A. Kell, safety engineer, Canadian National Railways, Toronto, Ont. Stereopticon views.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting Hotel Sherman, Chicago, October 3, 4 and 5.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meeting October 9, Copley-Plaza Hotel, Boston. Paper on Looking Ahead presented by R. H. Aishton, president of American Railway Association. Entertainment during dinner.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting October 25. E. T. Howson, editor of Railway Engineering and Maintenance, will speak on Some Operating Phases of Maintenance Work.

Railway Club of Greenville.—G. Charles Hoey, Plum street, Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Next meeting October 25. Annual meeting, election of officers, smoker. Will entertain American Welding Society.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Truscon Steel Company is preparing plans for a new plant at Pittsburg, Cal.

The Standard Steel & Bearings, Incorporated, has moved its Philadelphia, Pa., plant to Plainville, Conn.

S. Douglas Gibson, dealer in railway supplies has removed his offices from the Home Life building, to Suite 744, Transportation building, Washington, D. C.

The Superheater Company is preparing plans for the erection of a 120-ft. by 210-ft. addition to its plant at East Chicago, Ind., to cost approximately $75,000.

David G. White has joined the staff of the Hardwood Manufacturers Institute, Chicago, as forest economist and as an assistant to J. M. Pritchard, secretary-manager.

H. D. Conkey & Company, Mendota, Ill., manufacturers of cranes and industrial cars, have appointed the Florandin Equipment Company as New York sales agents.

The Prime Manufacturing Co., Milwaukee, Wis., contemplates the erection of a modern brass foundry of approximately 15,000 to 18,000 sq. ft. No definite plans have as yet been made.

C. F. McCuen, representative of the W. H. Miner Company, with headquarters at Chicago, has been appointed general sales agent of the Camel Company, with the same headquarters.

D. R. Day, resident manager of the Hall Switch & Signal Company, with headquarters at Chicago, has been appointed sales manager of the Bryant Zinc Company, with headquarters in the same city.

S. G. Eastman, western sales manager of the Niles-Bement-Pond Company, with headquarters at San Francisco, Cal., has been transferred to Chicago, to succeed G. F. Mills, Chicago sales manager, retired.

R. W. Benson, eastern representative at New York City of the Flannery Bolt Company, Pittsburgh, Pa., has resigned, and the company has closed its eastern office at 41 East Forty-second street, New York City.

Fairbanks, Morse & Co. have purchased a tract of land formerly owned by the county workhouse at Indianapolis, Ind., and are planning to erect a new factory building adjoining the present plant, which covers 4½ acres.

W. M. Bosworth has resigned as mechanical engineer of the Wine Railway Appliance Company, Toledo, Ohio, and is now affiliated with the Met'l Fibre Rope Company, Toledo, as vice-president and factory manager.

J. A. Cranston, northwestern manager of the General Electric Company, with headquarters at Portland, Ore., has been appointed Pacific Coast manager with headquarters at San Francisco, Cal., succeeding Dr. Thomas Addison, resigned.

The American Car & Foundry Company has purchased a tract of land 260 ft. by 1,931 ft. extending from the south branch of the Chicago river almost to Blue Island avenue and fronting on Wood street, Chicago, from the Edward Hines Lumber Company.

The Sullivan Machinery Company on August 11 formally opened its new western plant at Michigan City, Ind., which will replace the former plant located in Chicago. This company was organized in 1869 at Claremont, N. H., at which point their eastern plant is still situated.

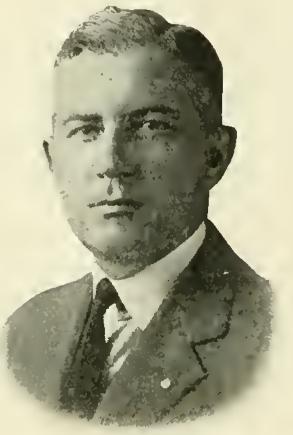
N. B. Norris has been appointed manager of the New Orleans, La., office at 938 Whitney-Central building, of the Pawling & Harnischfeger Company, Milwaukee, Wis. This company has opened a new office at 1124 Book building, Detroit, Mich., with James Van Buskirk in charge.

Major Walter Gresham Andrews, of the sales department of Pratt & Lambert, Inc., Buffalo, N. Y., has been elected a member of the board of directors. Harold E. Webster, purchasing agent, has been appointed secretary and Walter P. Werheim, advertising manager, has been made a director of the company.

The Consolidated Car-Heating Company, Albany, N. Y., has secured the patents, equipment, good-will and other assets of the Automatic Ventilator Company of New York City. The Consolidated Car-Heating Company is now prepared to fill orders for all types of automatic ventilators heretofore supplied by the Automatic Ventilator Company.

The Michigan office of the Truscon Steel Company, Detroit, Mich, is now located in its new building at 615 Wayne street, Detroit, occupying the entire second floor. The office includes a complete service organization and engineering department. The general advertising department of the company also is located on the same floor with the Michigan office.

Walter A. Deems has been appointed representative of the machine tool department, New York district, of Manning, Maxwell & Moore, Inc., with headquarters at 100 East Forty-second street, New York City. For the past ten years Mr. Deems served as master mechanic of the Baltimore & Ohio's New York Terminals and the Staten Island Rapid Transit Company, with headquarters at Tompkinsville, Staten Island, resigning on September 15, to go with Manning, Maxwell & Moore, Inc.


W. E. Corrigan

W. E. Corrigan, of the sales department American Locomotive Company, has been appointed general sales representative of the company on the Pacific Coast with the title of district sales manager and headquarters in the recently established branch office, Rialto building, San Francisco, Cal. Mr. Corrigan entered the service of the American Locomotive Company in 1909 and is a graduate of the four-year-course in locomotive construction which the company conducts in its engineering department in Schenectady. From May, 1913, he served in various capacities in the drawing office in Schenectady until 1915, when he was transferred to the Cooke plant, Paterson, N. J., where he was employed on elevation work and general calculating. He remained in this service until November, 1917, when he entered the United States Army where he served successively as second lieutenant, first lieutenant and captain in the artillery ordnance branch, field service, in charge of plant production at several gun carriage and ammunition plants. After the armistice, he became secretary and then ordnance district chief and chairman of the claims board in charge of the settlement of claims arising out of the cancellation of war contracts between the government and various manufacturers. In 1920, he re-entered the employ of the American Locomotive Company, serving for two years in the sales department at New York, when he was transferred to Chicago as salesman for Alco accessories in the middle western territory and subsequently was transferred to the Pacific Coast.

John Brunner, assistant inspecting engineer of the Illinois Steel Company, with headquarters at Chicago, has been promoted to manager of the newly created department of metallurgy and inspection, with the same headquarters. R. G. Glass has been appointed assistant manager in charge of the bureau of investigation, and F S. Crane has been appointed assistant manager in charge of the bureau of inspection of the department of metallurgy and inspection, both with headquarters at Chicago.

The J. W. Griffin Lumber Company, Burnside, Miss., has sold to the Reynolds-West Lumber Company 300,000,000 ft. of long and short leaf pine located near Burnside. P. J. M. Reynolds is president of the new company and J. M. West is vice-president. M. P. Barton, until recently with the Peavy Byrnes Lumber Company, will be manager of the Burnside mill. Plans for the future contemplate the construction of a new hardwood mill to be built by the Reynolds-West Lumber Company at Burnside this year.

The Connecticut Blower Corporation, Hartford, Conn., has been incorporated under the laws of Delaware with a capital of $200,000 and has taken over the International Blower Company and the Hartford Sheet Metal Works. The new company will manufacture and install blower systems of all kinds, exhaust fans, dust collecting systems, exhaust systems and ventilating systems. M. E Keeney is president; C. H. Keeney, treasurer, and C. E. Keeney, secretary,—all with headquarters at Hartford, Conn.

Stanley H. Smith, who represented the Pennsylvania Steel Company and the Bethlehem Steel Company in Cleveland and Chicago, and since leaving the latter company has been acting as a manufacturers' agent at 422 Frankfort avenue, Cleveland, Ohio, has been appointed district representative for Ohio for the Titusville Forge Company, of Titusville, Pa. Mr. Smith represents the Wyoming Shovel Works, the National Lock Washer Company, Harrisburg Pipe & Pipe Bending Company, and the Stevens Metal Products Company.

J. Leonard Replogle, who has resigned as president of the Vanadium Corporation of America, New York, on account of ill health, as was announced in the September issue of the *Railway Mechanical Engineer*, remains as a director of the corporation and when his health is restored will devote most of his time to his other interests including the Replogle Steel Company of which he is chairman. Mr. Replogle was born in Bedford County, Pa., on May 6, 1876, and received his education in the public schools of Johnstown. At the age of 13, he entered the employ of the Cambria Steel Company as office boy where he served successively in various positions until September, 1912, when he was elected vice-president and general manager of sales. He resigned in February, 1915, from the Cambria Steel Company to become vice-president and general manager of sales of the American Vanadium Company and in 1917 became president and general manager of sales of the same company, which in 1919, became part of the Vanadium Corporation of America. Mr. Replogle is also president of the Wharton & Northern Railroad and a director of the Wabash Railway Company and other companies. He also served during the war as director of steel supplies for the War Industries Board. In recognition of the services he rendered for the Allied cause, he has received from the United States the Distinguished Service Medal and decorations from the French, Belgian and Italian governments.

J. Leonard Replogle

The Elk Machine Tool Corporation has taken over the Elk Manufacturing Company of New York City. The new company will continue to manufacture and sell precision tools under the Elkin patents. The new company will be located on July 15 in its new plant at 243 West Seventeenth street, New York City. The company will have direct representatives and branches located in about twenty-five cities. J. C. Elkin, inventor and mechanical engineer, is president of the new company and will have charge of the manufacturing and production.

Exum M. Haas has resigned as manager of the railroad department of the H. K. Ferguson Company, Cleveland, Ohio, to open an office as consulting engineer at 2075 Taylor Road, Cleveland, Ohio. Mr. Haas will retain a connection with the Ferguson Company as consulting engineer on railroad projects and will specialize in railroad shop and terminal planning. He has been engaged in this phase of railway construction since 1917, having served as sales engineer for the Austin Company for three years and since August 1, 1920, as manager of the railroad department of the H. K. Ferguson Company.

The Continental Lumber & Tie Company has been incorporated at Peoria, Ill., with a capital stock of $1,500,000. Sales headquarters will be at St. Louis, Mo. The company represents a combination of several concerns operating saw mills, railroads, steamboats, barge lines and the rafting of logs. The incorporators are C. J. Case; Leonard Hillis; W. C. McClure and G. A. Case, of Peoria, Ill.; J. H. Hines, Memphis, Tenn.; Sterling Lumber Company, Bastrop, La.; J. H. Allen, St. Louis, Mo.; B. J. Altheimer, Chicago; J. H. Hines, Inc., and B. K. Boyston, Memphis, Tenn., and Dr. J. Leland Boogher, St. Louis, Mo.

George F. Murphy, having completed the reorganization of the New York office of the Heine Boiler Company, St. Louis, Mo., has taken charge of the Philadelphia territory, with headquarters in the Pennsylvania building, Philadelphia, Pa.; Harold P. Childs, formerly special representative of the executive offices of the General Electric Company, New York, has been appointed manager of the New York City office of the Heine Boiler Company, with headquarters at 11 Broadway; J. R. Fortune, formerly manager of the Detroit office, has assumed charge of the territories heretofore covered by the Pittsburgh, Cleveland and Detroit offices, with headquarters in the Dime Bank building, Detroit, and in the Park building, Pittsburgh. The Cleveland, Ohio, office has been discontinued.

The Central Brake Shoe & Foundry Company, Chicago, has opened a sales office in that city at 247 Railway Exchange. The officers of the company are F. Van Inwagen, president; A. C. Deverell, vice-president, and R. E. Frame, vice-president. Mr. Van Inwagen has been connected with the Corn Exchange Bank of Chicago and prior to that time was in the manufacturing business. Mr. Deverell was formerly general superintendent of motive power of the Great Northern and more recently western sales manager of the Locomotive Stoker Company at Chicago. Mr. Frame has been sales agent for the Pullman Company and was formerly manager of sales for the Haskell & Barker Car Company, Michigan City, Ind. The company's plant is located at Clearing, Ill.

At a meeting of the stockholders of the Vanadium Corporation of America, New York, which was immediately followed by a meeting of the board, Alfred A. Corey, Jr., was elected president to succeed J. Leonard Replogle, resigned. Merrill G. Baker continues as vice-president and Lawrence K. Diffenderfer, treasurer, was elected also secretary to succeed E. F. Nickerson, resigned. Mr. Corey was elected also a director; other new directors include Frederic W. Allen, Samuel F. Pryor, William E. Corey and Payne Whitney to succeed Joseph De Wyckoff, Charles M. Walton, Jr., E. R. Tinker and Edward F. Nickerson, resigned, and Charles M. MacNeili, deceased. Alfred Adams Corey, Jr., the new president of the corporation, is an iron and steel manufacturer. He was born in North Braddock borough, Pa., on January 4, 1878, and was educated in the public schools. He served as an apprentice in the machine shops of the Homestead Steel Works, Carnegie Steel Company, from 1893 to 1895, and then for one year was with the Illinois Steel Company, Chicago. He again returned to the Homestead Steel Works where he remained until 1900; from 1900 to 1904, he was assistant superintendent of structural mill and assistant superintendent of open hearth department, then superintendent of open hearth department and rolling mills, North Sharon plant, Carnegie Steel Company. He served from 1906 to 1909, as general superintendent of the Donora Steel Works & Furnaces, Union Steel Company, Donora, Pa., then became assistant general superintendent of the Homestead Steel Works, later serving with the Carrie Furnaces and Schoen Steel Wheel Works, in 1914 becoming general superintendent of the same. He also served as president of the Cambria Steel Company, Johnstown Water Company, vice-president of the Midvale Steel & Ordnance Company and Union Coal & Coke Company.

Alfred A. Corey, Jr.

H. N. Winner, former manager of the packing department of the United States Rubber Company, and manager of the Philadelphia branch of the Garlock Packing Company, has been elected president and general manager of the Crandall Packing Company, Palmyra, N. Y. R. M. Waples, formerly in the packing department of the United States Rubber Company and the Garlock Packing Company, has been elected vice-president and treasurer and R. P. Engle of Palmyra, secretary of the Crandall Packing Company. E. P. Watrous, formerly manager of the New York branch of the Garlock Packing Company, is now manager of the New York branch of the Crandall Packing Company. I. D. Lyon, former manager of the Clinton Manufacturing Company and of the mechanical goods division of the Goodyear Tire & Rubber Company, is manager of the Birmingham branch of the Crandall Packing Company.

The W. N. Matthews Company, manufacturers of mechanical painting equipment and railway electrical specialties, St. Louis, Mo., has been reorganized as the W. N. Matthews Corporation, with the same headquarters. W. N. Matthews continues as president of the new company and C. L. Matthews as vice-president and secretary. C. C. Fredericks, general manager of the W. N. Matthews Company, has been elected vice-president and general manager of the new corporation, and A. G. Williams has been appointed manager of railroad sales. Mr. Williams started as a mechanical apprentice in the Altoona, Pa., shops of the Pennsylvania Railroad and was promoted through various positions to that of engineer of motive power of the Southwestern region, with headquarters at St. Louis, Mo., which position he resigned on May 1 to take charge of the railroad sales of the mechanical painting equipment of the W. N. Matthews Corporation, St. Louis.

J. P. Moses has been appointed general manager of railroad sales for Joseph T. Ryerson & Son, Inc., with headquarters in Chicago, to succeed H. A. Gray, who has resigned to enter another field of business. Mr. Moses has been in the service of the Ryerson company for a period of over 22 years and is well known in railway circles. For a number of years he specialized in high-grade refined iron known as Ulster special, which is used largely by the railroad companies for staybolt purposes. H. T. Bradley has been appointed manager of eastern railroad sales, with office in New York City, for Joseph T. Ryerson & Son, Inc., Chicago. Mr. Bradley has been serving the railroad field for many years in the east. He entered the service of the Ryerson company in 1906 and spent a great deal of his time as a sales engineer in the machinery department. For the past seven years he has been associated with the railroad division as assistant manager. Although the company sells a complete line of iron and steel products to the railroads, Mr. Bradley has concentrated his efforts largely on staybolt iron and special railroad machinery.

J. P. Moses

"Vibrac" Steel

A new steel called vibrac is being made in Manchester, England, which has the virtue of never tempering brittle and of being absolutely reliable in behavior under any normal treatment. According to the London Times the claim is made for this new steel that it not only responds to even higher mechanical requirements than nickel chrome steel, especially as regards elastic limit, but may, after tempering, be either air cooled or furnace cooled, thus entirely avoiding the risk of distortion, and will yet give higher impact values than nickel chrome steel treated under the most favorable conditions. Another advantage is that in large masses it has a uniform consistency throughout the mass.

TRADE PUBLICATIONS

CO_2 Recorder Accessories.—Three devices, developed to prevent fouling and corrosion of CO_2 equipment and the tubing which conveys the gas sample to the instrument continuously, are described and illustrated in an 8-page bulletin, No. 166-A, which has recently been issued by the Uehling Instrument Company, Paterson, N. J. These devices are known as the Pyro-Porus filter, the gas dryer and the gas purifier.

Waterproofing Methods and Materials.—A 32-page, illustrated, large-size bulletin has recently been issued by Gardner & Lewis, Inc., New York, with an enclosed set of specifications for the Karnak waterproofing manufactured by this company. The bulletin gives a detailed summation of the requirements of various technical societies for waterproofing as well as the results of numerous tests made by laboratories and consulting engineers. A table is included of a large number of railway and other bridge and building structures, showing the asphalt specifications at various temperatures and the cloth specifications for each structure. Considerable space is given to the discussion of the various classes of asphalts and membranes and their characteristics. Methods of construction are explained and illustrated for specific problems.

Apparatus for Determining Stress Distribution.—Designing engineers who have endeavored to study stress distribution in complex structures or machinery through the construction of flexible models, will be interested in a pamphlet issued by Adam Hilger, Ltd., London, England, describing Professor Coker's apparatus for accomplishing this result with the aid of polarized light. By using transparent celluloid models of the structure it is desired to investigate, the variation and intensity of stress is portrayed in the colors of the spectrum, and by comparing these colors with those of a "calibration member," subjected to known stresses, it is possible to analyze the action of complex structures under load to a degree of accuracy said to come within two per cent. The pamphlet is illustrated with photographs and diagrams of the equipment and also of specimens subject to test.

Tool Grinding Machines.—An instructive 20-page bulletin (No. 102) has recently been issued by the Greenfield Tap & Die Corporation, Greenfield, Mass. This bulletin, which is attractively prepared and illustrated, describes the principal features, giving specifications and details, of the plain cutter and reamer and universal grinding machines made by the Greenfield Tap & Die Corporation. An opening paragraph points out the importance of tool grinders, the succeeding pages being devoted to a description of the Nos. 160, 162, 184, 190 and Greenfield Nos. 1 and 2 machines for tool, cutter and general machine shop grinding. The Greenfield machines are the largest of the group, being of the universal type adapted to any kind of tool sharpening or toolroom grinding within their capacity. A complete list of the sizes, shapes and grades of grinding wheels is included in the bulletin. On the last four pages directions and illustrations are given of the method of setting up various types of reamers and cutters for grinding. Light cylindrical and surface grinding operations are also illustrated.

Locomotive and Other Cranes.—The Industrial Works, Bay City, Mich., has issued an elaborate catalogue of its products commemorating the completion of a half-century of its existence. This book is a very elaborate presentation of the products of this company and is profusely illustrated with photographs showing details of the equipment and the manner of its use. Preceding the catalogue section is an interesting history of the development of cranes from the days of the pyramids to the latest designs of the present day. This is followed by sections devoted to (1) locomotive cranes of rail, traction and crawling tractor types, and large, wharf and gantry cranes; (2) crane accessories, such as clam shell buckets, magnets and drag lines; (3) wrecking cranes ranging from 75 tons to 200 tons capacities; (4) special railway equipment, such as pillar and transfer cranes, portable rail saws and transfer tables; (5) pile drivers, pile hammers, etc., and (6) facilities for foreign service. In addition to considerable detailed information regarding the products of the Industrial Works, the book contains much information of general interest to all users of equipment of this character.

EQUIPMENT AND SHOPS

Locomotive Orders

The Greenbrier & Eastern has ordered one 2-8-0 type locomotive from the Baldwin Locomotive Works.

The Norwood & St. Lawrence has given a contract to the American Locomotive Company for a 2-6-0 type locomotive of 125 tons.

Caminhos de Ferro de Lourenco Marques, Portuguese East Africa, has ordered two 4-6-2 type locomotives from the Baldwin Locomotive Works.

The New York Central has ordered 15 locomotive tenders from the Lima Locomotive Works, and also placed an order for 20 with the American Locomotive Company. These tenders are to have a capacity of 15,000 gal. and will have six-wheel trucks.

Locomotive Repairs

The Missouri Pacific will convert 104 locomotives into oil burners.

Passenger Car Orders

The Erie has placed an order for 44 steel suburban coaches with the Pressed Steel Car Company.

The Wabash has ordered one steel private car from the American Car & Foundry Company.

The Central Vermont has ordered two steel 55-ft. combination passenger smoking and baggage storage battery cars, equipped with Edison batteries, from the Railway Storage Battery Car Company, New York.

Freight Car Orders

The Norwood & St. Lawrence has placed an order for 35 freight cars.

The Montour Railroad has ordered 500 cars from the Standard Steel Car Company.

The Minnesota Steel Company has ordered 20 flat cars from the Standard Steel Car Company.

The Minnesota Steel Company has ordered 44 hopper cars from the Pressed Steel Car Company.

The Elgin, Joliet & Eastern has ordered 500 steel underframes from J. G. Heggie & Sons, Joliet, Ill.

The Union Pacific has ordered 200 tank cars of 12,500 gal. capacity from the Standard Tank Car Company.

Swift & Co., Chicago, has ordered 100 steel underframes for refrigerator cars from the Bettendorf Company.

The Atchison, Topeka & Santa Fe has ordered 300 gondola cars and 200 flat cars from the Pullman Company.

The Standard Oil Company of New Jersey has ordered 10 center bottom dump cars from the American Car & Foundry Company.

The New York Central has ordered 500 hopper car bodies of 55 tons' capacity from the Merchants Dispatch Transportation Company.

The Baltimore & Ohio has ordered 100 four-wheel steel tie cars and 15 four-wheel piling cars from the Pressed Steel Car Company.

The Bradford Oil Refining Company, Bradford, Pa., has ordered 5 tank cars of 8,000 gal. capacity from the General American Tank Car Corporation.

The Cuba Cane Sugar Corporation has ordered 35 cane cars of 30 tons' capacity from the American Car & Foundry Co., and 25 cane cars of 15 tons' capacity from the Koppel Industrial Car & Equipment Company.

The New York, Ontario & Western has placed an order with the Pressed Steel Car Company for 16 steel underframes with superstructures, for caboose cars, to be built in the railroad company's shop at Middletown, N. Y.

Freight Car Repairs

The Norfolk & Western has arranged for the repair for 500 hopper cars of 57½ tons' capacity with the Ralston Steel Car Company and 500 with the Virginia Bridge & Iron Company.

The New York Central will have repairs made to 500 box cars in the shops of the Ryan Car Company, and repairs to 200 box cars made in the shops of the American Car & Foundry Company.

The Central of New Jersey has arranged for the repair of 600 cars as follows: For 200 with the American Car & Foundry Company, 200 with the Pressed Steel Car Company and 200 with the Standard Steel Car Company at its Middletown works.

The Chesapeake & Ohio has arranged for the rebuilding of 500 steel coal cars of 55 tons capacity, as follows: To the Newport News Shipbuilding & Drydock Company, Newport News, Va., 250 cars and to the American Car & Foundry Company, Huntington, W. Va., 250 cars.

Machinery and Tools

The Seaboard Air Line has placed an order for two 100-ton bushing presses.

The Pennsylvania has placed an order for a 90-in. wheel quartering machine.

The Central of New Jersey has placed orders for a locomotive axle journal turning lathe and a car wheel borer.

The Southern Pacific has placed an order for a 36 in. by 18 ft. lathe, and for an axle lathe.

The Central Vermont has placed an order for a 36 in. by 17 ft. lathe, also for a 5 ft. radial drill.

The Elgin, Joliet & Eastern has placed orders for a 30-in. planer, an axle lathe, a car wheel lathe and a 44-in. boring mill, and has ordered one turret lathe from William Powell Company, Cincinnati, Ohio.

Shops and Terminals

Oregon Short Line.—This company will erect a new 650-ton coaling station at Glens Ferry, Ida.

St. Louis South Western.—This company will erect a 200,000 gallon capacity oil storage tank at Jonesboro, Ark.

Chesapeake & Ohio.—This company will construct a new engine house and additional tracks in its yard at Russell, Ky.

Western Fruit Express.—This company will construct a general car repair shop at St. Paul, Minn., to cost approximately $150,000.

Spokane, Portland & Seattle.—This company will construct a new blacksmith shop, 50 ft. by 90 ft., at Vancouver, Wash., to cost $30,000.

New York, Chicago & St. Louis.—This company plans the construction of a new repair shop, a roundhouse and other terminal facilities at West Frankfort, Ind.

Chicago, Milwaukee & St. Paul.—This company has awarded a contract to Jos. E. Nelson & Sons, Chicago, for the construction of water treating plants at Bensonville, Ill., and Mannheim.

Southern Pacific.—This company has completed plans for the construction of a one-story machine shop, 85 ft. by 498 ft., in Los Angeles, Cal., to cost approximately $390,000 with equipment.

Chesapeake & Ohio.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of water treating plants at Foster, Ky., Edgington, Stony Point, South Portsmouth and Maysville.

Alabama & Vicksburg.—This company has awarded a contract to the Truscon Steel Company, Youngstown, Ohio, for the erection of a steel repair shop, 208 ft. by 64 ft. at Vicksburg, Miss., to cost approximately $57,000.

St. Louis-San Francisco.—This company has awarded a contract to the Howlett Construction Company, Moline, Ill., for the construction of a 300-ton, three-track, reinforced concrete coaling station at the Lindenwood yard, St. Louis, Mo.

Pennsylvania.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 700-ton reinforced concrete coaling plant with duplicate elevating equipment and a 120-ton gravity sand plant for installation at Conemaugh, Pa.

Wabash.—This company has awarded contracts to Townsend B. Smith, Decatur, Ill., for the erection of an addition to its locomotive repair shop at Seventh street, St. Louis, Mo., at a cost of approximately $175,000, including equipment, and for the addition to its shops at Decatur, Ill., to Townsend B. Smith, Decatur, Ill., at an approximate cost of $175,000.

Illinois Central.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of water treating plants at Dixon, Ill., and Panola; and to the Graver Corporation, Chicago, for the construction of water treating plants at Parkersburg, Iowa; Iowa Falls, Webster City and Marcus. A contract has also been awarded to the Railroad Water & Coal Handling Company for the construction of a 300-ton coal chute at Dubuque, Iowa.

PERSONAL MENTION

General

William G. Knight has been appointed mechanical superintendent of the Bangor & Aroostook, succeeding Laird W. Hendricks, deceased.

J. W. Highleyman, superintendent of shops of the Union Pacific, with headquarters at Cheyenne, Wyo., has been promoted to assistant superintendent of motive power and machinery, with headquarters at Omaha, Neb.

William H. Fetner has been appointed assistant to the president of the Missouri Pacific. Mr. Fetner was born at Columbia, S. C. He began railway service with the Illinois Central, serving an apprenticeship in their shops at Water Valley, Miss. After completing his apprenticeship, he was engaged as shop foreman and locomotive engineer with the old Richmond & Danville, now a part of the Southern. He entered the service of the Central of Georgia on October 6, 1892, serving as gang foreman, erecting shop foreman and then general foreman. In 1904 he was promoted to the position of master mechanic at the Macon, Ga., shops, serving in that capacity until January, 1916, at which time he was appointed general master mechanic. On November 16, 1917, he was promoted to superintendent of motive power, which position he held until his resignation on July 15, 1923, to accept service with the Missouri Pacific in the above capacity.

W. H. Fetner

W. J. O'Neill, superintendent of motive power of the Second district of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., has been appointed general mechanical superintendent of the Denver & Rio Grande Western with headquarters at Denver, Colo. W. W. Leman, superintendent of motive power and car department of the Denver & Rio Grande Western, with headquarters at Denver, Colo., has resigned and the office of superintendent of motive power and car department has been abolished.

Master Mechanics and Road Foremen

B. Koontz has been appointed assistant road foreman of engines of the Seaboard Air Line, with headquarters at Hamlet, N. C.

B. H. Davis has been appointed master mechanic of the Delaware, Lackawanna & Western with headquarters at Scranton, Pa.

H. C. Caswell has been appointed master mechanic of the Delaware, Lackawanna & Western with headquarters at Binghamton, N. Y.

John Love has been appointed assistant master mechanic of the Lehigh & Susquehanna division of the Central of New Jersey with headquarters at Mauch Chunk, Pa.

J. D. Young has been appointed master mechanic of the Lehigh & Susquehanna division of the Central of New Jersey with headquarters at Ashley, Pa., succeeding A. B. Enbody, deceased.

W. R. Keithley and **Monroe Brittian** have been appointed road foremen of equipment of the Arkansas-Louisiana division of the Chicago, Rock Island & Pacific, with headquarters at Little Rock, Ark., to give special attention to the operation of oil-burning locomotives.

C. B. Rogers, whose appointment as general master mechanic of the Minneapolis & St. Louis at Marshalltown, Iowa, was announced in the September issue of the *Railway Mechanical Engineer*, was born at Newport, England, December 17, 1873. He attended the Kendrick School for Boys, Reading, England, also the grammar grades in the United States, entering the employ of the Burlington, Cedar Rapids & Northern at Esterville, Iowa, in 1892. From 1895 until October, 1917, he subsequently served as locomotive fireman, Iowa Central; locomotive fireman, Atchison, Topeka & Santa Fe; locomotive engineer, Iowa Central; locomotive engineer, Minneapolis & St. Louis; air brake instructor, International Correspondence Schools, and road foreman of engines, Minneapolis & St. Louis. From October, 1917, to January, 1921, he was in government service with the Engineering Corps in Siberia. In November, 1921, he was promoted to assistant master mechanic of the Minneapolis & St. Louis at Ft. Dodge, Iowa, and in June, 1922, became master mechanic of the Central and Western divisions with headquarters at Minneapolis, Minn.

Henry Harley Urbach, assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy with headquarters at Galesburg, Ill., has been promoted to master mechanic of the Brookfield division, with headquarters at Brookfield, Mo., succeeding D. R. McGrath, who has been assigned to other duties. Mr. Urbach was born on February 4, 1890, at Sutton, Neb., and attended high school at Liovett, Neb., entering the employ of the Chicago, Burlington & Quincy on February 18, 1907, as a machinist apprentice at Havelock, Neb. Completing his apprenticeship in July, 1912, he served as a machinist in the same shop until July, 1914, when he was transferred to Alliance, Neb. In August, 1914, he was transferred to Edgemont, S. D., and in April, 1915, became roundhouse foreman at Seneca, Neb. He was transferred as roundhouse foreman to Alliance in March, 1917, being appointed general foreman at Edgemont in November, 1917; general foreman at Alliance, in December, 1918, and general foreman at Denver, Colo., in October, 1920. In May, 1923, he became assistant master mechanic at Galesburg.

Shop and Enginehouse

C. W. Culver has been appointed works manager in charge of the locomotive and car shops of the Central of New Jersey with headquarters at Elizabethport, N. J.

Purchasing and Stores

C. F. Post, assistant purchasing agent of the Western Pacific, with headquarters at San Francisco, Cal., has been promoted to purchasing agent, with the same headquarters, succeeding W. T. Jacobs, deceased.

C. C. Dibble, supervisor of stores of the New York Central with headquarters at Indianapolis, Ind., has been appointed general supervisor of stores with the same headquarters. The position of supervisor of stores has been abolished.

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Fuel Association Prize Competition

Over two thousand papers were received in the International Railway Fuel Association competition which closed August 31. This contest was inaugurated by Eugene McAuliffe, who offered a prize of $100 for the best paper on fuel economy by an engineman, fireman, brakeman, conductor or switchman, to be conducted by the Fuel Association. The result is ample proof that the work of this association, and others perhaps less directly, has borne fruit to the extent of at least creating a widespread interest in the subject. The number of papers is significant of the interest of the rank and file of the transportation employees. The wide support given by railroad officers in advertising the contest among their men and in many cases supplementing the association prize by one to be awarded to the writer of the best paper among their own employees, is evidence that executives and operating officers are also alive to the importance of the fuel problem. The award of the prize, delayed because of the tremendous volume of articles contributed, is awaited with great interest, but the real value of the competition will probably lie more in the consensus of opinions and suggestions offered by two thousand men from railroads all over America, than in the ideas developed in a few outstanding papers which may head the list.

A Big Machine Tool Program

In a survey of the progress of the railroads in the prosecution of their 1923 improvement projects, which was recently made by the publishers of the *Railway Mechanical Engineer,* it developed that twenty-six Class I railroads owning approximately one-third of the cars and locomotives in the United States, contemplated the purchase of approximately four million dollars' worth of machine tools during the last quarter of 1923. This, in effect, is the unexpended part of the 1923 budget for shop machinery and tools, but in itself it is considerably greater than the average annual expenditure for the same proportion of the equipment ownership of the country. The balanced character of the types of tools included in this program confirms what is indicated from other sources of information, that this program is to a large extent one of expansion of facilities rather than the renewal and improvement of the machine tool equipment in existing shops.

This program of expansion was begun during Railroad Administration control, and has been progressing steadily since that time. While some roads have practically completed their programs, there are still many others which have yet to undertake them, and the expansion phase of shop development undoubtedly will continue for several years. When it has been carried out to such an extent that the repair shop capacity of the country has become adequate to care for the amount and character of the equipment now operating on American railroads, its effect should be reflected not only in lower equipment maintenance costs, other things being equal, but in a material increase in the proportion of the serviceable equipment time.

But the possibilities for further improvements in the cost of equipment maintenance by the purchase of new machine tools will not have been exhausted by the completion of the expansion program. It is significant that many of the recent shop projects have not been the building of principal shops but the addition of purely repair shops at outlying points to take care of the overflow of equipment from the principal repair shops. It is at these central repair shops that a large part of the manufacturing operations required to furnish finished or semi-finished parts on store orders for the system are conducted.

The need for the replacement of much obsolete machine tool equipment in many of these old shops must still be met. Furthermore, with the rapid increase in the amount of equipment which has recently taken place and will continue to take place in the future, the opportunity for the extension of specialized manufacturing facilities is constantly becoming greater, so that the railroads undoubtedly will give an increasing amount of attention to the possibilities of what may be termed the production type of tool.

Bulletin the Good Ideas!

There are several incentives which will make a man work hard at his particular job and endeavor to give good service for the wages received, one of these being the necessity of earning a livelihood and another the hope of advancement. Still another powerful incentive, too infrequently provided in railroad service, is frank praise for a good job well done. Everyone knows how beneficial this incentive is to an ambitious man. It frequently changes his entire mental attitude toward the work in hand, causing him to study carefully all possible methods of improving his work, secure in the belief that this effort will be appreciated and result in his ultimate advancement.

While not a new suggestion, it might be a good idea in railroad shops and enginehouses to award prizes, or make some public recognition for the development of efficient tools, jigs and labor-saving methods by listing them on the bulletin board accompanied by the names of the man responsible. It is probably safe to say that every individual operation in a railroad shop requires a combination of manual and mental effort of which the latter is by far the more important. The time and labor involved in the operation can be greatly decreased by inducing the workman to think about his work and endeavor to develop some way of making it easier.

As an example of the prize award idea, one prominent railroad in the Middle West recently gave two prizes in the form of handsome brass tablets inscribed with the name of the repair shops which showed the greatest improvement in operation during the year. These tablets are to be mounted in a conspicuous place in the respective shops. Whether prizes are offered and good suggestions bulletined or not, supervisory officers should constantly bear in mind that an important part of their duties is to recognize and give credit for initiative, industry and good workmanship on the part of their men, as well as to correct mistakes.

Tire Steel for Dies?

Freight locomotives cannot give as effective service hauling express trains as when coupled to tonnage freight trains, and it ought to be self evident that steel designed to be used in driving wheel tires cannot give its best service when made into dies and other tools for which it was not intended. That this practice is sometimes followed, however, was brought out during the Tool Foreman's convention, held in Chicago as reported in recent issues of the *Railway Mechanical Engineer.* One of the members asked, "What heat treatment can be given to scrap tire steel for dies to make it stand up? These dies are used only in stamping light gages." The answer is that scrap tire steel cannot be treated in any way that will make it entirely safe and suitable for use in dies.

In the first place it is not *safe* to use scrap tire steel in making dies because of its uncertain composition and the fact that no two worn tires will be found in just the same condition as regards hard and soft spots developed in service. One of the tool foremen summed the matter up in the statement that tire steel is as uncertain and variable in quality as the weather. Dies made of this material are liable to break with resultant danger to operators, damage to machinery and loss of labor in making the dies. Moreover it is not *economical* to use scrap tire steel in making dies because the low carbon content prevents efficient service. The carbon content of tire steel varies from about 50 to 70 points, depending on whether the tires are used in passenger, freight or switching service, and this is not high enough for a satisfactory die steel. A die is in reality a cutting tool and must be capable of holding a sharp cutting edge, particularly when used in stamping light material. The thinner the material, the harder it is to keep dies sharp and a higher carbon content, of about 70 to 85 points is needed for such tools.

Due credit should be given for all attempts to save, particularly in the use of material, in railroad shops, but it is false economy to try to substitute for a good grade die steel another steel which is both dangerous to use and frequently proves unsatisfactory after the expense of making it into dies has been incurred. Scrap tire steel is suitable for many purposes, such as lathe centers, shaper chuck screws and certain hot punches, but will hardly show good results when used for ordinary dies.

Future of Spray Painting—A Competition

The application of paint by spraying with air has been the subject of more or less discussion, and has been practiced to a limited extent for not less than twenty years. At the outset, the process appeared to offer big possibilities for increasing the labor output and decreasing the cost of equipment painting. It was pointed out that the process would greatly reduce the difficulty of applying paint to irregular surfaces of such a nature that access with the brush was extremely difficult, and that it also might be expected to increase the speed of covering flat surfaces in competition with the brush. During the intervening years, however, the extension of the process has been extremely slow. One of the greatest difficulties encountered in the early development of the spray process was the mist with which the atmosphere surrounding the job was filled, causing a considerable waste of paint and creating extremely unpleasant conditions for the operator, which were also dangerous when poisonous materials were being handled. This, no doubt, has led to some opposition to the adoption of the process on the part of many equipment painters as well as on the part of other men who work on or about equipment where the spray is in operation, especially when the work is being done inside the shop buildings.

Two facts were suggested by the discussion of this subject at the recent convention of the Equipment Painting Section of the Mechanical Division, American Railway Association. First, it is evident that since the early trials of the process, great improvements have been made in paint spraying apparatus as well as in the methods of employing it. Second, while many railroads are using the process to a limited extent, few have availed themselves of the full possibilities it apparently offers for the reduction of labor costs by making its use extensive.

What are the conditions that continue to limit the more extensive employment of the process? Do they lie in the attitude of the men, or in the economical handling of the paint material? Under what conditions can a successful practice be developed for the general application of the process in freight car painting? The process has been applied successfully to the finishing of passenger cars. Is this generally practicable? If not, what are the conditions which make it impracticable? Are its present limitations inherent, or can they be overcome?

Because we believe that a thorough discussion of this subject will be of great benefit not only to the readers of the *Railway Mechanical Engineer* but to the railroads as a whole, we offer a first prize of $50 and a second prize of $35 for the two papers received at our office of publication, 30 Church street, New York, on or before January 1, 1924, which most constructively answer any or all of these questions. Give the industry the benefit of your experience on this important subject.

Putting Repairs on a Manufacturing Basis

In the fourth article on Locomotive Scheduling at the Silvis Shops, which appeared in last month's issue, the authors ventured to point out the possibilities for increased output which would follow if the processes of locomotive repairs could be distinctly separated into the manufacturing operations, which would include the manufacture of new parts and the repairing of old parts, and the stripping and erecting operations. In its extreme application, this would require a complete stock of repair parts available for each class of locomotives entering the shop, which could be drawn on immediately by the erecting shop, with the manufacturing department proceeding to repair the old parts, or replace them with new parts, to be restored to stock. On another page in this issue will be found an article which shows clearly not only the practicability, but the desirability of this separation with respect to one group of parts—locomotive brake equipment—as it has been worked out on the Canadian National. The article points out that the practice, installed originally in order that the standards of maintenance might be better controlled by having all repairs confined to a few well equipped shops, has expedited the return to service of locomotives from which defective parts are removed. Furthermore, it has been the means of developing a simple system of finding comparative unit repair costs, that almost automatically has led to a marked reduction in these costs. A study of this article will suggest to the reader that the reason that the cost data have been developed with apparently so little additional clerical work is because the work has been removed from the category of locomotive repairs to the field of store orders. A system of standard store order numbers, each covering a single piece of apparatus or part, readily provides for developing unit costs in as much detail as may be desired.

The results obtained within the limited scope of locomotive brake repairs are sufficient to demonstrate the correctness of the principle involved in the suggestion for the complete segregation of repair operations from the operations of stripping and reassembling the locomotive ready for service. It would probably be impracticable under any conditions likely to be found on American railroads ever completely to develop such a system. There are probably few railroads, however, owning, say, 500 or more locomotives on which a partial application of the idea does not offer an opportunity for reducing idle locomotive time and effecting reductions in shop costs. Costs will be reduced, first, because a better balance of the operations in the repair department can be maintained, irrespective of the conditions in the erecting shop, and second, because a better control can be exercised over the unit costs of repaired detail parts through the medium of the store order system.

The limitations on the extension of such a system will depend on many local conditions, principal among which will probably be the number of locomotives per class and the extent to which details have been standardized between locomotives of more than one class. If, for instance, the valve motion has been made interchangeable on several classes of locomotives, the extent to which production methods can be employed in the manufacture of these parts may make it cheaper to scrap some of the parts, particularly pins and bushings, and renew them from stock, than to refit the worn parts. This not only means cheaper repairs but less time for the locomotive awaiting the application of repaired parts, particularly in the engine terminal. The possibilities for reducing the amount of repair work chargeable directly to the locomotive by the use of semi-finished parts, such as crank pins, knuckle pins, frame bolts, etc., have been set forth in numerous articles in these columns. But in cases where the number of locomotives in a class is large, are there not also possibilities for the extension of this scheme to include the side and main rods, crossheads, guides and pistons? The extension of this practice will inevitably tend toward more systematic procedure in the repair operations, and the facts about costs readily made available under the store order system will provide much better than the usual basis for the exercise of sound judgment by the supervision.

Turbo-Condensing Locomotives

The thermal efficiency of the ordinary type of steam locomotive is unquestionably much lower than would be tolerated in a stationary or marine power plant of the same capacity. While the railroad motive power man may look with envy at the low fuel and water rates of the large modern electric power plant, the power plant engineer, when he examines the modern locomotive invariably is impressed with the large horsepower which it is capable of developing per unit of weight or per cubic foot of space occupied. In cost, weight or space per unit of power developed, the locomotive is surprisingly different from other power plants. Moreover, it must carry its own supply of fuel and water. Increasing operating costs are accentuating the demand for increased efficiency of the locomotive and considerable attention is being given to investigations of the possibilities of the substitution of the turbine for the reciprocating steam engine. The success of any turbine driven locomotive will depend largely upon the solution of the two difficult problems of transmitting the energy developed by the turbine to the driving wheels and thus producing drawbar pull and of designing an efficient, compact and light weight condenser.

Three methods of transmission have been developed to a stage where they offer possibilities: Namely, reduction gearing, electric generator and motor and hydraulic. In the locomotives described in this issue the electric method has been adopted. The necessary generator, motors and control apparatus add to the weight, complication of equipment, cost and space occupied, but give a reliable and flexible speed control with large starting power. The complete Ramsay locomotive of 1,100 motor horsepower and 22,000 lb. tractive force weighs at the rate of 266 lb. per motor horsepower and 13.3 lb. per pound of tractive force. A light Pacific type locomotive, such as is frequently used on American roads, is of about 2,250 hp. and 40,000 lb. tractive force. In working order, including tender, the weight is about 210 lb. per cylinder horsepower, and 11.5 per pound of rated tractive force.

The problem of a compact and efficient condenser has been worked out for the Ramsay locomotive in a highly interesting way by rotating the nest of tubes filled with exhaust steam so that after dipping into a trough of cooling water they are subjected to an air blast from a motor-driven fan. This method is distinctly different from that employed for other turbine locomotives. On one of these the stationary tubes are sprayed with water and subjected to currents of air set up by the movement of the locomotive. On another design, thin flattened copper tubes are employed, these being cooled solely by currents of air produced by a fan. The efficiency of a turbine is dependent upon a high vacuum, and this means an effective condenser. If the condenser is to be of light weight as well as efficient, the rate of condensation must be quite rapid, and to be a success for locomotive service must produce the required vacuum at all temperatures under which the locomotive is to be operated. Considerably more data than is yet available must be collected before the relative effectiveness of the condenser designs thus far worked out can be determined or whether any of them will meet the difficult requirement demanded for successful locomotive operation.

New Books

A First Course in Machine Construction and Drawing. *By T. N. Naylor and W. Tattersall. 158 pages, 5½ in. by 8½ in. illustrated. Bound in cloth. Published by H. F. & G. Witherby, 326 High Holborn, London, W. C. 1.*

This volume is particularly adapted for use as a text book by the student of drawing who approaches the subject with no previous knowledge of engineering. It takes up first the simplest details, such as rivets, riveted joints, and screw threads, then progressing through the various types of machine details to the more complicated assemblies of parts. For each detail or assembly, typical sketches are arranged on the left-hand page, facing the descriptive text which briefly outlines types, uses, safe loads, etc. The book, therefore, not only provides plates to guide the student in his practice, but conveys a considerable degree of elementary information concerning most of the simple types of details and materials met with in machine construction.

Proceedings of the International Railway Fuel Association, 1923. *Edited by the secretary, J. B. Hutchison, 6,000 Michigan Avenue, Chicago, 389 pages, 6 in. by 9 in. Flexible binding.*

This volume contains the proceedings of the fifteenth annual convention of the International Railway Fuel Association, which was held at Cleveland, Ohio, May 21 to 24, inclusive, 1923. It contains the reports of committees and discussions on the following subjects: Boiler Feedwater Treatment; Fuel Stations; Locomotive Front Ends, Grates and Ashpans; Fuel

Accounting, Distribution and Statistics; Firing Practice, and Coal Storage. It also contains individual papers on the following subjects: Railway Fuel—A Reducible 13 Per Cent of Operating Expenses, by Julius Kruttschnitt; The Relation of the Coal Mines to the Railroads; Extension of Long Locomotive Runs; The Fuel Saving Aspect of Boiler Water Treatment; Lake Coal Handling; Classification of Coal; Economic Aspects of the Fuel Oil Situation; Value of Individual Fuel Performance Records; Incentives for Promoting Fuel Economy; The Superheater—Its Use and Abuse as a Fuel Saver; Economy in the Heating of Stations and Buildings; The Other Ten Per cent; Locomotive Oil Burning Refractories.

WELDING CYCLOPEDIA. *Edited by L. B. McKenzie and H. S. Card. 438 pages, illustrated, 6 in. by. 9 in. Bound in flexible imitation leather. Published by The Welding Engineer Publishing Co., Chicago.*

This is the third and enlarged edition of a reference book on the theory, practice and application of autogenous welding processes. The first half of the book consists of a dictionary of the terms used in the industry, together with instructions for welding operations of the usual type. Succeeding chapters treat of electric arc welding, electric resistance welding, oxyacetylene welding and thermit welding in detail. A further section covers the rules and regulations of federal and state authorities and insurance companies. Various charts and tables are included, and at the end of the book is a comprehensize catalogue of welding apparatus and equipment. In this edition information has been added on the training of operators and considerable new material relative to special welding jobs—including tanks, pipes and plate work—has been included.

What Our Readers Think

Babbitting Crossheads

ATLANTA, Ga.

TO THE EDITOR:

We are experiencing some difficulty due to the failure of the babbitt to adhere to the crossheads. Would like to know how this work should be performed and whether steel crossheads should be tinned before babbitting.

HENRY J. ARMSTRONG

(A method which is being used with success in the shops of one large road is as follows: After being set up on the babbitting table, the old babbitt is melted off the crosshead with a burner. This pre-heats the crosshead to about the proper temperature for pouring the new babbitt lining. When the old babbitt has been melted off, the crosshead is well brushed with a steel wire brush and thoroughly cleaned with sal-ammoniac. The surfaces are then tinned, after which the forming blocks are set up and the babbitt poured. It is reported that after the men become familiar with the work, they rarely fail to obtain a good job of babbitting and that but little trouble is experienced with babbitt becoming loose or falling off.

The fixtures and methods in use on the D. L. & W. for babbitting crosshead shoes are described on page 772 of this issue. It will be noted that on this road the forming blocks are made to such a size that the babbitt is never machined after it has been poured. The surfaces as poured against the blocks are harder, and it has been found that the babbitt wears considerably longer than when it is machined before the crossheads are placed in service.—EDITOR.)

Adjusting Safety Valves

MINNEAPOLIS, Minn.

TO THE EDITOR:

When adjusting the safety valves on a locomotive, which valve should be set first—the plain valve or the one with a muffler? Would like to know what is the general practice on different roads and the reasons for such practice.

OSBORN WILLIAMS

(The following procedure is the one which has been satisfactorily followed for some time on several large eastern roads: The open pop valve, which is adjusted at a slightly higher pressure than the one with a muffler, is always set first. The lower pressure muffled one is then adjusted. The men performing this work have been educated in regard to the proper blow-down of safety valves and to adjust them so as to obtain a blow-down of from 3-lb. to 4-lb., which gives the maximum lift to the valve. With a 2-lb. to a 3-lb. blow-down, a full valve opening is not obtained. It has also been found from experience that the valve seats cut much more rapidly by the severe wiredrawing of the steam when the opening is small.—EDITOR.)

How Should Driving Box Wedges Be Adjusted?

CHICAGO, Ill.

TO THE EDITOR:—

Am anxious to know what adjustment of the driving box wedges on Pacific type locomotives will give the best results in operation. The locomotives referred to are engaged in heavy and fast passenger service, making a run of 115 miles in about three hours, twice a day. They weigh 190,000 lb. on the drivers, have 11½ in. by 21 in. main journals and 11 in. by 14 in. front and back journals. The driving boxes are of cast steel, brass lined and packed with grease. Shoes and wedges also are of cast steel.

There is a considerable diversity of opinion among the roundhouse men who adjust the wedges as to how the work should be done. One man will set up all wedges snug with a 10 in. wrench and then pull the main wedges down ⅛ in. to 3/16 in., and the front and back wedges down ¼ in. to 5/16 in. Another man will pull all wedges down ⅜ in. or more.

Complaints of rough and hard riding are frequently made by engineers. At other times the same engines are known to ride smoothly. Can you advise just how tight the wedges on such engines should be set to prevent hard riding and at the same time to give as little pound as possible in the boxes?

W. V. MAXWELL.

(This question is one which roundhouse men are frequently called upon to answer. In many cases where rough riding has been complained of, it also is probable that traveling engineers have ridden the engines after the wedges have been adjusted to give a definite amount of clearance. We would be pleased to receive and publish replies from our readers giving the practices which they have followed themselves, or know that others have followed with satisfactory results. While Mr. Maxwell refers specifically to a Pacific type locomotive in fast passenger service, those replying might, with advantage, take up the whole broad problem of wedge adjustment for all kinds of equipment.—EDITOR.)

Engineering Building—Montana State College

What Does a Successful Executive Require?

Is It a Knowledge of the Technique of the Business or an Understanding of Men?

First Prize in Special Apprentice Competition

By Dale C. Sheffield*

Special Apprentice, Chicago, Milwaukee & St. Paul, Bedford, Ind.

SINCE executives are beginning to realize more and more the value of an apprenticeship course for college graduates, they have endeavored to shape its schedule to provide a thorough training; one that will cover an appreciation of such things as the necessity for reducing turnover and stabilizing employment, give a better understanding of elementary economics as applied to the concern, and, above all, inculcate in the candidate a greater interest in, and loyalty to, the company. But since the direct supervision over this training is passed down the line, it is doubtful if the student is so influenced as to absorb the above points from those who have direct charge of him during the training period.

Most foremen are interested in the amount of work accomplished and, as a rule, will not go out of their way to see that the apprentice is properly instructed along lines to develop his loyalty and good faith towards the company. The railroads are still clinging to the old method of having the foreman "break in" all new men, and consequently the technical graduate is put through a course very similar to that of the regular apprentices. Part of the shop work is essential to the proper training of the apprentice, but that which is not should be eliminated from the course. It hardly seems reasonable that the apprentice should be compelled to repeat the training which he has already had under a competent instructor in his college. Yet such is the case. Take, for example, the training period to be spent in the blacksmith shop. The foreman in charge does not realize that the student has already had an extensive training in the heat treatment of metals, welding and general foundry work under instructors who have been especially trained to teach just these subjects. Such faults could be corrected by allowing a group of men who are familiar with the average engineering college curricula to check over and revise the schedule.

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*Mr. Sheffield is a graduate of the Mechanical Engineering Department of Montana State College, Bozeman, Mont.

When a young man spends four of the best years of his life in college, learning the fundamentals of his profession, he becomes discouraged and restless when he has to repeat subjects, because he is in the habit of learning new things. If the management thinks it is advisable to repeat certain subjects, then it should select the proper man to act as an instructor in those subjects. Too frequently a man is chosen to teach just because he knows the subject. Very often the man who is not the expert is a better teacher, since he has the gift of teaching or has received special training in that art.

Put Real Problems Up to Special Apprentices

The greatest evil of the special apprenticeship course is the time element. Non-technical men do not realize the greatness of the engineering field, nor of the rapid development of every phase of the profession, and, above all, the important part science plays in the solution of engineering problems. When the apprentice is allowed to spend all his time in the shop his knowledge of thermodynamics, mechanics, and other such subjects—which are essential to the profession of an engineer—begins to slip away from him, for the lack of exercise; by the end of two years he will find that he is pretty rusty in those fundamentals which were so hard to get. The field is developing at such an ever-increasing ratio that the latest text books of four years ago are completely out-of-date, and to the college professor this presents a difficult problem. If the apprentice is allowed to help solve the engineering and economic problems of the company from the beginning of his course, it will keep his interest from going astray and enable him to be of greater use to the road later on. If he is not, it shows that the management does not have confidence in one of its most important investments.

The Importance of Character

All apprentice courses, no matter how ancient or up-to-date, disregard the most important factor that is essential to the development of all foremen, superintendents, and executives of every department, and that is, personal character. It is a proved fact that personal qualities, such as common sense, integrity, resourcefulness, initiative, tact, accuracy, efficiency, and understanding of men are universally recognized as being no less necessary to a professional engineer than are technical knowledge and skill. The college student of engineering regards literature and sociology as unnecessary chores, to be endured rather than enjoyed; this is due to the tendency to magnify the importance of technique or problems of research and natural science. All through college, one's standing is based on correct answers, which naturally minimizes the importance of personality. The greatness of the personal character element was shown by the reply which was received to the letter sent to 30,000 members of four large engineering societies, who were asked to number six groups of qualities headed: character, judgment, understanding of men, technique, knowledge, and efficiency, in order of importance. A summary of the replies to the request showed that character was placed at the head of the list by a vote of 94.5 per cent, while technique was voted to the bottom of the list by an equally decisive majority.

This indicates that to the man who would deal successfully with human labor and with business, personality is a greater asset than technical knowledge and skill. About 90 per cent of the so-called political-pull is really a promotion based on personality. The college graduate has the foundation of knowledge of technique, but as a rule his personal character is badly in need of development. The best possible way to grasp the secret is by the close association with men who have battled their way, without the aid of a college education, from the bottom to positions which require executive ability. To develop this requirement, the apprentice should be allowed to go occasionally on trips of inspection with master mechanics and superintendents, where he can learn from observation and conversation. At the same time he will be storing away valuable information that will be very useful to him when he attains the executive position for which he is being trained. Success today depends more on mental than material equipment and the wise investor is beginning to believe that it is better to judge the future of the company by its attitude in that direction rather than by its past earning power. The expense of such trips would probably meet with objections from the management, since it would not be possible to show the returns in concrete figures.

Great organizers and leaders in industry are those who shape and control their organizations through their power accurately to estimate the value of the underlying principles of good management. Engineers recognize this fact and the value of it to the young technical graduate when they declare that character, judgment, efficiency, and understanding of men are more important to the engineer than is the technique of engineering and knowledge of science. This is especially true to the one who is working towards an executive position. To the designer such qualifications are not so important.

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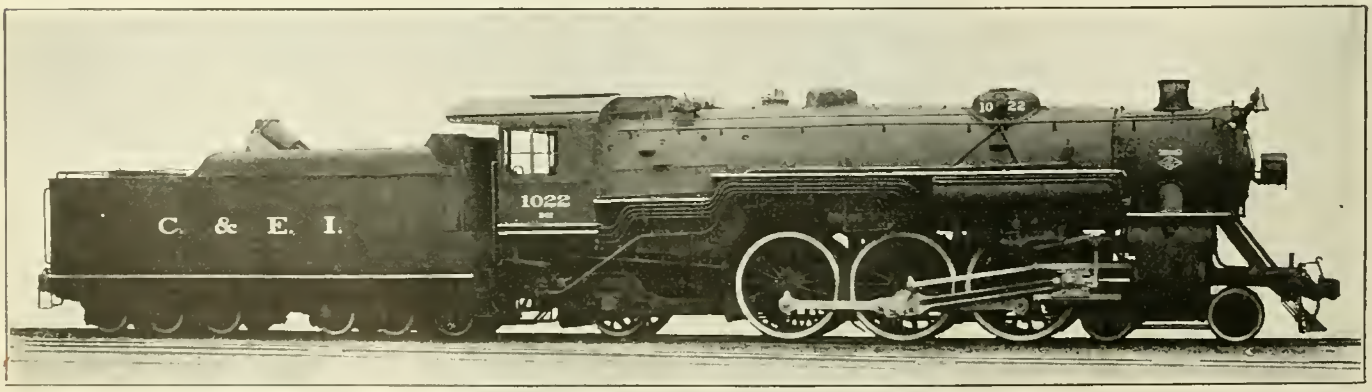
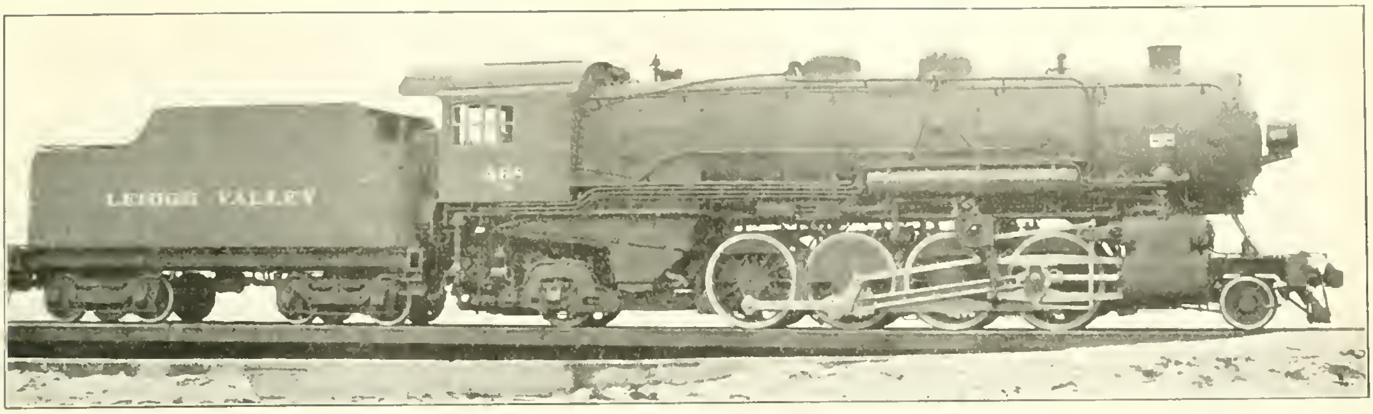


Pacific Type Locomotive Built by the Lima Locomotive Works for the Chicago and Eastern Illinois

The design is similar to the U. S. R. A. heavy 4-6-2 type, but is equipped with a tender carried on six-wheel trucks and a special coal pusher.



Lehigh Valley Class N-5-B Mikado Locomotive Built by American Locomotive Company

Mikado Locomotives for the Lehigh Valley

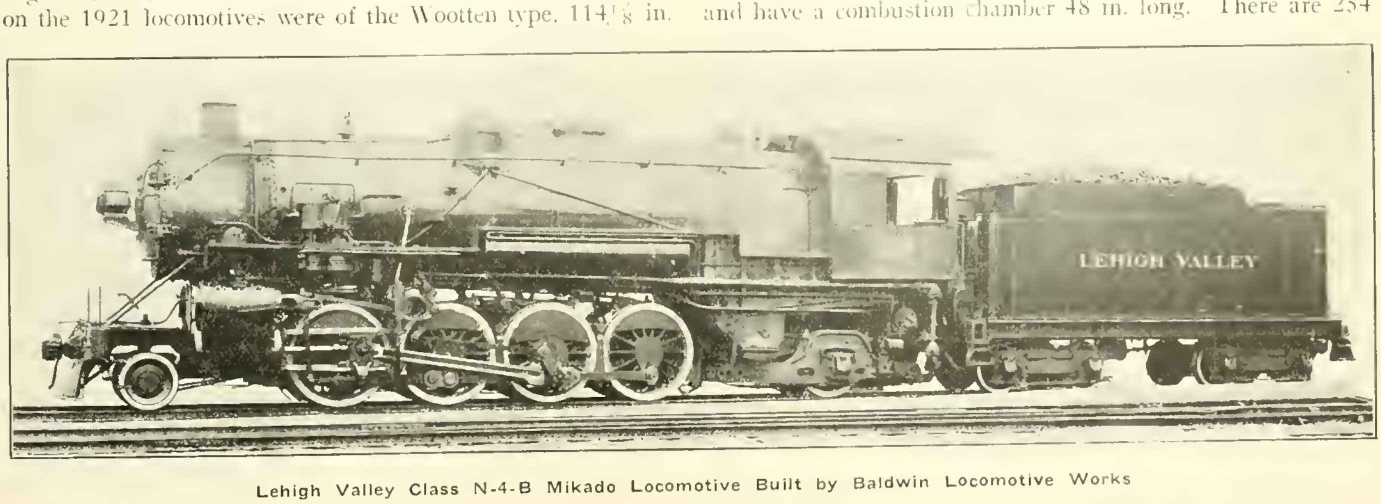
Heavy Freight Engines for Anthracite Road Burn Soft Coal—Booster Increases Tonnage Capacity

THE Lehigh Valley has recently increased its freight handling capacity by the addition of 30 heavy Mikado type locomotives. The order for this new power was divided equally between the Baldwin Locomotive Works and the American Locomotive Company, each builder furnishing 10 locomotives without a booster and five with a booster. Although similar in weight and in general proportions, there are, however, a number of differences in the designs as worked out by the two builders.

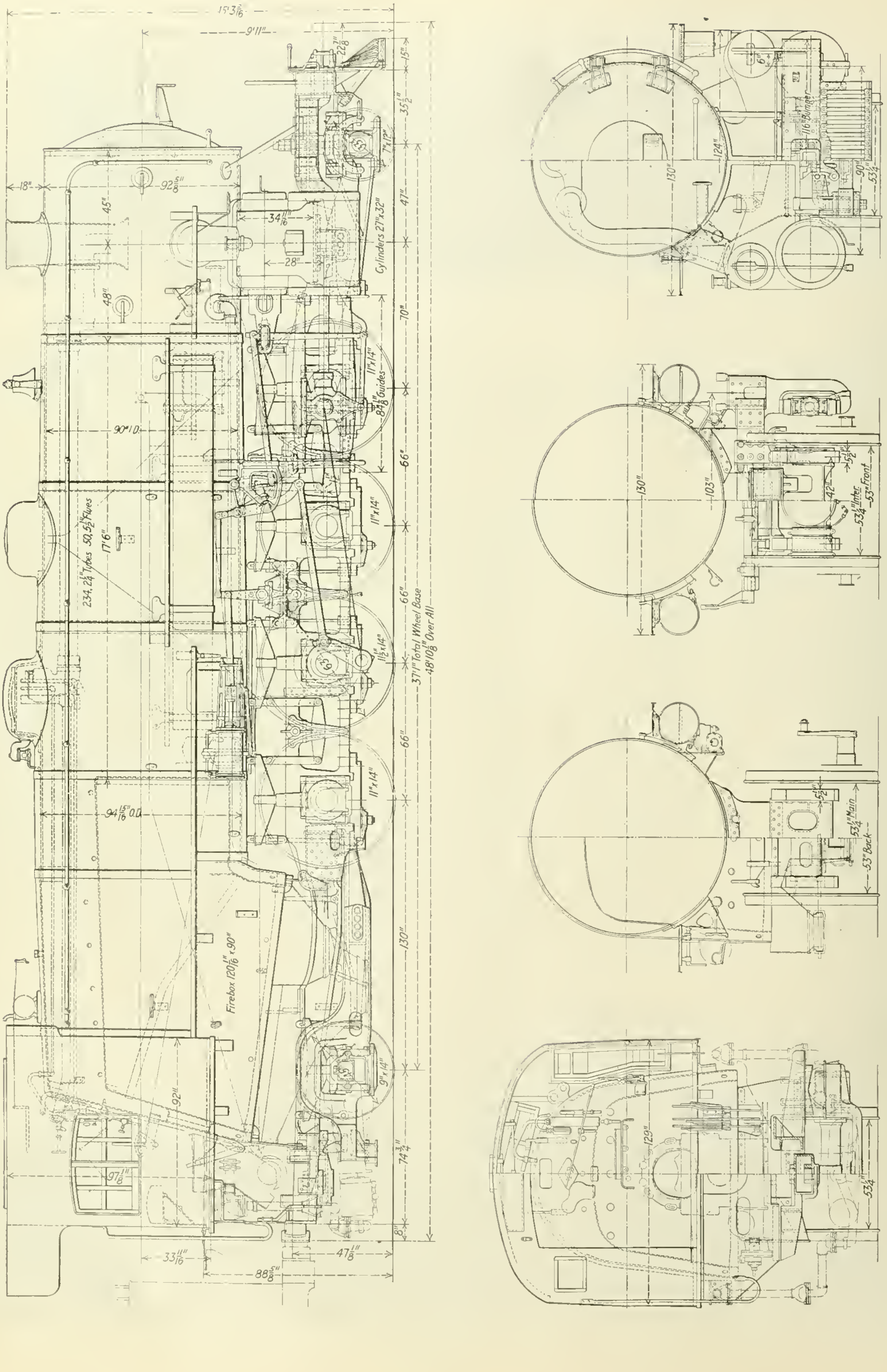
Locomotives of the 2-8-2 type were first used on the Lehigh Valley about 11 years ago, and the number has been steadily increased as additional power has been purchased from time to time. In the past, the 2-8-2 type locomotives on this road have been fitted with wide fireboxes having a large grate area suitable for burning a mixture of anthracite and bituminous coal. The Mikado locomotives recently received are the first ones of this type on the Lehigh Valley which are fitted with medium wide fireboxes and a grate designed for burning soft coal. In this connection, a comparison between the locomotives built by the Baldwin Locomotive works in 1921, known on the road as Class N-3-A, and those furnished by the same builder in 1923, which are known as Class N-4-B, is of interest. Both designs had 27-in. by 30-in. cylinders, 63-in. driving wheels and were of approximately the same weight. The older engines carried 190 lb. steam pressure and had a rated tractive force of 56,100 lb. An increase in steam pressure to 200 lb. raised the tractive force on the 1923 engines to 59,000 lb., exclusive of the booster. The fireboxes on the 1921 locomotives were of the Wootten type, 114⅛ in. wide by 126 1/16 in. long inside, which gave a grate area of 100 sq. ft. and a heating surface of 264 sq. ft. in the firebox and 84 sq. ft. in the combustion chamber. In the new soft-coal burning locomotives, the fireboxes are 90 in. wide by 120 1/16 in. long, which gives a grate area of 75 sq. ft. and a heating surface of 224 sq. ft. in the firebox and 112 sq. ft. in the combustion chamber. Both have the same number of tubes and flues, all of them being 17 ft. 6 in. long.

The boilers used on the Mikado type locomotives built by the Baldwin Locomotive Works in 1923 were practically the same as those designed for the Lehigh Valley locomotives of the Pacific type, Class K-5, the first of which were built in 1916. These locomotives are used in fast freight and heavy passenger train service and burn soft coal. The standardization of locomotive boilers and the use of one design for more than a single type of engine, where such use is possible and the details have been well worked out, simplifies the maintenance and reduces the cost. Standardization of mechanical parts is frequently, if not usually, given careful attention, but standardization and interchangeability of boilers have often received far less consideration than their importance warrants.

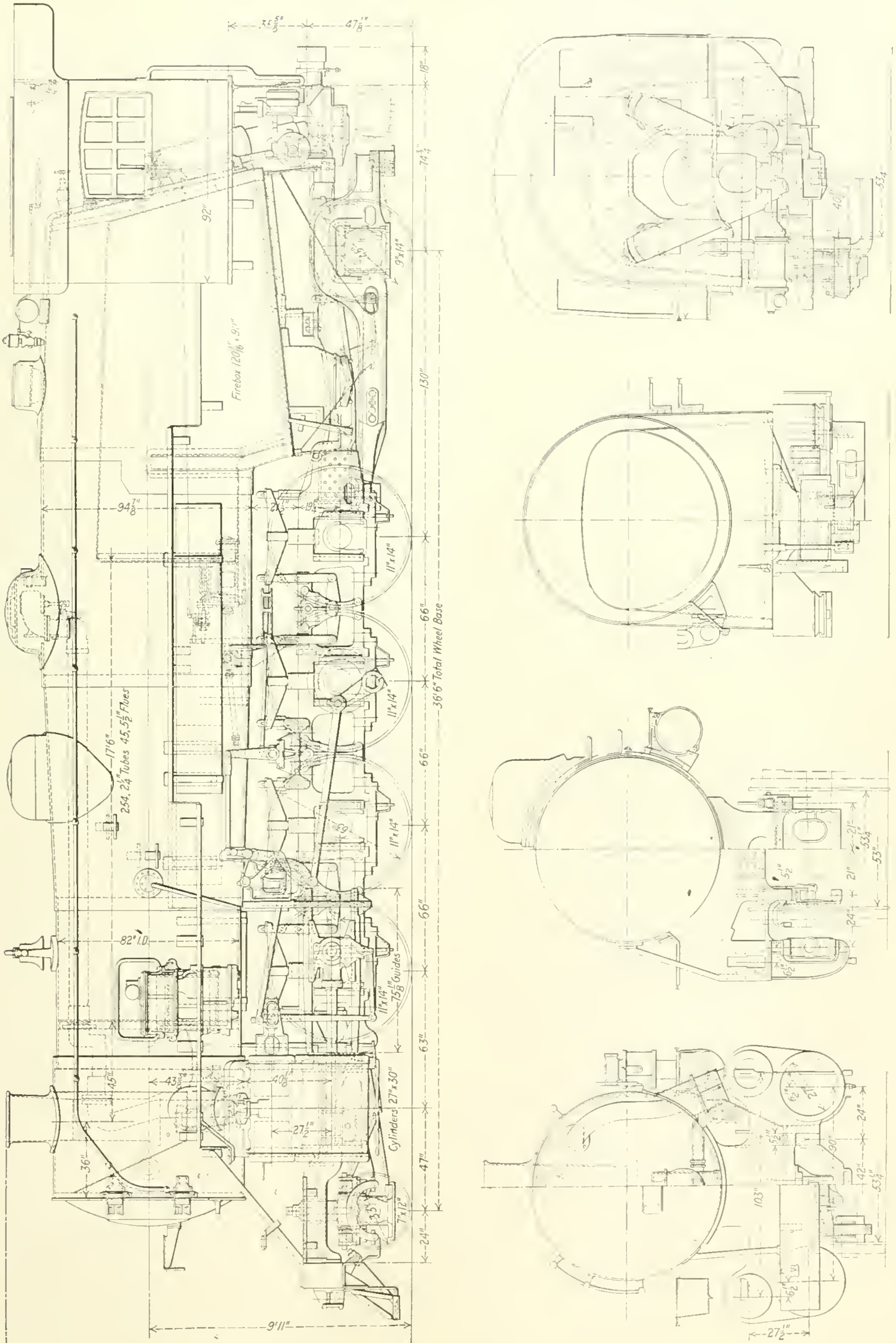
The new Baldwin Mikado locomotives with boosters weigh 325,200 lb. in working order, of which 257,900 lb. is on the drivers. The cylinders are 27 in. diameter by 30 in. stroke. The rated tractive force of the locomotive alone is 59,000 lb. with 11,000 lb. additional for the booster. The boilers are of the wagon top type, 82 in. diameter inside the first ring, and have a combustion chamber 48 in. long. There are 254



Lehigh Valley Class N-4-B Mikado Locomotive Built by Baldwin Locomotive Works



Mikado Type Locomotive Built by the American Locomotive Company for the Lehigh Valley



Mikado Type Locomotive Built by the Baldwin Locomotive Works for the Lehigh Valley tubes, 2¼ in. diameter, and 45 flues, 5½ in. diameter. The total evaporative heating surface is 4,110 sq. ft. and the superheating surface is 980 sq. ft. According to Cole's ratios, the boiler horsepower is 2,770 and the cylinder horsepower 2,624. The estimated coal rate is 113 lb. per sq. ft. of grate per hour. These proportions should give a boiler which will furnish ample steam without heavy forcing.

The Mikado locomotive, with booster, built by the American Locomotive Company, weighs 325,000 lb. in working order, of which 239,000 lb. is on the drivers. The cylinders are 27 in. diameter by 32 in. stroke. The rated tractive force of the locomotive alone is 63,000 lb. and 74,000 lb. with the booster added. The boilers are of the straight-top type, 90 in. in diameter inside the first ring, and have a combustion chamber 46 in. long. Of the staybolts, 650 are of the flexible type. There are 234 tubes, 2¼ in. diameter and 50 flues, 5½ in. diameter. The total evaporative heating surface is 4,009 sq. ft. and the superheating surface is 1,074 sq. ft. The rated boiler horsepower is 2,760 and the cylinder horsepower 2,624. The estimated coal rate is 113 lb. per sq. ft. of grate per hour. Tubes and flues are welded to the back flue sheet. In comparison with the Baldwin locomotive, it will be noted that the stroke of the cylinders is 2 in. longer, which somewhat increases the tractive force. The boiler is 8 in. larger in diameter, the superheating surface is larger and the number of tubes somewhat less.

The Lehigh Valley locomotives are counterbalanced in accordance with the Master Mechanics' standards, and particular attention is given to keeping the weight of the reciprocating parts as light as consistent with the required strength. The piston rods, main and side rods, crank pins and axles are of open-hearth steel. On the American locomotives the piston and rod weigh 801 lb., the cross head 607 lb., the combination link 35 lb. and the front end of the main rod 404 lb. On the Baldwin locomotives the piston and rod weigh 752 lb., the crosshead 601 lb. and the main rod, total, 1,065 lb.

The Baker valve gear operates piston valves of 14 in. diameter and a maximum travel of 6 in. A power reverse gear is provided, Alco Type E being used on the American locomotives and the Ragonnet on the Baldwin locomotives. All of these locomotives are fitted with stokers, those on the Baldwin engines being of the Duplex type and those on the American engines being of the Elvin type.

The following are among the other specialties used: Type A superheaters, Delta trailing trucks, Commonwealth frame cradles, Unit drawbars and radial buffers, Franklin adjustable wedges, Smith adjustable hub liners, Chambers throttle valves on American engines and railroad standard balanced type on Baldwin engines, Talmadge drifting valves, Detroit lubricators, Hancock injectors, Nathan water columns, Vissering sanders, Pyle-National headlights, Butterfly fire doors, Okadee smokebox hinges, Hunt-Spiller cylinder and valve bushings, also piston and valve rings, King piston and valve steam packing, one 8½ in. cross compound air compressor and Beyers pipe.

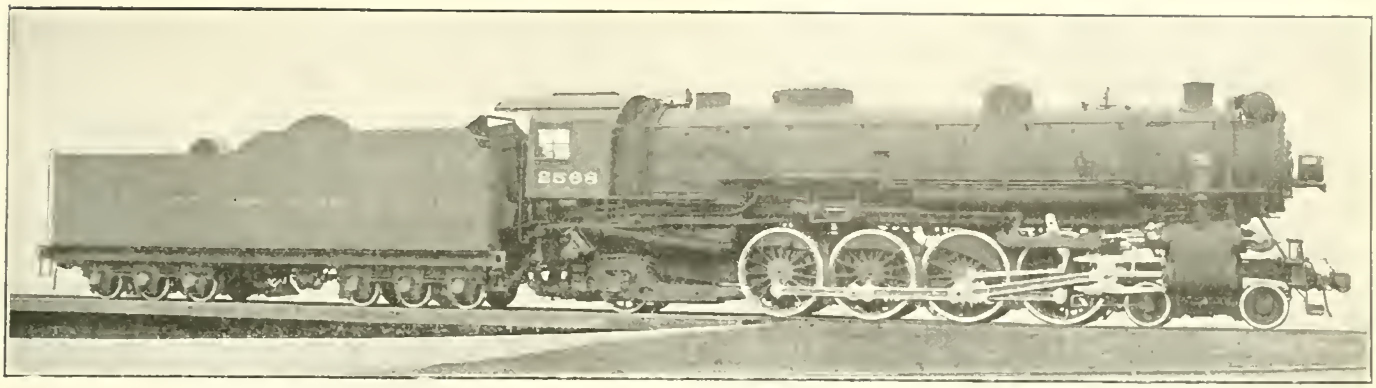
The tenders are of the Acme water-leg type and have a capacity for 8,000 gal. of water and 12½ tons of coal.

No official tests have been made with these new Mikado locomotives, although a number of very satisfactory preliminary runs were made to determine tonnage ratings. On one of these trial runs with increased tonnage up the Wilkes-Barre mountain from Pittston Junction, near Croxton, the train consisted of 60 loaded cars which gave a total tonnage of 3,856 tons back of the tender. This train was handled by one of the new Baldwin locomotives without a booster at the head end and two American helper locomotives with boosters, on the rear end. The train left Pittston Junction at 11.45 a. m. and arrived at the top of the mountain at 3.15 p. m., the distance being 20.5 miles, with a continuous grade of 61 ft. to the miles most of the way. Curves are compensated. The previous Mikado locomotives have been rated at 950 tons on this grade, or 2,850 tons for three engines. It will be noted that on the trial where two of the engines were equipped with boosters, the tonnage handled was 1,006 tons in excess of the rating for the previous locomotives.

On another trial run, with a single locomotive equipped with a booster, between Pittston Junction and Mountain Top, the train consisted of 20 loaded coal cars, which gave a total tonnage back of the tender of 1,453 tons. This train left Pittston Junction at 12.10 p. m. and arrived at the top of the mountain at 4.15 p. m. The actual running time was 2 hr. 25 min., which corresponds to an average speed of a little more than 8 miles per hour.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Builder	American	Baldwin
Type of locomotive	2-8-2	2-8-2
Service	Freight	Freight
Cylinders, diameter and stroke	27 in. by 32 in.	27 in. by 30 in.
Valve gear, type	Baker	Baker
Valves, piston type, size	14 in.	14 in.
Maximum travel	6 in.	6 in.
Outside lap	$1\frac{3}{16}$ in.	$1\frac{3}{16}$ in.
Exhaust clearance	$\frac{1}{32}$ in.	$\frac{1}{32}$ in. lap.
Lead in full gear	$\frac{5}{16}$ in.	$\frac{5}{16}$ in.
Weights in working order with booster:		
On drivers	239,000 lb.	237,900 lb.
On front truck	29,500 lb.	29,300 lb.
On trailing truck	56,500 lb.	58,000 lb.
Total engine	325,000 lb.	325,200 lb.
Tender	164,500 lb.	151,800 lb.
Wheel bases:		
Driving	16 ft. 6 in.	16 ft. 6 in.
Rigid	16 ft. 6 in.	16 ft. 6 in.
Total engine	37 ft. 1 in.	36 ft. 6 in.
Total engine and tender	69 ft. .0¼ in.	68 ft. 5¼ in.
Wheels, diameter outside tires:		
Driving	63 in.	63 in.
Front truck	33 in.	33 in.
Trailing truck	45 in.	45 in.
Journals, diameter and length:		
Driving, main	11½ in. by 14 in.	11 in. by 14 in.
Driving, others	11 in. by 14 in.	11 in. by 14 in.
Front truck	7 in. by 12 in.	7 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Straight-top	Wagon-top
Steam pressure	200 lb.	200 lb.
Fuel, kind	Soft coal	Soft coat
Diameter, first ring, inside	90 in.	82 in.
Firebox, length and width	$120\frac{1}{16}$ in. by 90 in.	$120\frac{1}{16}$ in. by 90 in.
Height mud ring to crown sheet, back	68½ in.	70 in.
Height mud ring to crown sheet, front	90½ in.	$89\frac{1}{16}$ in.
Arch tubes, number and diameter	5—3½ in.	5—3½ in.
Combustion chamber length	46 in.	48 in.
Tubes, number and diameter	234—2¼ in.	254—2¼ in.
Flues, number and diameter	50—5½ in.	45—5½ in.
Length over tube sheets	17 ft. 6 in.	17 ft. 6 in.
Grate area	75.2 sq. ft.	75.2 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	316 sq. ft.	336 sq. ft.
Arch tubes	41 sq. ft.	40 sq. ft.
Tubes	2,399 sq. ft.	2,606 sq. ft.
Flues	1,253 sq. ft.	1,128 sq. ft.
Total evaporative	4,009 sq. ft.	4,110 sq. ft.
Superheating	1,074 sq. ft.	980 sq. ft.
Comb. evaporative and superheat'g	5,083 sq. ft.	5,090 sq. ft.
Special equipment:		
Brick arch	Yes	Yes
Superheater	Type A	Type A
Feedwater heater	No	No
Stoker	Elvin	Duplex
Booster	On 5	On 5
Tender:		
Style	8 wheel-water leg	8 wheel-water leg
Water capacity	8,000 gal.	8,000 gal.
Fuel capacity	12½ tons	12½ tons
General data estimated:		
Rated tractive force, engine 85 p. c.	63,000 lb.	59,000 lb.
Rated tractive force, booster	11,000 lb.	11,000 lb.
Cylinder horsepower (Cole)	2,624 hp.	2,624 hp.
Boiler horsepower (Cole) (est.)	2,760 hp.	2,770 hp.
Speed at 1,000 ft. piston speed	35.2 m.p.h.	37.5 m.p.b.
Steam required per hour	54,600 lb.	54,600 lb.
Boiler evaporative capacity per hr.	57,450 lb.	57,660 lb.
Coal required per hour, total	8,528 lb.	8,528 lb.
Coal rate per sq. ft. grate per hour	113.3 lb.	113.3 lb.
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	73.6	72.9
Weight on drivers ÷ tractive force	3.80	4.02
Total weight engine ÷ cylinder hp.	123.9 lb.	124.0 lb.
Total weight engine ÷ boiler hp.	117.8 lb.	117.5 lb.
Total weight engine ÷ comb. heat. surface	64.0 lb.	63.9 lb.
Boiler proportions:		
Boiler hp. ÷ cylinder hp., per cent	105	105.5
Comb. heat surface ÷ cylinder hp.	1.94	1.94
Tractive force ÷ comb. heat. surf.	12.38	11.58
Tractive force × dia. drivers ÷ comb. heat. surface	781	730
Cylinder hp. ÷ grate area	34.9	34.9
Firebox heat. surface ÷ grate area	4.75	5.00
Firebox heat. surface, per cent of evap. heat. surface	7.0	7.4
Superheat. surface, per cent of evap. heat. surface	21.1	19.2
Tube length ÷ inside diameter	104.5	104.5



The First Three-Cylinder Locomotive in America

New York Central Three-Cylinder Locomotive

4-8-2 Type for Freight Service, with Booster, Develops 75,700 Lb. Tractive Force; Adhesion Factor 3.73

FOR several months past the New York Central has been operating in freight service on the Mohawk division a three-cylinder simple locomotive of the 4-8-2 type. The design is similar to the two-cylinder Mohawk locomotives built in 1916 and 1917.* The locomotive was constructed by the American Locomotive Company for experimental purposes to determine whether the division of work between three sets of pistons, crossheads and main rods would be desirable in a heavy freight locomotive, as well as to determine whether the three cylinders will make possible an increase in thermal efficiency by more expansive use of the steam.

The locomotive has three simple cylinders, 25 in. in diameter by 28 in. stroke. The boiler is equipped with a Type E superheater, the Superheater Company's feedwater heater and a trailer booster. Including the effect of the booster, the maximum tractive force is 75,700 lb. The tractive force of the two-cylinder Mohawk type is 51,400 lb.

Since this is the first application of the three-cylinder principle on a heavy freight locomotive in this country, it may be of interest to review briefly the advantages of this type from the mechanical standpoint. Among the most important benefits is the reduction of stresses on each set of pistons, crossheads and main rods. In this case, while the three-cylinder arrangement increased the tractive force 21 per cent, it also reduced the piston thrust, based on 200 lb. pressure, from 123,000 lb. to 98,000 lb., or 20 per cent. The even turning moment on the driving wheels obtained with three cylinders is also advantageous in permitting the use of higher tractive force with the same weight on drivers. In any locomotive, the adhesive weight must be great enough to prevent slipping with the maximum tractive force developed throughout a complete revolution. In a three-cylinder locomotive, the maximum is only 8 per cent higher than the average, while with two cylinders, it is 23 per cent above. This means that for a given weight on drivers the three-cylinder locomotive can develop 15 per cent greater rated tractive force than a two-cylinder design without increasing the tendency to slip the wheels. The factor of adhesion used on the three-cylinder locomotive is 3.73, which would be equivalent to about 4.29 in the two-cylinder type. In Great Britain and Germany, where the three-cylinder arrangement has been extensively used, it is claimed that the six exhausts per revolution have a marked effect in increasing the efficiency of combustion.

Details of Construction

The two outside cylinders of the locomotives are placed horizontally with the center lines 2 in. above the centers of the wheels. In order to avoid using a main rod passing around the front axle, the center cylinder has been inclined at an angle of 8½ deg., with the center line passing about 4 in. above the center of the main axle. This brings the front end of the cylinder higher than the bottom line of the boiler barrel and the bottom side of the smokebox has been raised at the forward end to give the required clearance. The right and center cylinders and valve chambers are made in a single casting which extends to the inner side of the left frame where it is bolted to the left cylinder casting.

The crank axle is of the built-up type, with step-fits in the crank cheeks. The inside crank pin has a bearing 7½ in. wide by 12 in. in diameter. This bearing is lubricated with hard grease, which is forced in from the outside of the axle and passes through holes in the crank cheeks and the center crank pin to the surface of the bearing. The center guides, which are of the two-bar type, are lubricated through oil pipes from the running board.

One of the interesting features of the design is the method of driving the valve for the inside cylinder from the outside valve gear. The center lines of the three valves are all horizontal and at the same height. A transverse forked lever is placed ahead of the cylinder castings, one end of the lever being connected to the front extension of the left valve stem, the stationary fulcrum being one third the distance from the opposite end. The right-hand end of this lever forms a fulcrum for the center of a floating lever, one end of which is connected to the right valve stem, while the other end drives the valve for the center cylinder. This simple arrangement avoids the necessity for the third set of valve motion. In order to facilitate the application of the valve motion levers, the bumper beam braces are secured by pins at the top and bottom ends, making them readily removable.

Double ported piston valves, 11 in. in diameter, are used for all three cylinders. The valves have a maximum travel of 6 in. with 1⅛-in. lap, ⅛-in. exhaust clearance, and 3/16-in. lead.

To permit the application of the booster a cast-steel Delta type trailer truck with equalizers between the driving

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*For a description of these locomotives, see the *Railway Mechanical Engineer* for February, 1918, page 77.

wheels and the trailer, was installed. Because of the large cylinder volume on the three-cylinder locomotive, it is necessary to provide the maximum possible boiler capacity. There are 216 flues 3½ in. in diameter by 2 ft. 11 in. long, all but 40 of these containing superheater units. The use of the Superheater Company's feedwater heater also increases the capacity of the boiler and helps to bring it up to the requirements of the cylinders.

The tender used with this locomotive has a capacity of 15,000 gal. of water and 16 tons of coal. It is of the rectangular, water-bottom type and has a cast-steel frame carried on Commonwealth six-wheel trucks.

It is expected that dynamometer tests of the three-cylinder locomotive will be conducted during the next few weeks, which will give an opportunity for comparing its performance with that of two-cylinder locomotives from the standpoint of hauling capacity and fuel consumption. Operation over a more extended period is necessary to enable any estimate to be made of the relative expense of maintaining three-cylinder locomotives as compared with the ordinary two-cylinder design of the same capacity.

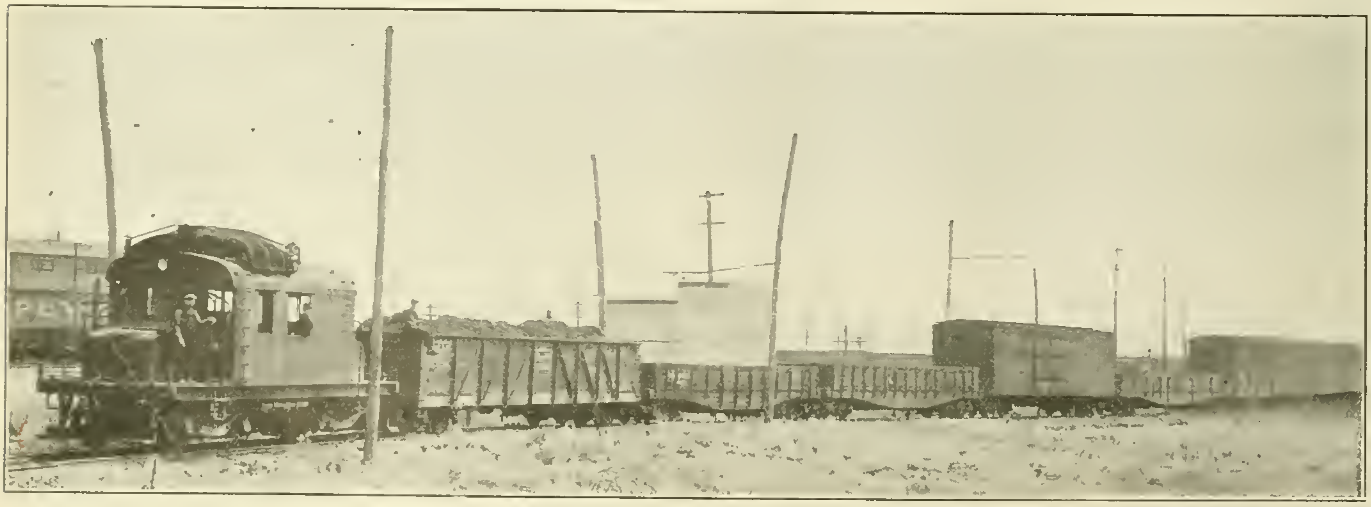
Table of Dimensions, Weights and Proportions

Type of locomotive	4-3-2
Service	Freight
Track gage	4 ft 8½ in.
Cylinder, diameter and stroke	3—25 in. by 28 in.
Valve gear, type	Walschaert
Valves, type, size	Double ported Piston—11 in.
Maximum travel	6 in.
Outside lap	1⅛ in.
Exhaust clearance	⅛ in.
Lead in full gear	3/16 in.
Weights in working order:	
On drivers	241,500 lb.
On front truck	66,000 lb.
On trailing truck	59,500 lb.
Total engine	367,000 lb.
Tender	267,800 lb.
Wheel bases:	
Driving	18 ft. 0 in.
Rigid	18 ft. 0 in.
Total engine	40 ft. 7 in.
Total engine and tender	82 ft. 6 in.
Wheels, diameter outside tires:	
Driving	69 in.
Front truck	33 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main	11½ in. by 13 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	200 lb.
Diameter, first ring, inside	80 in.
Firebox, length and width	114¼ in. x 84½ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber length	None
Tubes, number and diameter	None
Flues, number and diameter	216—3½ in.
Length over tube sheets	24 ft. 11 in.
Gas area through tubes	328 sq. in.
Net gas area through flues	1,054 sq. in.
Total gas area through tubes and flues	1,382 sq. in.
Grate area	66.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber including arch tubes	242 sq. ft.
Tubes and flues	4,913 sq. ft.
Total evaporative	5,155 sq. ft.
Superheating	2,158 sq. ft.
Comb. evaporative and superheating	7,313 sq. ft.
Special equipment:	
Brick arch	Security
Superheater	Type E
Feedwater heater	Superheater Co.
Stoker	Elvin
Booster	Franklin
Tender:	
Style	Rectangular
Water capacity	15,000 gal.
Fuel capacity	16 tons
Trucks	6 wheel
General data estimated:	
Rated tractive force, 85 per cent	64,700 lb.
Tractive force of booster	11,000 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	65.8
Weight on drivers ÷ tract. force	3.73
Total weight engine ÷ comb. heat. surface	50.2
Boiler proportions:	
Tractive force ÷ comb. heat. surf	8.85
Tractive force × dia. drivers ÷ comb. heat. surface	611
Firebox heat. surface ÷ grate area	3.62
Firebox heat. surface, per cent of evap. heat. surface	4.70
Superheat. surface, per cent of evap. heat. surface	41.9

Gasoline Electric Locomotive

Work on the development of gasoline-electric locomotives, halted by the war and subsequent activity, has been resumed by the General Electric Company. A new 40-ton unit embodying marked improvements in design and construction over previous types was completed recently; a simple throttling controller without resistance makes it possible to use the full power of the engine at all speeds. Comprehensive tests have been given the new locomotive, which show it to be more economical in operation than mechanical drive locomotives of the auto bus type. Nine months' operating results indicate that the maintenance costs will also be very low.

The locomotive is expected to find wide application on steam road branch lines for freight and passenger service, switching, haulage, etc. It is equipped with four GE-820, 500-volt, 60 hp. mine type motors operating from a 100 kw. generator direct connected to a Sterling six-cylinder Dolphin engine. The locomotive has a double end control. The running gear consists of two, four-wheel, swiveling, arch bar trucks with floating bolster. G-E straight and automatic air brake equipment is furnished, including a 600-volt motor-driven compressor. An auxiliary ratchet type hand brake is also furnished.



Gas-Electric Locomotive Hauling a 353-Ton Trailing Load

Transportation—Master Key to Progress[*]

General Prosperity Will Follow if Railroads Are Properly Encouraged to Improve Their Service

By Edward J. Kearney

President, National Machine Tool Builders' Association

MACHINE tools are called, and rightly so, the "master tools of industry;" but they are not a primary product, creating their own demand, or connected, except indirectly, with individual consumption. It is not known among businessmen generally that the machine tool industry suffers during the downward swing of the business cycle to a far greater extent than ordinary manufacturing lines, for the reason that our product is bought mainly during periods of expansion. The carpet-sweeper manufacturer, when his business shrinks 5 per cent, buys no more machine tools, so that our business, as far as he is concerned, falls 100 per cent. The example could be extended almost indefinitely. Is it any wonder that we are asking one another "What is the next development that will sustain the machine tool industry?" Every one has an answer. I have mine. It is general, mechanical, industrial, and agricultural development and prosperity, with *transportation the master key to progress.*

Future progress depends on adequate transportation facilities. So important is this that it should be a matter of the most serious concern of every businessman and citizen. It is this that leads me to present an outline of the case and show where we can do something for ourselves and in the public interest.

There are few people not actively connected with railways or who have not made a study of their growth, who have any idea as to the enormous extent to which transportation in this country has grown, or to where it will lead with the present rate of growth continued. This is why we should be concerned.

Passenger Traffic

It seems to be a part of our national genius to travel. For example, the Iowa farmer, when the corn crop is good and hogs are high, spends the winter at Long Beach, California. The Colorado school teacher spends her vacation attending summer school at Columbia University. The Ohio business man goes South for a late and an early game of golf, and all the newly-weds see Niagara.

In addition, the system of marketing our products has brought about extensive travel on the part of representatives of manufacturing concerns, wholesalers, and others, so that railway travel, in spite of the coming of the automobile, is growing rapidly. In 1880 the per capita travel was approximately 100 miles, which has continued to grow steadily until it is now about 400. The number of passenger-miles traveled at the present time is over eight times what it was in 1880.

Freight Traffic

In freight, we find a similar condition with the difference that the rate of increase is much more rapid. The per capita ton-miles rising steadily during the period, multiplied itself about six to one. In 1880 the number of tons of freight hauled one mile was 32 billion while it is estimated that for 1923 it will be beyond 415 billion or 13 times as much.

Some investigators are of the opinion that the length of haul will diminish, owing to the tendency to establish factories in other than strictly industrial sections and nearer the point of consumption. This would have the effect of keeping down the ton-miles as compared with the number of cars loaded. But, on the other hand, the motor truck is taking away many short hauls, tending again to lengthen the average haul. At present the products of the mine, forest, and farm furnish 70 per cent of all freight. State traffic furnishes but 15 per cent of the whole, while interstate traffic furnishes 85 per cent. In this discussion passenger traffic would be eliminated, but people will and must travel, and the high-speed trains furnished for their accommodation clutter up the tracks, increase the time and cost of getting slower freight, and consequently increase the number of freight cars and locomotives necessary for a given volume.

Future Transportation Requirements

Every factor in the economic progress of our country points to greater production, greater wealth, and higher standards of living; consequently, greater consumption, necessitating more and better transportation. There are ample grounds for the prediction that within 20 years we shall demand of the railroads the moving of twice the amount of freight carried today, or more than 800 billion ton-miles. In addition, they will be called on to provide for a 75 per cent increase in passenger-miles traveled. Given the vitalizing power of sustained credit, without which nothing can be done, is it a task capable of accomplishment? Will it be possible in this space of time to provide facilities to dispose of this overwhelming volume? Are there any improvements in sight that, if applied, will help to a solution?

[Attention was here called to the economies obtained by improvements in locomotive design and the introduction of superheaters, feedwater heaters, water rectification, thermic syphons, boosters and improved brake equipment. The possibilities of electrification and the need of increased sidings, switches and signals was also referred to.]

Keeping the Equipment in Service

One of the greatest economies in railway operation is to keep the equipment in use the greatest possible amount of time. In our own business we recognize the value in reduced overhead when our equipment can be used full time, or better still with more than one shift. The same is true of railway equipment. In order to bring this about, there must be facilities for taking care of locomotives at the terminals so that they will be the least possible time out of service. This means better and larger roundhouse facilities, sanding and coaling devices, boiler washing equipment, and last, but certainly not least, modern machine tools for both the roundhouse shop where temporary and emergency repairs are made, and for the general shop where thorough overhauling is done.

Is Management Incompetent?

Reference is frequently made in certain quarters to the incompetency of railroad management. Let us see as to that. Since taking back the roads from the government on March 1, 1920, the number of employees has been reduced by 150,000, while the amount of traffic being moved at the present moment is the largest in history, with a steadily rising car surplus. This hardly looks like incompetence.

The only thing that stands in the way of growth of transportation facilities is lack of capital. The capital will be forthcoming if there is prospect of security for the investment and a continued satisfactory return compared with what can be obtained in other industries. The selling methods of our political leaders have not improved as rapidly as have those of the makers of some less important commodities, with the result that the people are misinformed and led to believe false economic doctrines. When any considerable class is adversely affected, such for example, as the wheat growers or the coal consumers, what is the first suggestion for relief? Take it out of the railroads.

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[*] From an address before the National Machine Tool Builders' Association, at Lenox, Mass., October 3, 1923.

Commission Has Double Responsibility

In the Transportation Act of 1920, Congress places the regulation of the railroads in the hands of the Interstate Commerce Commission with instructions to see that no injustice is done any shipper; also charges them with an equally important duty of seeing that the railroads receive a return which will attract capital sufficient for adequate growth and development.

Mechanically the railroads are on the way to handle the ever-increasing volume of traffic and to do it so much more economically as to give promise of ultimate freight rate reductions. Our opportunity is in using our influence with those in authority to promote and maintain a government policy favorable to the development of transportation, the master key to progress. Vital to mechanical progress by the railway is the investment of vast capital. Underlying such investment is confidence in the stability of railway income. Behind this in turn is stability of government policy. Efforts are being made to repeal the act or so to amend it that the revival of railroad credit will be impossible and public interest suffer irreparable damage. Some men in public life do not seem to know that one dry bearing will be just as disastrous to the operation of the whole machine as if no oil were used at any point. The immediate objective is a further trial of the Transportation Act without experimental amendments. In future years the objective is so to guide the progress of perfecting the law that always embedded in it will remain the principle of net income adequate for the attraction of investment capital.

Can you not picture a shrinking map with the Missouri valley products only 48 hours from Atlantic harbors? Can you not visualize with the prosperity incident to these developments an enormous increase in the use of mechanical equipment on the farm, in the home, on the railway, in the air—wherever there are tasks for human hands to perform? Does this not mean that the manufacture of machine tools will become a more stabilized industry depending less on the activities of any one line and more on the general prosperity of all the people?

Ramsay Turbo-Electric Condensing Engine

An Interesting Experimental Locomotive Which Has Been Under Development in England for Two Years

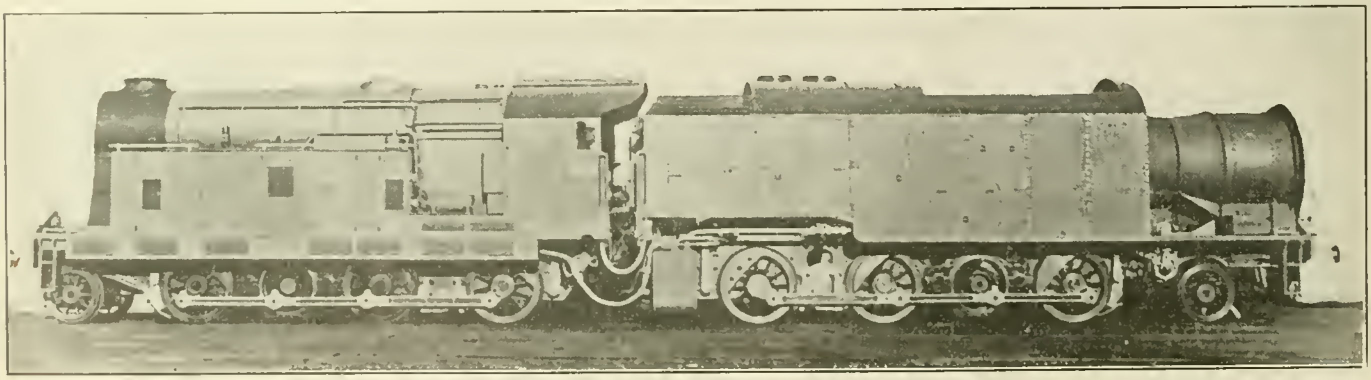
THE Ramsay turbo-electric condensing locomotive was built by Sir W. G. Armstrong, Whitworth & Company, Scotswood Works, Newcastle-Upon-Tyne, Great Britain, in 1921 for the Ramsay Condensing Locomotive Company. This locomotive was designed for experimental purposes and during the past 18 months has been submitted to numerous stationary and road tests, various modifications being made from time to time as experience dictated. The results have been so encouraging, however, that a new locomotive embodying the same principles is now being designed. While several references have been made to this interesting locomotive, only the most general data has thus far been published.

The locomotive is 69 ft. 7½ in. long overall, weighs 293,000 lb. in working order and has a rated tractive force of 22,000 lb. It consists of two sections connected together by a universal joint. Each section is carried on three pairs of driving wheels and a two-wheel truck. The front section contains the boiler under which is placed the main turbine and generator and the auxiliary turbine and generator, while the back section contains the condenser with fan, water tanks and coal bunker. Communication between the turbines and condenser is by way of an exhaust pipe which is provided with a flexible rubber connection reinforced with aluminum rings.

Power is developed in the main turbine and the transmission of power from the turbine to the locomotive wheels is by electrical means. The turbine is coupled to an electrical generator, the electrical energy from which is transmitted to four motors, two of which are fitted to the wheels of the front section and two to the wheels of the rear section.

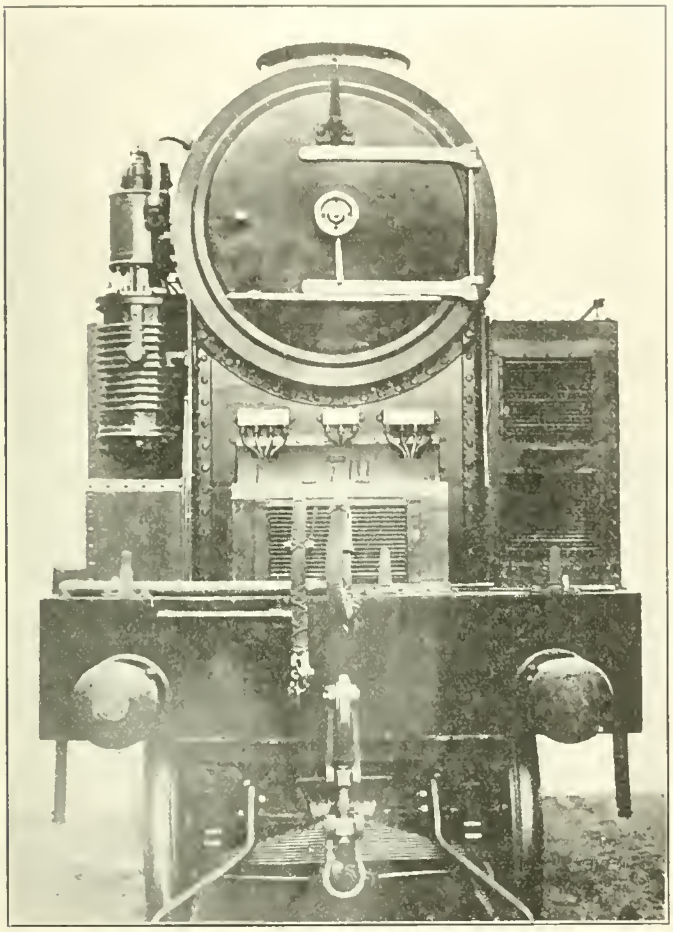
The main turbine is of the impulse type and contains nine stages, the mean blade diameter being 36 in. It is designed for a steam pressure of 200 lb. per sq. in., superheated 300 deg. F., and exhausting to a vacuum of 27½ in. The maximum speed of the turbine is 3,600 r. p. m. The main turbine drives a three-phase generator, which is designed to develop 890 kw. at 3,600 r. p. m., the pressure then being 600 volts.

The auxiliary turbine, which is a single stage one, drives a direct-current dynamo, which excites the poles of the main


Ramsay Turbo-Electric Locomotive of 22,000 Lb. Tractive Effort

generator and also provides electrical energy for the motors driving the condenser fan, the condenser rotor and the extraction pump and also the current for lighting the train. This turbo-set runs at 3,600 r. p. m. and is subjected to the same steam conditions as the main turbo-set.

The boiler is supplied with air by a forced-draft fan placed in the cab. The grate area of the boiler is 28.5 sq. ft.; the heating surface, 1,243 sq. ft., and the superheater surface 300 sq. ft.



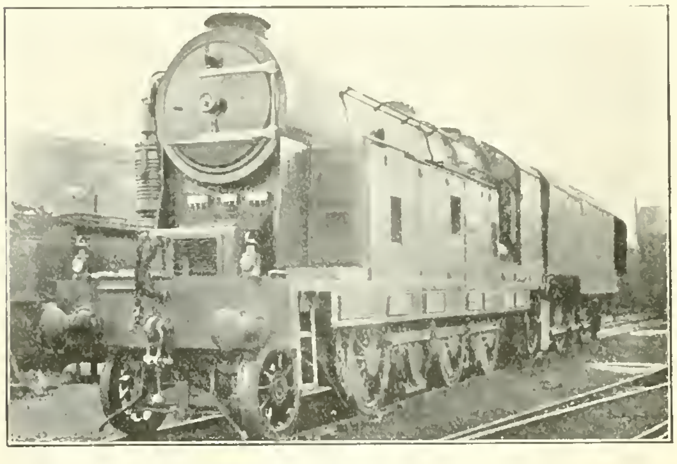
Front End View of Ramsay Locomotive

The Condenser Design

The condenser consists of an annular nest of tubes built into two headers; the exhaust steam from the turbines enters one header, passes through the tubes, is condensed and the water resulting from the condensation is collected in the other header. From there the water passes into a well and is returned to the boiler to be converted into steam again.

The accelerated evaporative principle is employed in the condenser. The nest of tubes is in the form of a drum which rotates in bearings. The drum is housed in a tank, the bottom of which contains water kept at a constant level by a pneumatic float valve. The tubes pass through the water as they rotate. After they leave the water, rapid evaporation is produced by passing air over them at a high velocity and the result is a correspondingly rapid condensation of the steam inside the tubes. The air is supplied by a specially designed fan. The inlet to the fan has a scoop or air guide which forms an easy path for the entering air and so eliminates the losses from the shock which would occur if no such provision were made.

The water used in the boiler and that used for wetting the tubes are kept separate. The former is used in a closed circuit and is not wasted except by small leakages, hence very little new water is required. The advantage of this is specially felt where locomotives are obliged to use bad water which results in rapid deterioration of the boiler. By using a condensing system, taking in bad water during runs is obviated as ample water can be carried to satisfy any run that the locomotive may be called upon to perform. A prolonged life of the boiler is insured in any case by using a condensing system because shortly after the run the feedwater becomes partially distilled. Wetting the tubes by impure water does not affect the vacuum, neither does it injure the tubes. Repeated tests having shown this to be the case, any water may be used for condensing purposes.

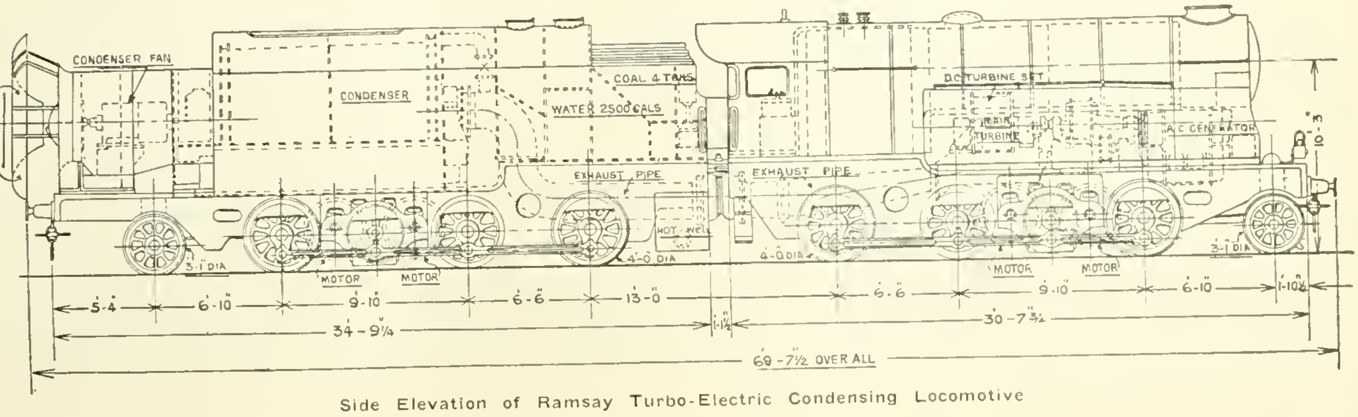


Photograph by Railway Gazette, London

Locomotive Ready to Back Onto a Passenger Train

The Electric Driving Motors

The four main driving motors are of the alternating current slip-ring type, ventilated by fan runners mounted on the rotor shafts. The continuous output capacity of each is 275 brake hp. with one hour's rating at 360 brake hp. The speed of the motors at 60 m. p. h. is 1,175 r. p. m. and the pressure 600 volts. Each pair of motors is belted to a center stretcher



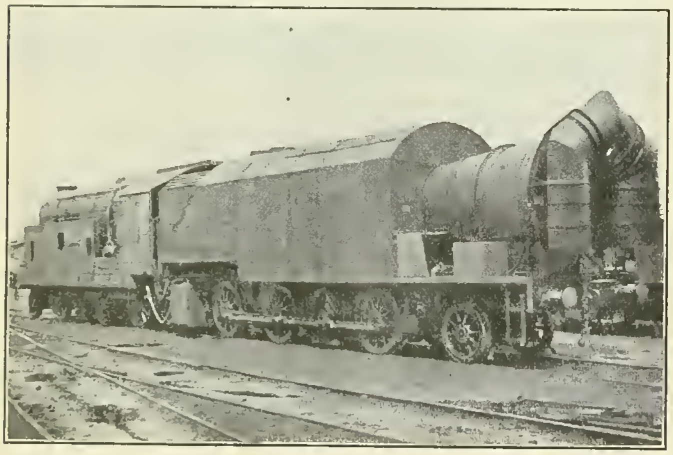
Side Elevation of Ramsay Turbo-Electric Condensing Locomotive carrying a transmission shaft and spur wheels. Pinions are keyed to the motor shafts and these gear with the spur wheels, the power being transmitted through coupling rods from the spur wheels to the driving wheels in the ordinary manner.

The following are the tractive efforts at the rim of the wheels for the acceleration period from starting to 60 miles per hour.

Speed, M. P. H.	Tractive Force
Starting	22,000 lb.
15	22,000 lb.
30	11,050 lb.
60	8,600 lb.
Normal running	....
60	6,000 lb.

The starting torque of the motors is about three times that of the normal and it is obtained as follows: Before starting the locomotive, the auxiliary turbine is run up to full speed, thus providing excitation for the main generator and energy for the auxiliaries. The main turbine is then run up to half speed; viz., 1,800 r. p. m. At this period the motors are connected in cascade. It is then that the locomotive may be started.

When a turbine speeds up from rest to full speed its torque decreases in the ratio of two to one, and when passing through half speed its torque is one and a half times the normal and this is the torque of the main turbine when running at 1,800 r. p. m. Again, two alternating current motors when connected in cascade and running at half the speed of the generator have twice the turning moment which they have when connected in parallel with the same power consumption. Therefore, with the motors in cascade and the turbine running at half speed, the torque from rest to quarter speed will be two times one and a half, or three times the normal torque. The motors are now connected in parallel, the turbine still running at half speed, and the speed of the locomotive increases from one quarter to one half speed, the torque at the latter speed being 1.5 times the normal. After this the turbine speed is brought up to its maximum and the torque drops from one and a half times the normal to normal.



Photograph by Railway Gazette, London

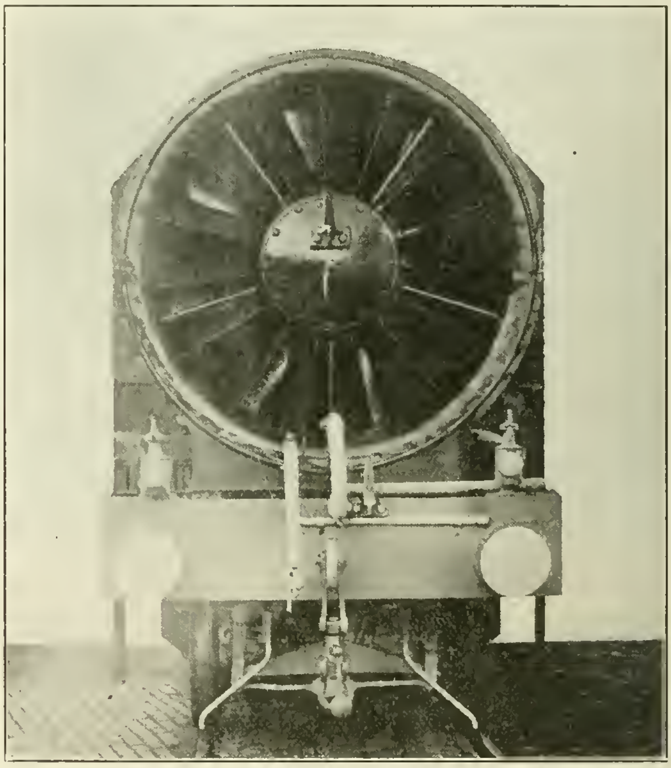
View From Rear Showing Air Scoop

In controlling the speed from rest to 60 m.p.h., the main and auxiliary turbines having been brought to speed by means of a handwheel in the cab, which regulates the steam inlet, all control of the locomotive is now carried out electrically by means of the control wheel on the controller fixed in the cab, the main turbo-generator running at 1,800 r.p.m. The control wheel being in the zero position, the motors are without current and connected in cascade. To start the locomotive, the control wheel is moved to the first notch, thereby closing the excitation circuit to the turbo-generator and connecting the motors in cascade, with resistances wholly in circuit. Resistance is now cut out by further movement of the control wheel until the first running position 15 m.p.h. is obtained. If a greater speed is desired, the control wheel is further moved to alter the motor connections from cascade to parallel, the excitation circuit again being closed; the motors once more operate under current resistance again being cut out until a second running speed of approximately 30 m.p.h. is reached. Additional notches are provided on the controller, each of which corresponds to a given speed of the locomotive. These speeds are reached by further moving the control wheel round, step by step, whereby the setting of the main turbine governor is correspondingly altered, i.e., the speed of the turbo-generator is increased and thereby the periodicity. In this matter, the locomotive speed can be increased from 30 to 60 m.p.h.

A reduction in the speed of the locomotive is obtained by turning the control wheel quickly back to the zero position, thus observing the reverse succession of notches to those for starting up to full speed. The excitation circuit being thereby opened, the notches are without current and connected in cascade ready for starting up again.

Results of Tests

The present locomotive is, of course, purely an experimental one and for demonstration purposes. The trials have been very exhaustive and have extended over a period of 18 months or more.



Rear View of Ramsay Locomotive With Air Scoop Removed to Show Condenser Fan

By disconnecting the terminals of the generator from the motor and connecting them to water resistances, the turbine and generators can be run when the locomotive is at rest, the electrical energy being dissipated by heating up the water. This affords a convenient means of testing the condenser and taking readings which would be difficult to obtain while running. Numerous tests have been made under these conditions and considerable valuable data collected. In addition to these tests, many runs have been made between Horwich and Bolton and others between Horwich and Southport. During all these runs, a breakdown has never occurred. On one of the runs a distance of 100 miles was traversed and a speed of 60 m. p. h. attained with a load of 275 tons.

The efficiency of a turbo-condensing locomotive mainly depends on the design and operation of the condenser. Tests have shown that a condensing apparatus can be placed within the confined space of the locomotive which will maintain the required high vacuum necessary to deal economically with large loads.

Selling Safety to the Man on the Firing Line*

By W. N. Doak

Vice President, Brotherhood of Railroad Trainmen

The peace of mind of the individual plays a more important part in our successful endeavors than one may imagine at first glance. Worries of any character will no more mix successfully with railroading than will water with oil. Many things may cause worry or disturbed condition of mind. The more frequently brought to my attention are those concerning the administration of discipline and the personal handling of employees by superiors. Train delays of apparent unnecessary duration, partiality and favoritism, together with over-zealousness on the part of officers and fellow employees, many times tend to disturb the peace of mind of employees, and as a result carelessness and indifference follow with the attending allies, accidents, resulting in injuries, death or property destruction. Weed out elements of discord as you would the tare from the wheat.

Security in employment is of paramount importance to successful performance of duty. Were each employee, who is worth while, properly impressed with the fact that he is secure in his position so long as he obeys instructions, lives up to the rules and is careful, we would find the best results following. Above everything, eliminate the feeling of "It's hell if you do and hell if you don't." This spirit will not only wreck your safety efforts, but as well, the success of your industry.

Good wages, properly and discriminatingly distributed in such a manner as to compensate in proportion to the services performed, are of such magnitude that we may well turn our attention to them as having the most telling effect in the operation of trains and the general safety first movement. Safety first principles demand that we all boost for fair wages as the best step toward responsibility, and recognized responsibility leads to safety.

All movements contemplating changes in thought and action are slow, and in general the safety movement has been slow, but fortunately progressive and forward. Your safety first movements were regarded at one time as unsound theories, or hobbies. However, recently I was told by a high official of an important railway that the best asset his line had and the biggest dividend payer was the safety first movement. Others have told me that through the good work of their safety first movements they had turned losses into profits—thus disproving the old theory of these movements being expensive.

Labor organizations, such as ours, at first looked with some skepticism upon the safety movement but have now so far changed their viewpoint that "safety matters" are not only a part of their work, but an order of business in their ritual, thus making it an important part of organization work. The reason for this change of opinion is education and fair dealing. The results are written in undeniable evidence on our accident records and insurance reports—thereby proving that the movement has had tangible value to us from a purely organization standpoint in dollars and cents.

An erroneous idea has been too long prevalent in this country that the railroads and their employees were pitted against each other. Of course, there has been the desire on the part of some to cause friction in the hope that these two may not unite for mutual benefit and protection. There is no industry on earth where closer co-operation should prevail than between investor, management and employees of the railroads. Their interests are common and they should be encouraged in their efforts of co-operation. The only reason they are encouraged to do other than work together is because some outsider desires to profit by their differences. It is not only safety, but it is safety first to assist in uniting these principles in this great industry behind the common cause for the common good. In selling safety to the men on the firing lines, instill in them the spirit of co-operation and confidence.

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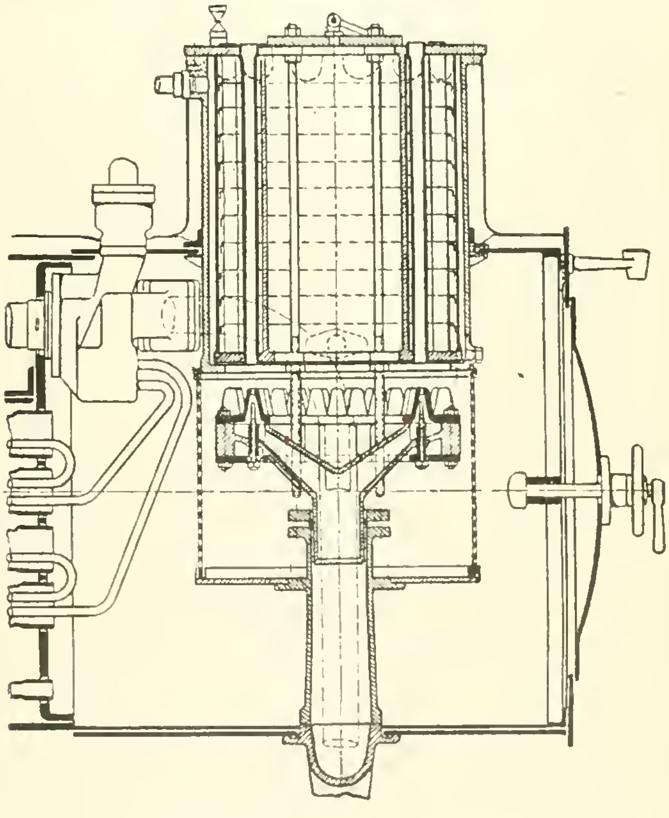
*Abstract of an address before the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4.

Gas Type Feedwater Heater

A new type of small locomotive, built by A. Borsig, Berlin-Tegel, for the Voldagsen-Duingen-Delligsen light railway, was described in a recent issue of the German technical paper Verkehrstechnik. Among the new features of this locomotive is a smokebox feedwater heater, shown in the illustration. The hot gases enter the heater through a circular perforated cylinder and are entrained by an annular series of steam jets placed below the vertical smoke tubes of the heater. The water space of the heater has a series of light horizontal baffles. An internal smoke tube type of superheater is also fitted. The feedwater, delivered by an automatic pump, first passes through an exhaust steam feedwater heater of the Knorr type, where its temperature is raised to about 195 deg. F. It then circulates through the smokebox feedwater heater and its temperature is further increased up to 265 to 285 deg. F. Compared with the old saturated steam type of locomotive commonly in use on light railways, the new locomotive is said to show about 40 per cent saving in fuel.



Gas Type Feedwater Heater for Small German Locomotive

Determining Water Readings in Locomotive Boilers

By William Hall

WHY do boilers explode? It is due to low water or to faulty indication of water in the boiler? After an explosion, and if the engineer and fireman live to tell the tale, they will say, nine times out of ten, that the glass showed an ample supply of water. They are no doubt honest in their assertions, but was the water glass honest in its indications?

It is a well known fact that some engineers dislike to carry too much water as it enables them to carry more steam, others carry too much, and consequently are working water through the cylinders, washing away lubrication. Also in cases where they have a long up-hill drag, they run the water at the lowest possible point. This in itself is not a safe practice, especially if at the top of the hill they immediately start to descend again, for while climbing the hill the crown sheet was covered with water, but when the dip down came the water rushes from the crown sheet towards the front end of the boiler, leaving the crown sheet dry, in some cases with disastrous results. It is not to be supposed that the engineer was wilfully negligent, but being anxious to get his train over the road, which is very commendable, he will take a chance on allowing the water to get low, depending upon the injectors to bring the water past the danger point as soon as he reaches the top. We all know that injectors will fail sometimes, and should it happen at the critical moment then the inevitable happens.

The recognized method of getting the water level of a boiler is, first, by taking the level of the boiler. How? By removing the dome cap or the man hole cover, trying the level on the joint. When the boiler is supposed to be level, then a rubber hose of suitable length, with a glass tube inserted in each end (a mark being filed on each tube ⅝ in. from the end) is filled with water. Two men are required to operate this rubber hose, one man inside the firebox and one outside. The man inside holds one tube against what he supposes to be the highest point of the crown sheet, while the man on the outside holds the other end, ready to mark off the location of the water glass cock. This in theory is alright, for everyone knows that water will find its own level when at rest. But here are two men from 10 to 15 ft. apart, the man outside trying to listen to the man inside who is supposed to be carefully watching his tube. Under these conditions hearing is quite difficult, they can not see each other, and yet they are trying to locate one of the most important boiler safety devices. We can imagine the result. If one man could handle both ends of the tube or both men could see both ends of the rubber hose I would have more confidence in the safety of the device, but under the present system, I have none. I do not believe it is a reliable method; in fact I have seen a variation of from 1 in. to 1½ in. by this method.

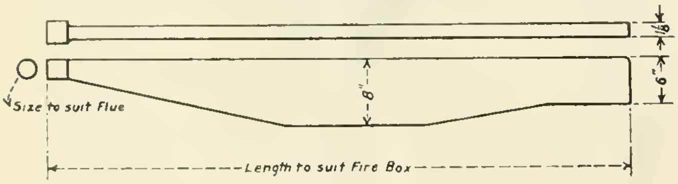


Fig. 1—Straight Edge for Locating Highest Point of Crown Sheet

The following method has been tried and found to work out very satisfactorily: A straight-edge was constructed as per sketch, Fig. 1, long enough to reach from the back flue sheet and project about 2 ft. through the fire door hole, the front end being of a diameter to fit one of the flues. It is not necessary to have the boiler absolutely level, as the straight-edge should be set at the same angle as the boiler; this being taken with a long adjustable spirit level. An adjustable gage, Fig. 2, is then taken by an experienced boiler maker and the highest point of the crown sheet located. He then transfers the gage to the outside and marks off the highest point of the crown sheet on the back head. After this he proceeds the same as when using the rubber hose. The method is extremely simple and absolutely safe. There is no guess work about it.

This gage should have several lengths of pointers to cover the variations in fireboxes. Care should be taken in making the straight-edge, provision being taken to prevent warping, etc. It should be well braced and when not in use kept in a place where it would not be subject to danger of being misused, and should be kept for this purpose alone.

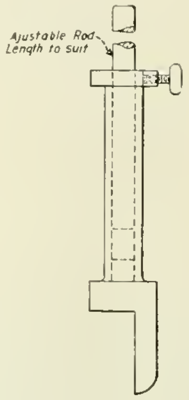


Fig. 2—Adjustable Height Gage for Crown Sheet

Where is the proper place to take the level of boiler from? Some take it from the dome joint, some from the man hole joint, which may be O. K. providing these joints have been set in the boiler level with the top of the wagon top or straight with the shell of the boiler. As most boiler explosions occur around the firebox, I believe the straight part of the wagon top is the logical place from which to level the boiler. It is easy of access at any and all times and while it may cost a little money to strip the wagon top for this purpose it is money well spent and wisely, for what is such cost compared to that of an explosion and possible loss of life. Objection may be made to having to take down the brick arch, in fact that objection has been raised, but what is the cost of rebuilding a brick arch, to the performing of a most important function, the accuracy of which may save the loss of many lives, besides a very large monetary loss to the company.

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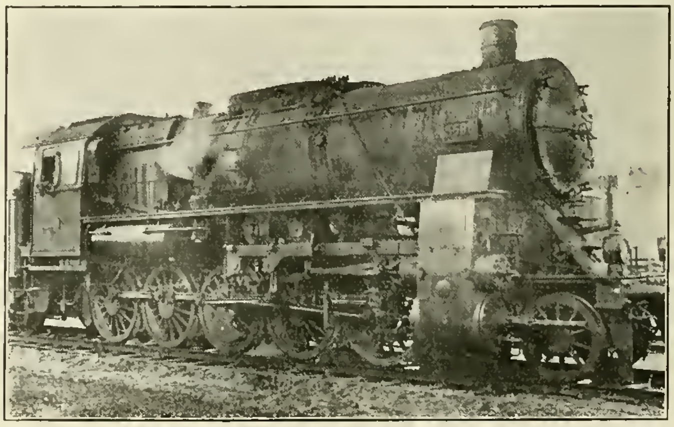
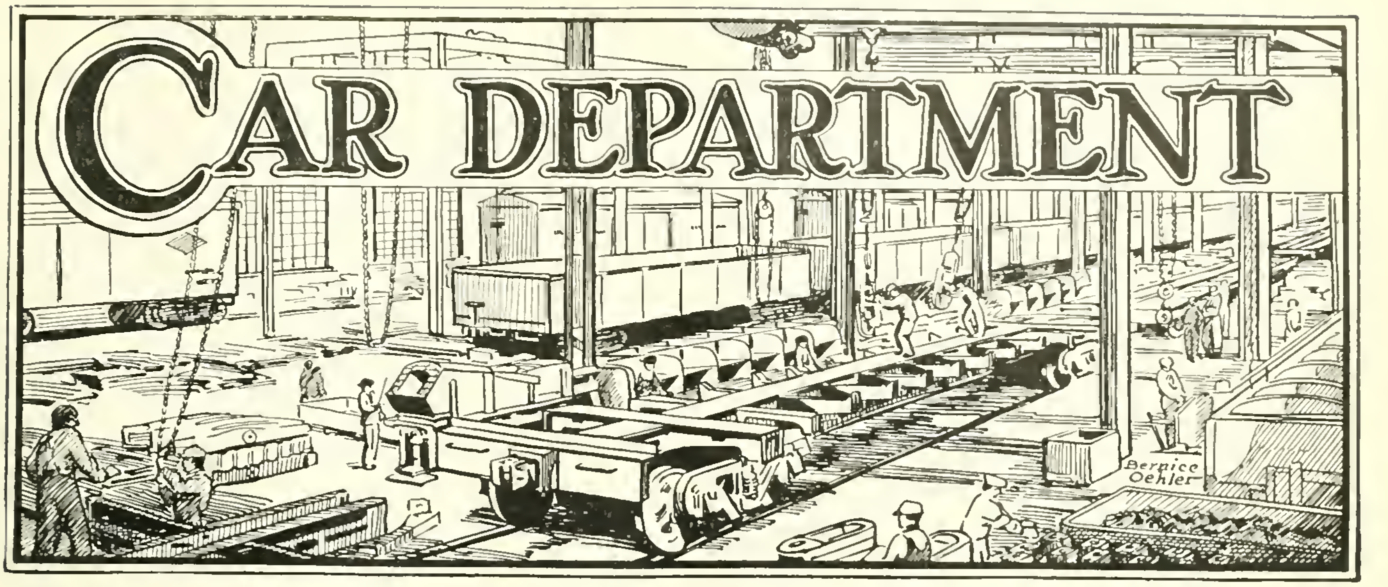


Three-Cylinder Simple 2-10-0 Type Freight Locomotive for the German State Railways



Substitutes for Turpentine and Linseed Oil

Practical Tests Indicate that Improvement Is Being Made in the Quality of These Products

THE Committee on Tests of the Equipment Painting Section of the Mechanical Division, American Railway Association, in its report presented at the Cleveland meeting of the Section, held on September 4, 5 and 6, gave the results of a number of tests of substitutes for turpentine and linseed oil. The tests were reported by the members of the committee individually and abstracts of these reports are given below.

Turpentine Substitutes

Six samples of substitutes were submitted for test.

Of these six samples only three could be classed as somewhere near satisfactory for all purposes. Some were discarded on account of extreme high boiling point; one on account of low boiling point; the others on account of obnoxious odor.

These three samples classed as satisfactory were tested, for specific gravity, residue, initial boiling point, evaporation, moisture, color and odor.

The typical constants of sample No. 4, which is one of the three satisfactory samples, as compared with pure gum turpentine, classes very favorably for general use. While it has a slightly higher boiling point than turpentine, it requires no more time for complete evaporation and hardening than does turpentine. Also, while 95 per cent distills over below 190 deg., C., the absence of excessively high boiling materials in its construction is assured and actual tests for rate of evaporation when used with body color and varnish films, show that the percentage of evaporation of this sample equals that of turpentine after two hours' exposure of film, while the immediate or initial evaporation is a little slower. The slower initial evaporation should not be considered disadvantageous for paint and enamel, as it would, to a certain degree, allow enamel to flow out and would prevent brush marks.

Tests indicate that the solvent power of this sample is equal, if not superior, to that of turpentine. In the case of rosin, limed rosins, ester gums and kauri, satisfactory solutions were obtained with this product alone and it was observed that it greatly aided mineral spirits as a solvent for these gums, as well as for short oil hard resin varnishes.

When used alone it will dissolve pale Damar, giving a clear, non-cloudy solution. The cloudy, semi-precipitated condition obtained when mineral spirits are used with Damar can be obviated by the use of this product in conjunction with mineral spirits.

The souring, or curdling of the poorer grades of Japan colors when reduced with mineral spirits, can be obviated entirely by its use, either separately or in conjunction with mineral spirits.

It has a distinctive pine odor, while turpentine has a mild pine odor. It should offer no disadvantage on this score for use in paints and varnishes. Owing to the low moisture content, which is less than one per cent, this product can be used in practically all proportions, without any cloudiness from precipitation of water. The color is the same as turpentine, water-white. Odor: not objectionable; reaction: neutral; evaporation (on filter paper): complete; sulphur, by white lead test: none. Price: substitute, 70 cents per gal.; turps, $1.23 per gal.

[This part of the report was signed by the chairman of the committee, Theo. Himburg. A short paper on the same subject, not given here, was presented by C. F. Mayer.—EDITOR.]

Combination Reducing Oils as a Substitute for Linseed Oil

Three papers were included in this part of the report, each setting forth the results of tests made by one of the members of the committee.

Paper by C. F. Mayer

Four substitute oils were tried out by practical tests for such purposes as freight car paint, caboose car paint, interior of baggage cars, and other miscellaneous work on which we are using boiled linseed oil. These products are simply reducing or thinning oils, whereas these products are offered and placed on the market to replace linseed oil for all purposes in the mixing of paint, with equal if not better results than obtainable by the use of linseed oil.

These substitute oils mix readily with linseed oil, turpentine and Japan and show no signs of curdle or separation. They also hold in suspension the pigments equally as well as those mixed with boiled linseed oil. I have also found that the covering and working qualities of paint mixed with them are equally as good as those mixed with boiled linseed oil. It is our custom to add a small quantity of Japan dryer to our paints mixed with boiled linseed oil, and I find that paint mixed with these substitute oils dries as well, without adding dryer, as the paint mixed with boiled linseed oil and dryer. Some of these oils, however, are a little darker in color than boiled linseed oil, and where white or light colors are used they show a little discoloration, which might be objected to where light colors are used.

I prepared 10 wooden panels, two each of which are done with the substitute oils and two done with boiled linseed oil. On one set of panels the pigment is white lead, ground in oil, and on the other set of panels Venetian red, ground in oil. The colors were carefully mixed, and the same amount of pigment and oil was used in each one, and the color applied with separate brushes. The panels were placed on the south side of our paint stockroom at an angle of about 45 deg. The panels were placed out for exposure test March 4, 1921, and taken in July 31, 1923, making an exposure of about 28 months.

The panels on which white lead was used as a pigment show signs of cracking and breaking down. Those on which Venetian red was used as a pigment are in much better condition and show no signs of cracking or breaking down. Upon close examination, the panels done with boiled linseed oil have a trifle more life and are in better condition than those done with the substitute oils.

We have all had occasion to test a great many substitutes of various kinds. A great many of these are obsolete at the present time and nothing more is heard of them. From my tests with these linseed oil substitutes, a great improvement has been made, and the time is fast approaching when there will be suitable substitutes for linseed oil in the painting industry.

Owing to the exorbitant prices, and the claim that there is a shortage of linseed oil, it is the duty of every foreman painter to make tests with linseed oil substitutes, to prove to his own satisfaction that equally as good if not better results are obtainable by the use of substitutes, at a less cost to the railway he is serving. He should, however, not stop at this, but should conduct consecutive tests in order to be sure that the same product is being furnished as originally offered.

Paper by H. C. Allehoff

In January 1921 samples of substitutes for linseed oil were sent to me with request to make tests. Sample panels were painted with two coats, white lead, box car red and carbon black. These panels have been exposed since February, 1921.

While mixing these oils with the pigments, I found them to mix equally, the time of amalgamation being the same. When mixed, they disclosed a slight variation in colors. The table shows the difference in shade, the lowest per cent showing the lightest in color.

After painting on glass and allowing three hours to set, I found the suspension equal, excepting No. 5, which separated and resembled frosted glass, on the box car red only. The white and black remained in suspension.

I found the drying of the substitutes much better than the linseed oil. The table will show the per cent of variation in exact drying time.

I tested the clear oils for buoyancy by placing teaspoonfuls on pieces of glass. The table shows the number of inches or fractions thereof that each one flowed. For the buoyancy when mixed and standing for 12 hours, showing the amount of liquid floating, by separation, see Column G of the table.

After 90 days' exposure, painted on glass, I tested the elasticity of the film by scratching it with a knife. I found the substitutes very hard and brittle, whereas the linseed oil would cut off in long elastic films. The table will show the per cent of difference.

On the test panels, after 90 days' exposure, I found the substitutes receding in gloss. The chart will show the per cent of variation at the end of 90 days.

As to the combination of reducing oils and the amount of linseed that should be added, in order to prolong life or add to the wearing qualities, this is a matter of judgment depending entirely on the weight of the reducing oil. A light oil will give better wear by adding 50 per cent of linseed, whereas, a heavy reducing oil would only require 25 per cent in order to make it as serviceable as the other with 50 per cent. I have noticed from practical experience, when using a reducing oil thin in body, that it requires so much pigment in mixing to the right consistency for painting, that when dry it will only show a dull, silky gloss. By adding 25 per cent linseed, a good semi-gloss will be obtained, and by adding 50 per cent of linseed, it will resemble a linseed oil painted surface.

Paper by J. McCarty

I have tested out three grades of substitute turpentine that are now in use to a considerable extent. Two are of a petroleum product, especially refined and free from grease. When used in Japan colors the evaporation and flattening-out is much slower than pure turpentine, their solvent power varies considerably when coming in contact with some of the various makes of Japans and an immediate souring takes place when mixing with varnish materials. These substitutes are not of much value in railway equipment painting.

Comparative Test Data for Linseed Oil and Several Substitutes

								A	B	C	D	E	F	G	H
Identification No.	Oil wt. per gal.	Amount of pigment red	Amount of oil red	Carbon blk. pigment	Carbon blk. oil	White lead pigment	White lead oil	Suspension	Shade	Drying, hr.	Buoyancy, in.	Luster or gloss	Elasticity	Buoyancy, mixed	Estimated valuation, 5-21
1	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	24-36	3 in.	100	100	1/32 in	100
2	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	14-24	4 in.	96	100	1/32 in.	100
1-A	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O K.	98	8-14	7 in.	100	70	¼ in.	75
2-A	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O K.	98	8-14	7 in.	96	70	¼ in.	75
3	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	14-24	4 in.	110	110	1/32 in.	125
4	7	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	99	8-14	6½ in.	96	90	5/16 in.	75
5	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.		100	8-14	6½ in.	98	90	¼ in.	75

Note:—No. 1 is raw linseed; No. 2, boiled linseed; Nos. 1-A and 2-A a substitute oil, raw and boiled, respectively; No. 3, raw linseed oil, 1 gal., and 1 lb. litbarge, heated until amalgamated; Nos. 4 and 5, substitute oils.

Column B—Test for color by placing between two glasses, allowing 1 per cent per shade difference in decrease of light.

Column C—1-A, 2-A, 4 and 5, set up in 8 hours, dry in 14 hours; 2 and 3 surface dry 14 hours, dry 24 hours; Nos. 1 and 3, 6 hours.

Column G—Amount of liquid flowing after standing twelve hours.

Column H—Estimated valuation two coats allowing four years' exposure.

One other turpentine substitute which is more expensive than the petroleum products but much lower in price than pure turpentine, is solvent in all grinding Japans and varnish materials, and does not show any signs of souring when coming in contact with varnish or enamel. When mixing with Japan colors the evaporation and flattening-out is about the same as pure turpentine. This substitute is taking the place of pure turpentine for all classes of work and general use at the present time in all paint materials at our shop.

In making tests of the substitute linseed oil samples sent to me I had sample boards painted with a mineral paint, ground to semi-paste with pure linseed oil and thinned with each of these sample oils, painted three coats and exposed to the weather for 14 months on the south side of our paint stock building at an angle of about 45 deg.

A chemical test of these oils shows the following results*:

	1-A	2-A	4
Volatile	53.6 per cent	54.4 per cent	46.3 per cent
Time of drying at 100 deg. F.	5 hrs.	2½ hrs.	1½ hrs.
Water test—whitening	none	none	none
Film	tough	tough	tough

There is a considerable variation in the percentage of volatile matter (benzine); sample No. 4 contains considerably less than the others. There was also a good deal of difference in the time of drying. Sample No. 1-A is much lower than the others. This drying test was made at a temperature of 100 deg. F. in order to make duplicate tests at any time of the year. In practice when exposed at ordinary shop temperature the time of drying would be over double that found at a temperature of 100 deg. F.

These samples all appear to be composed of China wood oil or a similar base, and all are resistant to water. A good deal of the value of this oil material in preserving wood would depend upon the thickness of the paint film, and consequently the results in service would not be likely to be so durable as though a paint composed of pure linseed oil were used. The sample panels that were exposed to 14 months' weather test show up well and the durability of these oils and the linseed oil are about the same. In pressing the paints between two pieces of glass no difference of shade in color was noticeable. In flowing out a sample on glass the substitute oils show more weight in body than linseed oil.

TIME OF DRYING ON GLASS AFTER FLOATING

	Hours to dry to bottom
Sample No. 4	6
No. 5	20
No. 2-A	14
No. 1-A	20
Boiled linseed oil	24

Precipitation in mineral paints takes place more readily with the No. 5, No. 1-A and No. 2-A oils than with linseed oil. The No. 4 sample holds the paint in suspension equally as good as linseed oil. These paints were put in glass jars, sealed and let stand for 12 months. When opening the oil and No. 4 oil mixture the oil was floating on top but mixed up readily. The samples mixed up with No. 5 oil and the No. 1-A and No. 2-A oils were precipitated solid in the bottom.

Discussion

The discussion of this report dealt principally with the necessity for practical tests to determine the physical characteristics of paint materials to supplement the chemical tests. One case was cited in which a substitute for turpentine had been pronounced satisfactory for universal use on the basis of the results of a chemical analysis, which would not dry when used as a paint material. After standing several hours, an appreciable amount of paraffin had separated at the top, and rubbing the finger over the painted surface caused a change of color. The importance of finding suitable substitutes for turpentine and linseed oil were also touched upon, as only in this way can the cost of these materials be kept at a reasonable figure. Not all substitutes are satisfactory, however. Some substitute materials have been found to be dangerous to use, causing soreness of the hands and faces of the painters handling them.

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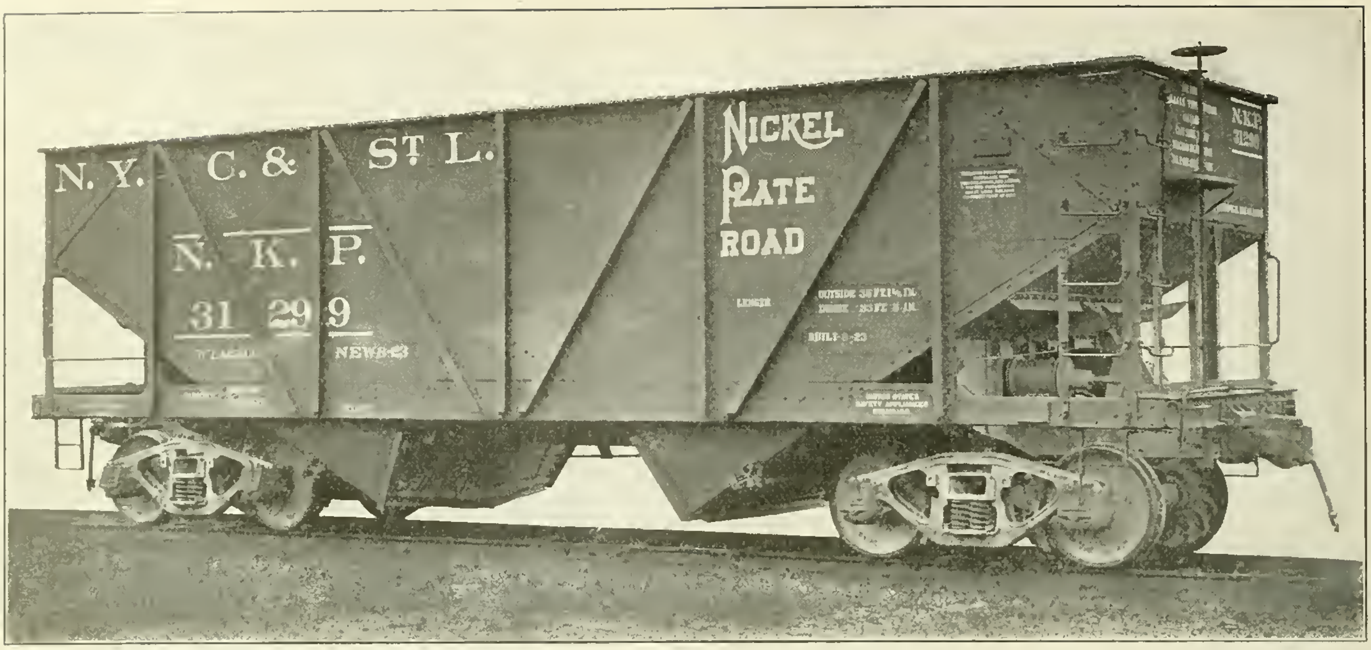
*These samples are of the same materials as those referred to in Mr. Allehoff's paper, which bear the same numbers.

Relation of Draft Gear Capacity to Rough Handling

THE study of the rough handling of cars made by the Freight Claim Division of the American Railway Association shows that speed is the principal contributing factor, followed closely by draft gear capacity. It has been found that when cars collide, the forces between them increase at a much greater rate than the velocities. Tests made by the Inspection and Test Section of the United States Railroad Administration and data of the Norfolk & Western on two 40-ton cars equipped with draft gears which close at an impact velocity of two miles per hour, show that when the cars traveled at 1 mile per hour, the reaction forces amounted to 20,000 lb.; at 1½ miles per hour, 40,000 lb.; at 2 miles per hour, the impact velocity at which the gears close, 70,000 lb., and at 2½ miles per hour, 630,000 lb. This shows that after the gears close, an increase of only ½ mile per hour, or 25 per cent in speed, resulted in an increase in the reaction forces of 560,000 lb., or 800 per cent. Another test, using two 57½-ton cars equipped with draft gears closing at a speed of 4 miles per hour, showed that at 4 miles per hour the reaction forces were 370,000 lb., and at 4½ miles per hour, 1,140,000 lb. In this case with an increase of ½ mile per hour, or 12½ per cent in speed, there was an increase of 770,000 lb., or 208 per cent in reaction forces, and that after the draft gears go solid they no longer serve their purpose.

Orderly Arrangement of Lumber Piled by Sizes Between Modern Car Shop and Dry Kiln

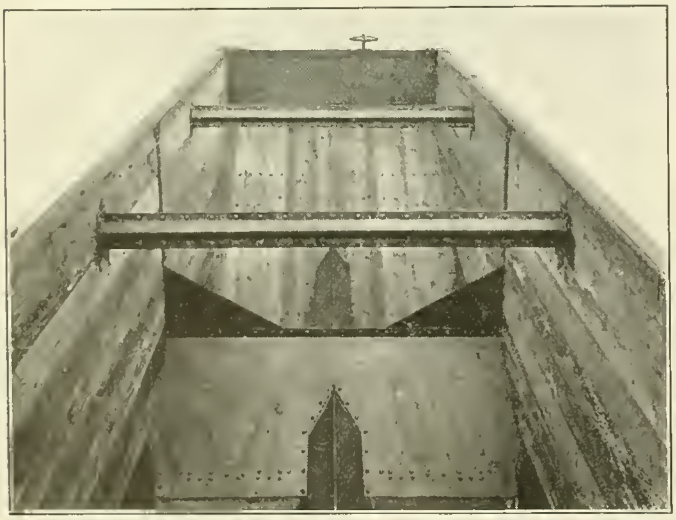


Composite Hopper Car Built for the New York, Chicago & St. Louis by the Pressed Steel Car Company

Composite Hoppers for the Nickel Plate

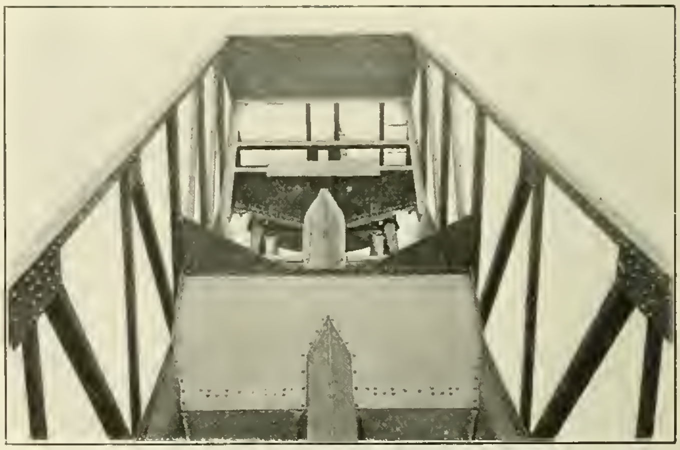
Wooden Sides and Flooring Are Found to Be More Economical Than All Steel in Cost of Building and Maintenance

COMPOSITE hopper cars of unique design have just been completed for the New York, Chicago & St. Louis by the Pressed Steel Car Company, McKees Rocks, Pa. The entire construction of the cars, from the side sill down and including also the center sills, center sill cross ridge and the entire ends of the car, is the same as commonly used in the construction of all-steel hopper cars. The essential difference is the application of wooden sides and flooring to the steel frame. The superstructure consists of an all-steel frame to which planks for side wall and flooring have been bolted.



Interior View of the Completed Car

Replacement of the wooden sides and flooring with steel can be readily accomplished without otherwise making any changes in the car, except, possibly, the removal and replacement of some of the rivets through the framing. To avoid corrosion as far as possible, copper-bearing steel is used for all sheets exposed to coal loading.

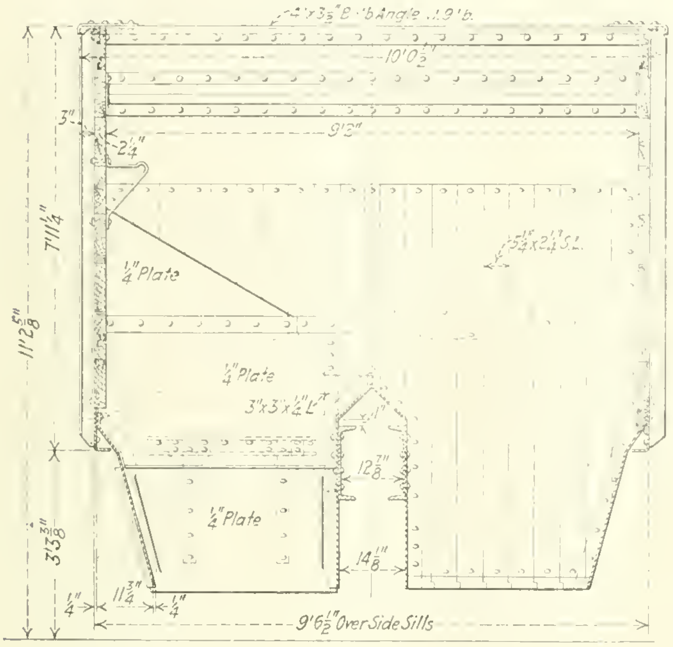


Interior View of the Car Before Wooden Flooring and Side Walls Are Applied

The original design was developed in 1916, at the request of J. J. Bernet, president N. Y. C. & St. L., to avoid the use of steel as far as possible on account of the high price and scarcity of steel that prevailed at that time and having in mind also the heavy maintenance of all-steel cars due to corrosion. During the five years that the original cars have been in use, the maintenance has consisted chiefly of repainting the steel parts.

Changes From Original Design

There were 750 cars built according to the original design. These cars have given satisfactory service to the railroad company for over five years, and there were very few changes in working up the design for the new cars. The only important changes made were increases in the length and height to obtain greater cubic capacity. The inside length was increased from 30 ft. to 33 ft. 8 in., and the height from the bottom of the side sill to the top side angle was increased from 7 ft. 3¼ in. to 7 ft. 11¼ in. Friction draft gears were applied to conform to recommendations of the American Railway Association and some slight reinforcements of center sills and body to compensate for the increase in length were also made. The distance between the truck centers was increased from 21 ft. 9 in. to 24 ft. 9 in., which increased the total distance over the striking plates from 31 ft. 11½ in. to 35 ft. 7½ in. The design of the truck side frames was changed also to conform to present practice. These changes effected an increase of 390 cu. ft. and 19,800 lb. in the capacity of the car, when loaded with soft coal.

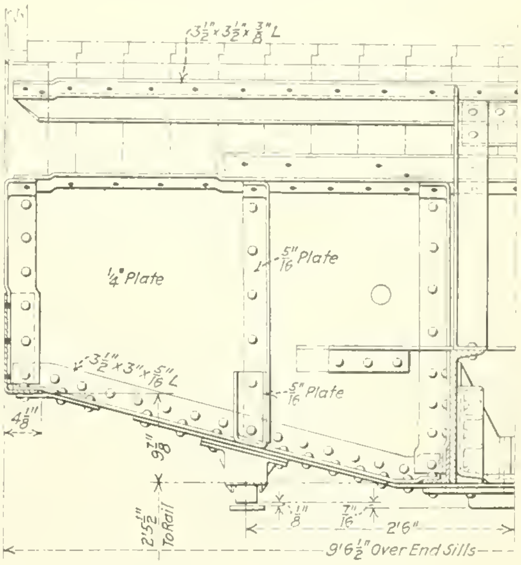


Cross Section of Nickel Plate Composite Hopper Car

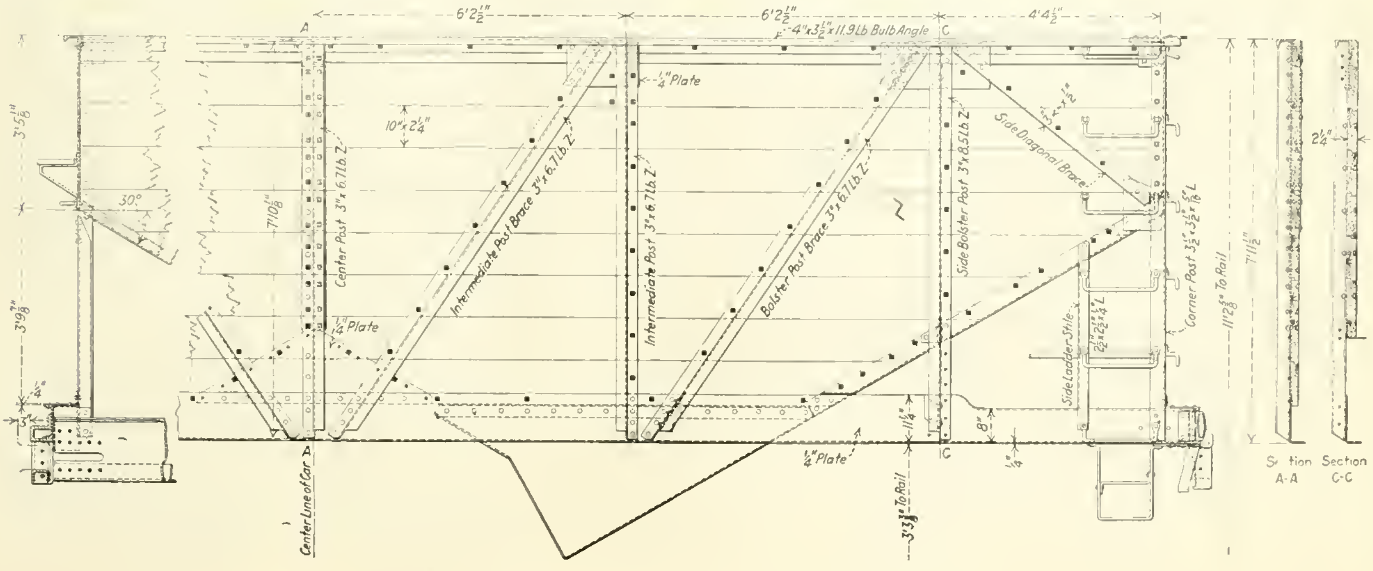
Underframing

The center sills consist of two 15-in., 55-lb. channels, 34 ft. 8¼ in. long, spaced 12⅞ in. apart for their entire length. No cover plate is applied, but reinforcement is obtained by means of three corrugated pressed steel stiffeners, two 2 ft. 4¼ in. from the center line of the body bolster and one at the center of the car, respectively, and also at the bottom by 4-in. by ⅜-in. by ⅜-in. angles which extend from the outward end of the center sill 50⅞ in. beyond the center line of the body bolster to the slope sheet of the hopper. This bottom angle overlaps the application of the hopper inside sheet and the center sill cover so that the center sill is considered as reinforced to an extent approximately equal to that of a top cover plate. The cross-section of center sills, not including the bottom reinforcing angles, is 32.36 sq. in.

The end sills are made of 8-in., 11½-lb. channels fastened to the side sills with 3½-in. by 3½-in. by 5/16-in. angles. They are reinforced by diagonal braces of 5-in. by 3-in. by 5/16-in. angle section, extending from the outside corners to a 5/16-in. angle section, extending from the outside corners to a 5/16-in. cover plate connecting the body bolster and draft sills. The side sills consist of ¼-in. plate, flanged at the bottom, with 11¾-in. vertical sides, to which the side posts and side post braces are riveted. The hopper and the floor framing are riveted directly to the side sills and center sills, thus giving the necessary stiffness. The body bolsters consist of ¼-in. plate reinforced at the bottom, center sills, intermediate section and side sills by 3½-in. by 3-in. by 5/16-in. angles and by ½-in. top and bottom cover plates. The center plate casting is riveted directly through the center sill channels to the bolster.



Section at the Bolster of Nickel Plate Composite Hopper Car



Side Construction of Nickel Plate Composite Hopper Car

Side Framing

The sides are built of 2¼-in. by 10-in. shiplap siding bolted to a framework of 3 in., 6.7-lb. Z-bars, except the Z-bar at the ends of the bolster, which is 8.5 lb. In order to facilitate interchangeability from wood to steel, the side planks are cut to reach from the end to the center of the center side post. A ¼-in. copper bearing steel plate is used as a splice and extends from the top side bulb angle down to the cross ridge gusset. The measurement, from the bottom of the side sill to the top of the top angle, is 7 ft. 11¼ in. and the total height from the top of the rail is 11 ft. 2⅝ in. These measurements are 6⅝ in. above that of the U. S. R. A. standard hopper cars of all-steel construction. Each of the side posts is riveted directly to the side sill and braced as shown in the drawing. The corner post is a 3½-in. by 3½-in. by 5/16-in. angle, to which the siding is bolted. The end sheets are steel and riveted to the corner posts. The top side angle is a 4-in. by 3½-in. bulb angle, commonly used on all-steel cars.

Flooring

The same size shiplap used for the sides is also used for the flooring and is bolted to the frame in much the same manner as an all-steel floor would be riveted. The hoppers and hopper doors are constructed of copper-bearing steel to prevent corrosion. With the single exception that the sides and flooring are of wood, the general interior appearance is the same as any ordinary hopper car.

The trucks have box section, cast steel bolsters and cast steel side frames with the journal boxes cast integral with the frame. The stencilled capacity of the car is 110,000 lb. The light weight averages about 42,300 lb., which compares favorably with an all-steel hopper car of equivalent strength and cubic capacity. The cubic capacity of the new cars is 2,050 cu. ft. level full and 2,295 cu. ft. with a 10-in. heap.

The Pullman Company's Contribution to Railroad Safety*

By E. F. Carry

President, Pullman Company

THE Pioneer, the first Pullman car constructed from the ground up by Mr. Pullman, in 1865, was fittingly named. It marked with its monitor roof and general sturdiness a tremendous advance in the art of car building, and was truly a pioneer in so far as strength, safety and solidity in passenger car construction was concerned.

The record of Pullman achievement in improvement and development of railroad equipment is one of constant progression. Probably the Pullman vestibule would be accorded premier position by railroad men the world over as the device which has done more than any other to render railway travel safe. Communication between cars in a train at high speed would be perilous were it not for this vestibule. It not only renders passage from car to car secure and protects passengers from exposure, but it provides to a marked extent a bulwark against serious damage to the body of the car and its occupants from the lighter shocks and wrecks. The enclosed vestibule of today is a development of the narrow vestibule brought out in 1887, and since its introduction in 1893 has become the universal standard for all important trains.

The Six-Wheel Truck a Contribution to Safe Travel

Another important Pullman development for the heavier passenger train cars is the six-wheel truck with its long wheel base. Its excellent general arrangement and fine riding qualities contribute greatly to comfortable travel. The excellency of this truck design has led to its general adoption for heavy passenger equipment cars. Its contribution to safety, particularly in high speed service in our heaviest train, lies in the fact that with six wheels a journal broken or burnt off in service will not necessarily cause a wreck, while with a four wheel truck disaster practically would be unavoidable.

Other Mechanical Developments in Pullman Car Safety

Early recognizing the importance of providing a bulwark against collisions (in addition to the enclosed vestibules), special protective features, generally designated as anti-telescoping devices, were first introduced in Pullman cars. These devices consisted of steel introduced at the sills, in the ends, and at the top of the vestibule. To the extent to which such devices are capable of absorbing energy by resistance to distortion and rupture, they afford collision protection to the car, and the use of extra metal for this purpose has become general in the construction of passenger equipment.

Among other noteworthy improvements developed or adopted for use on Pullman equipment in recent years there may be listed:

Locking bolts for connecting trucks to bodies as an anti-telescoping feature.

New truck design which permits of greater ease of inspection and with its pivoted and boxed in equalizers is a safeguard against the possibility of wreck due to a broken equalizer.

Development and adoption of a practical application of the new A. R. A. standard Type D freight coupler for passenger cars and correspondingly strong draft gear attachment to prevent the breaking in two of long trains and the breakage of coupler knuckles occasionally experienced with ordinary couplers.

Improved generator suspension to insure against the possibility of wrecks due to the loosening and dropping of generators.

The improved step box, with a larger surface area and without the hand-hole on the top of the box in which small French heels are sometimes caught.

The anti-pinch device on car doors to prevent fingers getting caught between the door and door jamb.

Guard rails on the hallway windows.

The floor lights in the aisle at night when the major lighting system has been turned off.

Berth locking device to prevent the upper berth folding up unexpectedly. Safety step ladder to be used in ascending to and descending from the upper berth.

Curtain guards for upper berths to prevent the occupant rolling out.

Inside vestibule grab handle to steady the passage from car to car.

Vestibule roller curtains, to prevent people catching their fingers between diaphragm and face plates.

Improved hinged buffer plate, to prevent feet being caught between the end sill and the buffer. This plate also presents a smooth surface and eliminates tripping hazards.

Vestibule ceiling lamp over the trap door. This not only provides illumination during transit from car to car, but also guides the footsteps when entering and leaving the car.

Pullman equipment is constantly scrutinized and all suggestions affecting the safety or comfort of passengers receive careful consideration. Inventive geniuses in car equipment all over the country regard Pullman approval as a mark of merit and gladly afford the Pullman Company a chance to investigate and try out new devices. Our own chemical and physical laboratories are constantly engaged on the work of research, investigation, examination, and check on materials, and an inspection force is everlastingly on the job. They examine materials, they keep an eye on equipment and watch service.

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*Part of a paper read before the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4.

Ventilation Studies for Passenger Health

Among the important contributions of the Pullman Company to the hygiene of railway travel are its studies in car ventilation, which began in 1905. When our study of this subject was begun the science of ventilation was just emerging from the dark ages of misconception and error, and rays from the light of exact knowledge were just beginning to touch it. The sun is fully up now, and it enables us to see how important are heat and heating facilities in connection with air supplies. Indeed, it has shown us the proper control of heat is a more important hygienic problem, and a rather more difficult one, than the maintenance of a proper supply of air. This has led us to multiply our heat units and controls for a car from one to seven. That also makes for health.

The blow fan is an important adjunct to the maintenance of good air conditions which was first introduced into railway service by the Pullman Company. And the small louvre mounted in the window sash, which may be opened and closed by the passenger according to his desire, is a recent innovation which is worthy of a place in this list.

Pure Water Facilities on Pullman Cars

Of almost equal importance with air is the water supply of a car. It *must* be supplied for drinking, and its availability for the purposes of toilet and cleaning adds to comfort and healthful conditions. In recent years, the United States Public Health Service, in co-operation with state and city boards of health, has taken over the task of seeing to it that the waters supplied by common carriers are of proper standard of purity; they must all be examined and certified at regular intervals. And it is fair to say that they are practically all and always safe now as delivered to the car.

But there are sources of possible contamination after the water is safely aboard—the cooler; ice that goes into it; and worst of all, its final container, the cup. In 1912 we began dividing water coolers into two compartments so that ice and water would be kept separate. But this left the cooler open for the possible entry of foreign materials, so in 1920 we developed a method of doing away with the open cooler entirely, substituting for it a cooling chamber which is part of the pressure system about which the ice is packed—undoubtedly the best and safest plan that has ever been put into use. The common drinking cup was universally abolished and the individual paper cup substituted about 10 years ago.

Lest we be too generous with ourselves in the appropriation of laurels, let it be admitted at once that dividing the water cooler and abolishing the common cup were not original conceptions. They were first demanded by the state health officer of Kansas. But once the demand was made, the idea was accepted by the Pullman Company and costly improvements were made universal that were only locally necessary. And the common towel was unknown in Pullman cars long before it became the object of the official taboo in any of the states.

There are many minor sanitary features of Pullman equipment and service that would be worthy of being classed as contributions to the safety of travel in a more extended discourse—plumbing and toilet arrangements, the care and handling of linen, fumigation and disinfection, the encasing of beds and bedding, first aid packets on cars, and others —but they may be only mentioned here. Particular claims may be made, however, for the dental lavatory, adopted in 1909, and the open-front toilet seat, adopted five years ago.

The Standard Railway Sanitary Code

In 1905 the Pullman Company established, and has since maintained, the first department of sanitation conducted by any common carrier in this country. Through this department it has kept in close touch with sanitary progress in general and with railway sanitation in particular. One of the things we have had to contend with is a great diversity of sanitary laws and regulations in the states, which have sometimes been contradictory, often inharmonious, and occasionally entirely impractical or absurd. Partly through the efforts of our department of sanitation there has been developed in the last few years a Standard Railway Sanitary Code, covering all the important features of safeguarding the health of railway travelers, as a proposed substitute for the diverse state and national laws and regulations which went before it. This has now been adopted by 31 of the states, and the interstate regulations have been so revised as to be entirely harmonious with it, so that uniformity of public requirements is fast replacing the former chaos. In so far as we have contributed to the formation and the introduction of this code—and that is materially—we have contributed not only to the safeguards of health in railway travel, but to the peace of the railways as well.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Owner Responsible for Defects Resulting from Long Usage

On January 17, 1921, the Union Refrigerator Transit refrigerator car No. 3806 underwent repairs at the Corbin, Ky., shops of the Louisville & Nashville, which involved the renewal and repair of the center sills, cross tie members, part of the flooring and one intermediate sill. Charges for repairs made to this car were included in the Louisville & Nashville bill for August, 1921, to the amount of $352.88 against the Union Refrigerator Transit Company, the total cost of repairs to this car being $216.01.

Exceptions were taken to the entire charge for repairs made to this car by the Transit company, claiming that in order to bring about this damage the car evidently met with unfair usage. The Louisville & Nashville claimed that after a thorough investigation of the movements in the handling of this car over its rails, it was found that the car met with no unfair usage as defined in Rule 32 and that all repairs were necessitated by ordinary wear and tear for which a car owner is responsible.

It was decided by the Arbitration Committee that "the evidence submitted does not warrant the claim that the defects in question were the result of any of the conditions enumerated under Rule 32. Therefore, owner is responsible."—*Case No. 1262, Louisville & Nashville vs. Union Refrigerator Transit Company.*

Repairing Line's Judgment Sustained as to Needed Repairs

The A. E. Staley Manufacturing Company's tank car No. 25 underwent repairs, on account of decayed running boards, at the Trans-Mississippi Terminal Railroad shops at Gouldsboro, La. The A. E. Staley Manufacturing Company refused to pay the bill for these repairs. It was claimed that the car in question had been inspected by the owner's inspector at Decatur, Ill., before the car had left that point and it was found to be in good condition. The car went through two interchanges at Decatur, Ill. On June 2, 1922, it was set back on the Illinois Central interchange at New Orleans and the Trans-Mississippi Terminal shopped it to its Gouldsboro, La., repair track. The owner contended that the car should not have been accepted from the Illinois Central until after repairs had been made. The Trans-Mississippi Terminal claimed that these repairs were made in good faith in accordance with the A. R. A. Rules and the United States Safety Appliance requirements. Its records show that "the running board was decayed and necessitated renewal and the expense was properly charged to the car owner."

The Arbitration Committee decided that "no evidence had been submitted to prove that the contention of the repairing line is incorrect. Therefore, bill against car owner is sustained."—*Case No. 1263, Trans-Mississippi Terminal Railroad vs. A. E. Staley Manufacturing Company.*

Another Case of Damage Due to Weak Construction

On April 11, 1922, the Wheeling & Lake Erie reported Green Bay & Western box car No. 2192 under M.C.B. Rule 120, enumerating certain defects of the body of the car, which it claimed was the result of switching cars in train No. 83 at Creston, April 10, 1922. The Green Bay & Western refused to handle this case under Rule 120, contending that the evidence pointed to unfair usage and asked that the handling line restore the car to serviceable condition at its own expense. The evidence submitted in this case was similar to that in Case 1261, Lehigh Valley vs. Pere Marquette, which was reviewed in the October number of the *Railway Mechanical Engineer.*

The Arbitration Committee rendered practically the same decision and decided that there was no evidence of the car having been subjected to any of the unfair usage referred to in Rule 32. Car owner is responsible.—*Case No. 1264, Green Bay & Western vs. Wheeling & Lake Erie.*

Owner's Defects Associated With Unfair Usage Defects

The Chicago, Rock Island & Pacific at its Blue Island shops on August 31, 1921, repaired St. L., B. & M. car No. 2011, which is the property of the Gulf Coast Lines. The repair bill included a number of items, part of which were caused by the car being cornered in terminal movement on the Rock Island lines. When the car was sent to the shops for repairs, it was found to be in generally bad order and additional repairs to various parts of the car were found necessary. In accordance with the provisions of Rule 41, the Rock Island separated the owner's defects from the delivering line defects and the owner was not billed for the items of repairs necessary on account of unfair usage. The Gulf Coast Lines maintained that inasmuch as this was a car having a steel underframe and superstructure, that it would not be likely to break out at the ends and in its opinion, the damage was the result of the car being cornered, and that the entire charge should be cancelled.

The Arbitration Committee decided that "in view of the assurance of the Chicago, Rock Island and Pacific that the defects caused by cornering were marked 'no bill' and that the other defects were owner's responsibility under Rule 41, in the absence of evidence to the contrary, the charge of the Chicago, Rock Island & Pacific should be accepted."—*Case No 1265, Gulf Coast Lines vs. Chicago, Rock Island & Pacific.*

Non-Interested Line Delivers Defective Car to Owner

The Rio Grande & Eagle Pass was notified by the Gulf Coast Lines that R. G. & E. P. car No. 313 was in its yard at Robstown, Tex., in a damaged condition, and requested joint inspection to be made, as the Texas Mexican Railway refused to accept the car. This was agreed to, with the proviso that upon receipt of the joint evidence certificate by the Rio Grande & Eagle Pass, it would advise disposition of the car. Without waiting for instructions from the owner, the Texas Mexican received the car from the Gulf Coast Lines and delivered it to the owner at Laredo, Tex. Joint inspection had been made at Robstown by the inspectors of the Gulf Coast Lines and the Texas Mexican. A second inspection was made at Laredo by the inspectors of the Texas Mexican and the Rio Grande & Eagle Pass, and this inspection showed additional defects not shown on the joint evidence certificate resulting from the inspection at Robstown.

The car owner contended that the nature of the defects indicated the damage was due to unfair usage, and a bill covering the repairs to this car was presented to the Texas Mexican which refused payment. The Texas Mexican claimed that responsibility for these damages should be placed with the Gulf Coast Lines. Evidence of the interest of the Gulf Coast Lines in this case was shown by a letter from that railroad to the secretary of the association. The Texas Mexican pleaded "not interested."

The Arbitration Committee decided that no evidence had been submitted in support of the owner's contention that the car must have been damaged by unfair usage. The car owner is responsible.—*Case No. 1,266, Rio Grande & Eagle Pass vs. Texas Mexican.*

Another Case Where Rule 32 Does Not Apply

On May 12, the Seaboard Air Line reported A. B. & A. car No. 10110 for disposition under Rule 10. The car was in a train of 61 cars that were being switched in the Portsmouth, Va., train yard of the Seaboard Air Line. The train was moving at about three or four miles an hour when the brake pipe pressure dropped suddenly and stopped the train. This car, a wooden frame flat car, broke in two in the middle and the coupler on Northern Pacific flat car No. 68457 was also broken. This was the only damage sustained by any of the equipment in the train. In a letter from the Seaboard Air Line reporting the accident it was also stated that neither this car nor any other car in the train had been sideswiped, cornered or derailed. The Atlanta, Birmingham & Atlantic was not satisfied with the statements from the Seaboard that the car was not damaged under the provisions of Rule 32, and it took exception to this statement, claiming that the car was damaged on account of the sudden reduction of air pressure; also that handling a train of 61 cars with the air brakes operating on about 18 or 20 cars constituted unfair usage.

It was the decision of the Arbitration Committee that the evidence furnished did not show that damage occurred under any of the conditions of Rule 32. Therefore, the car owner was responsible under Rule 43 and should furnish disposition per Rule 120.—*Case No. 1267, Seaboard Air Line vs. Atlanta, Birmingham & Atlantic.*

Prices in Effect on Date of Repairs to Govern Charges Under Rule 120

Seaboard Air Line Box cars No. 16464, 17676, 18240 and 18741 were set aside at the Rutherford, Pa., car shops of the Philadelphia & Reading in accordance with United States Railroad Administration Division of Operations Circular No. 20, and the recommendation that they be dismantled was submitted to the regional director on the prescribed form. On March 31, 1920, after the end of Federal control when Circular No. 20 was modified, these cars were reported to the owner for disposition under Rule 120. Inspection certificates dated December 19, 1919, were submitted with an estimate of $1,900.34 covering the total cost for general repairs to the four cars. This estimate did not include betterments or the percentage allowed under Rule 106.

The Seaboard Air Line authorized that these cars be repaired, with betterments, under date of April 23, 1920. The Reading, although admitting that it was obliged to repair these cars, contended that they should be dismantled owing to their age and worn out condition, and set forth that its shop situation was such that they could not be rebuilt with any degree of promptness. The Seaboard Air Line claimed that the Reading arbitrarily delayed repairs approximately a year and a half; also, that the cost of these repairs should not exceed the total estimate, plus $50 per car and betterments, and 30 per cent, under Rule 106, added to the total. On this basis, the owner estimated that the total cost of repairing the four cars, at the time of authorization, should have been $3.567.41. The repairing line contended that the bill, based on the rules in effect on the date the repairs were made, should be accepted.

The Arbitration Committee decided that the prices in effect on the date the repairs were completed should govern.—*Case No. 1268, Seaboard Air Line vs. Philadelphia & Reading.*

Labor Allowance for Applying Draft Gear Bolts

The labor allowances contained in Rule 107 of the 1921 Code omit a specific charge for the application of yoke bolts. The St. Louis-San Francisco billed the Missouri, Kansas & Texas one hour for this operation as formerly allowed for several years under this rule. The owner declined to accept the charge of one hour, claiming that it should be reduced to .4 hours as per Item 91 of the 1921 Code. After the exchange of several letters, Supplement No. 2 was issued allowing .6 hours for this operation. The St. Louis-San Francisco then reduced their charge to .6 hours. The Missouri, Kansas & Texas still declined to accept the reduced charge on yoke bolts applied prior to the issuance of Supplement No. 2, contending that the labor allowance should be reduced to .4 hours.

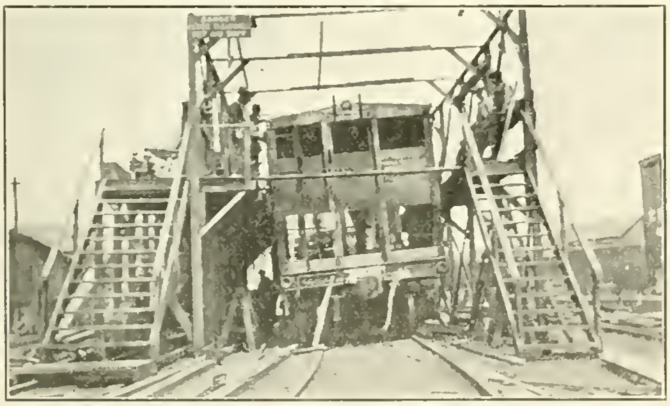
The Arbitration Committee sustained the objection of the Missouri, Kansas & Texas, stating that Item 91, Rule 107, applies to repairs made prior to July 1, 1922, in the absence of a specific allowance for the bolts in question—*Case No. 1,269 St. Louis-San Francisco vs. Missouri Kansas & Texas.*

Repairing Freight Cars By Progressive Methods

By W. W. Warner

Works Manager, Youngstown Equipment Company

A practical application of the "straight line" system in repairing steel frame box cars is being used in the Kent shops of the Youngstown Equipment Company. The cars are spotted at station No. 1, where a complete inspection is made, the defective parts marked and all defective wood work, old bolts, nails and broken parts removed from the car. All dope is removed from the journal boxes. This station is under the supervision of an assistant foreman, who performs the work with an inspector and eight carmen.



Permanent Scaffolds at Station No. 4

The car is then switched to station No. 2 where all the metal parts of the body are repaired or renewed by a gang consisting of an inspector and 30 carmen under an assistant foreman. They are then moved to station No. 3, on what is known as the "build-up" track. Here the work of applying the flooring, sheathing, roofing, doors and safety appliances is performed. Permanent scaffolds, shown in the illustration, with wide platforms are used for the roof gangs. The roofing material is piled on this scaffold within easy reach of the workman. Items of small material, such as bolts, nuts, washers, screws, etc., are placed in small bins where the workmen can reach them by simply turning around. These bins are kept supplied with material at all times by the material deliverers.

Cars Undergoing Repairs At Station Number 6.

The workmen at this station are divided into two gangs under an assistant foreman. Eighteen men are used to jack up and set the bodies on trestles, repair the trucks, pack journal boxes, apply and bolt the floor, perform the air brake work and jack the car down on the trucks. A gang of six men under the same assistant foreman, puts on the side doors and safety appliances.

The cars are moved along the "build-up" track to station No. 4 by means of a flexible wire rope attached to an air driven winch. This rope is equipped with "S" hooks every 50 ft. so that it can be hooked to any car on the track. At this station the roof purlines, ridge pole, facing, roof sheets, nailing strips, roof boards and running boards are applied. The work at stations No. 4 and 5 are under the direction of the same assistant foreman. Ten carmen are detailed to do the work at station No. 4. At station No. 5, the work of applying the side and end lining is taken care of by nine carmen.

After the work at station No. 6 has been completed, the cars are placed on the paint track, station No. 7, where three painters clean the exterior surface and apply the first and second coats. The painting is done with an air spray. Paint and other materials are delivered to the proper station by electric trucks. This method of delivery, on account of the large quantity of material used has effected considerable saving.

The work of stations No. 7 and 8 is under the supervision of the same assistant foreman. At station No. 8, one painter does the work of stencilling and an inspector employs part of his time in testing the air brakes and making the final inspection.

Air motors are used for all boring. Special screw drivers are used in air motors for driving screws in roofs and running boards. Socket wrenches are used in the same manner for tightening the ½-in. nuts on bolts that secure the side and end sheathing and the flooring. An air motor driven circular saw is used to cut off the roof boards.

A Mathematical Law of Impact Between Cars

A Study of the Time of Partial and Full Draft Gear Closures, Checked by U. S. R. A. Test Results

By E. M. Richards

THE function of a draft gear, as is well known, is to equalize velocities between adjacent cars without injury to the car structures. It is often supposed, however, that in thus minimizing shocks more time is taken by a draft gear for dissipating the energy of severe run-ins or pull-outs than for milder cases. Putting it another way, it is frequently believed that more time is required for a draft gear to be compressed to its full travel—the entire travel for which the gear is designed—by a given train action than for it to be forced through only a portion of that travel by a train action of lesser magnitude.

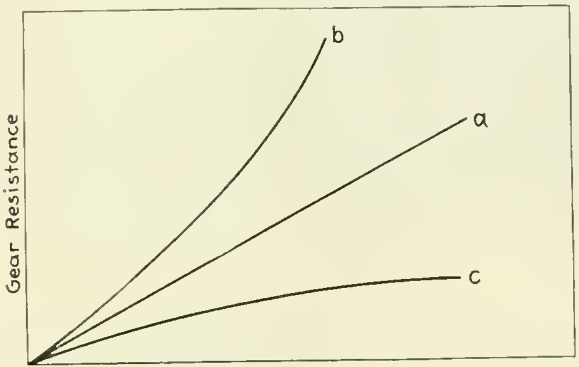


Fig. 1

But the truth of the matter is that the time in each instance is substantially the same. In other words, for given gears in given cars, the maximum gear closure—not necessarily full gear travel—on each impact, whether it be ½ in., 1 in., 2 in. or full gear travel, takes practically the same length of time.

These latter statements, however, are subject to qualification, because there is some variation in time, although not usually a great deal, depending upon the shape of the "gear resistance-gear travel" curve. If a straight line relation exists between gear resistance and gear travel, as shown by curve *a* in Fig. 1 and as usually assumed when a study of draft gear action is made, then the times are exactly the same. If the line bends upward, as shown by curve *b*, Fig. 1, then strange though it may appear at first thought, the farther a draft gear is driven inward on different impacts, the shorter the time of its compression travel, *i. e.*, the more severe train actions are dissipated in a briefer time than those of lesser degree. Only when the line bends downward, as in curve *c*, Fig. 1, does the gear perform as one would ordinarily expect, and take a longer time for its travel the farther it is driven in on different impacts.

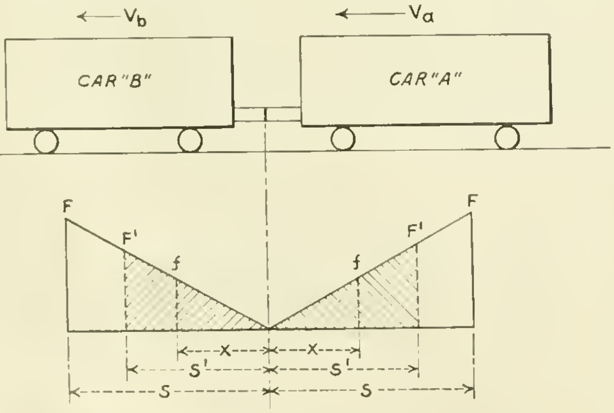


Fig. 2

The validity of these statements can be established from the report of the United States Railroad Administration draft gear tests,* with which tests the author was connected. Before going into these data, it should be borne in mind that, in addition to draft gear action, the figures of these tests must necessarily include the influence of car resistance, grade, the variation in the coefficient of friction with different rates of movement of the frictional elements at various degrees of impact and the fact that gears perform somewhat different every time they are operated. While academically exact figures cannot be expected, yet with all these outside influences, the test results, as will be seen, unquestionably establish the truth of these statements.

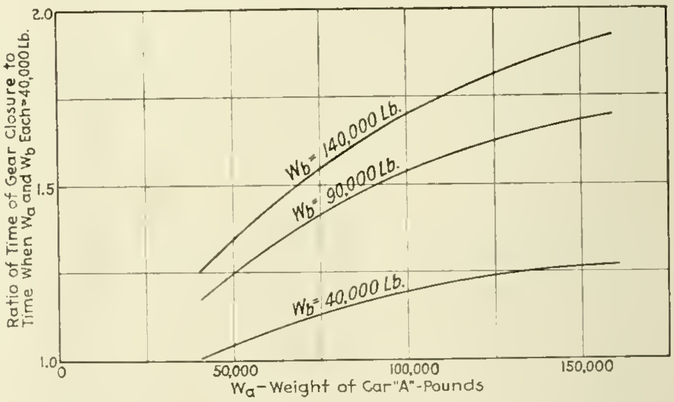


Fig. 3

One more digression must be made before getting into the question of time as shown by the tests. Reference is made in the present article to the "gear resistance-gear travel" curve. This curve must not be mistaken for the well known static diagram, for which the latter gives a "gear resistance-gear travel" relation, the U. S. R. A. tests show that it is not at all like the dynamic diagram developed by the same gear during impact in a car, either in size or general shape. This can be appreciated by comparing the static diagram of the Westinghouse NA-1 gear on page 45 of the test report with the dynamic diagram on page 172 and by similar comparisons of the Sessions K gear on pages 46 and 158, and the Cardwell G-25-A gear on pages 48 and 207. Not only are the general shapes entirely different, but the resistance values also. For instance, the Westinghouse NA-1 gear showed at 1½ in. travel on static test, 360,000 lb. and 490,000 lb. resistance and on the dynamic test, 60,000 lb. and 110,000 lb.; the Sessions K gear at 1½ in. travel on static test developed 290,000 lb. and 460,000 lb. and on dynamic test, 110,000 lb. and 160,000 lb.; the Cardwell G-25-A gear at 2 in. travel on static test developed 270,000 lb. and 300,000 lb. and on dynamic test, 60,000 lb. and 90,000 lb. Since it is the dynamic relation which obtains during impact, this is the relation considered in this article.

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*Published in book form in 1921, by the Simmons-Boardman Publishing Company. References in the article are to this book.

With the foregoing in mind, the times of maximum gear travel for different impacts for both partial and full gear closure, as taken from the U. S. R. A. tests and tabulated in Table I, may be considered. The first column under "Time of Partial and Complete Closure" is for compression movements less than the full travel as developed with an initial velocity difference of approximately one mile an hour; the second column is for full gear travel developed with a velocity difference of two to five miles an hour, depending on the capacity of the various gears.

Table I—Time of Partial and Complete Gear Closure

Compiled from Pages 122-127, U. S. R. A. Tests

Name of gear	Amount of draft gear closure, inches (Average of both gears)		Time of partial and complete closure, seconds	
	At 1 m.p.h. initial velocity difference	At initial velocity difference just sufficient to close gears. (Approximately 2 to 5 m.p.h.)	At 1 m.p.h. initial velocity difference.	At initial velocity difference just sufficient to close gears. (Approximately 2 to 5 m.p.h.)
National H-1	.63	2.53	.092	.091
Sessions K	.54	2.03	.075	.095
Miner A-18-S	.32	2.61	.065	.098
Westinghouse NA-1	.81	2.98	.143	.124
National M-1	.55	2.61	.092	.104
Sessions Jumba	.57	2.92	.097	.121
National M-4	.55	2.49	.093	.111
Cardwell G-18-A	.66	3.21	.119	.144
Cardwell G-25-A	.30	2.76	.072	.116
Westinghouse D-3	1.20	2.48	.173	.112
Gould 175	.82	2.48	.148	.114
Murray H-15	.66	2.60	.126	.127
Christy	.42	2.15	.063	.104
Miner A-2-S	.40	2.52	.074	.138
Waugh plate	1.17	2.31	.189	.116
Bradford K	1.34	2.45	.211	.137
Harvey	1.31	1.86	.206	.117
Coil springs	.99	1.90	.164	.175
Average	....	....	.117	.119

Table II—Comparison of Calculated and U. S. R. A. Test Results on Time of Draft Gear Closure

	s	E		t Time of closure, seconds	
Name of gear	Amount of full draft gear travel, inches. (Average of values in columns 12 and 13 plus ½ values in column 14, pages 122-123 U. S. R. A. tests)	Energy taken up by gears, ft. lb. (One-half of values in Column 19, pages 122-123 U. S. R. A. tests)	$\sqrt{E}$	By formula (16)	U. S. R. A. tests, Column 15, pages 122-123 U. S. R. A. tests
National H-1	2.62	63,150	252	.091	.091
Sessions K	2.19	46,910	216	.088	.095
Miner A-18-S	2.70	48,900	221	.106	.098
Westinghouse NA-1	3.06	42,550	206	.129	.124
National M-1	2.71	44,796	211	.112	.104
Sessions Jumbo	3.00	45,370	213	.122	.121
National M-4	2.56	41,800	204	.110	.111
Cardwell G-18-A	3.29	36,465	191	.149	.144
Cardwell G-25-A	2.83	40,319	200	.123	.116
Westinghouse D-3	2.54	32,719	181	.122	.112
Gould 175	2.57	31,148	177	.127	.114
Murray H-15	2.68	29,210	171	.136	.127
Christy	2.23	34,115	185	.105	.104
Miner A-2-S	2.66	25,308	159	.145	.138
Waugh plate	2.39	22,433	149	.140	.116
Bradford K	2.53	18,963	137	.161	.137
Harvey	1.92	13,324	115	.145	.117
Coil springs	1.91	8,333	91.3	.182	.175

From the table it will be noted that the Waugh and Harvey gears take less time for complete closure than for partial closure, the times being .116 and .117 seconds for complete closure against .189 and .206 seconds for partial closure, respectively. The resistance-travel dynamic curves of these gears are upward like curve *b* of Fig. 1 (pages 248 and 260).

On the other hand, the Cardwell G-18-A and Miner A-2-S gears take more time for complete closure than for partial closure, the times being .144 and .138 seconds for complete closure against .119 and .074 for partial closure, respectively. The resistance-travel dynamic curves of these gears are downward like curve *c* of Fig. 1 except at the very end of the travel (pages 200 and 242).

The coil springs take nearly the same time for full and partial closure, the times being .175 seconds for complete closure and .164 seconds for partial closure. The resistance-travel dynamic curves of this gear are nearly straight like curve *a* of Fig. 1 (page 265). The most difficult curve to get test figures on is this straight one, as all the test curves are irregular, some tending downward at the outset and upward at the end of travel. The closest approach to a straight line would probably be a composite curve of all the curves, under which condition the various irregularities would be nearly ironed out. In this event, if the statements made at the outset are correct, then this composite curve should show the same time for complete as for partial closure. This is exactly what happens, as seen from Table I, for the average time for complete closure is .119 seconds against an average time of .117 seconds for partial closure, a difference of but little more than one per cent.

These gear performances, however, are not at all peculiar, for a little study will show that they are functioning exactly according to physical laws. The author will attempt to prove that such is the case.

Let us consider the condition where two cars have draft gears of the same capacity whose dynamic diagrams on compression follow a straight line, as curve *a*, Fig. 1 in which the following symbols represent:

s' = the maximum gear travel (not necessarily the full gear travel) for a given impact, in inches.
s = the full gear travel (maximum possible), in inches.
f = the gear resistance for any gear travel x, in lb.
F' = the gear resistance at the maximum gear travel s', for a given impact, in lb.
F = the gear resistance for the full gear travel s, in lb.
g = the acceleration of gravity, 32.2 ft. per sec. per sec.
S_a = the distance covered by car A during the period of gear compression, in ft.
S_b = the distance covered by car B during the period of gear compression, in ft.
t = the time of impact from the start up to the point of maximum compression for a given impact, in seconds.
V_a = the velocity of car A just before impact, in ft. per sec.
V_b = the velocity of car B just before impact, in ft. per sec.
W_a = the gross weight of car A, in lb.
W_b = the gross weight of car B, in lb.
x = any amount of gear travel at any time during an impact, inches.
E = energy taken up by gears at maximum gear closure, in ft. lb.

The two cars are represented in Fig. 2. Just at the point of impact, car *A* has a velocity of V_a and car *B* a velocity of V_b. These velocities may be of any magnitude with both in the same or opposite directions, but for simplicity the velocities will be considered in the same direction with V_a greater than V_b. As soon as impact begins these velocities change, so the velocities of cars *A* and *B* may be represented by the differential quantities $\frac{dS_a}{dt}$ and $\frac{dS_b}{dt}$.

The bodies of the cars then approach each other at a rate equal to $\frac{dS_a}{dt} - \frac{dS_b}{dt}$, which difference equals the sum of the rates at which both draft gears are compressed, or half this difference is the rate at which one gear is compressed, $\frac{1}{12}\frac{dx}{dt}$, viz.,

$$\frac{1}{12}\frac{dx}{dt} = \frac{1}{2}\left[\frac{dS_a}{dt} - \frac{dS_b}{dt}\right] \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

It is also known from the laws of momentum that the sum of the products of the velocities by their respective masses at any instant during impact equals the sum of the products of the velocities by their respective masses just before impact, that is

$$\frac{W_a}{g}\frac{dS_a}{dt}+\frac{W_b}{g}\frac{dS_b}{dt}=\frac{W_aV_a}{g}+\frac{W_bV_b}{g}$$

Or

$$\frac{dS_b}{dt}=\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_adS_a}{W_bdt}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Substituting (2) in (1)

$$\frac{dx}{dt}=6\left[\left(\frac{dS_a}{dt}-\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_adS_a}{W_bdt}\right)\right]$$

Collecting terms

$$\frac{dx}{dt}=\frac{6}{W_b}\left[(W_a+W_b)\frac{dS_a}{dt}-(W_aV_a+W_bV_b)\right]\ldots\ldots\ldots(3)$$

In order to obtain a workable equation, the terms of equation (3) should be converted into terms of draft gear travel and force.

The term $\frac{dS_a}{dt}$ can be eliminated by an energy equation. In other words, the kinetic energy in car A, $\frac{W_a}{2g}\left\{\frac{dS_a}{dt}\right\}^2$, plus the kinetic energy in car B $\frac{W_b}{2g}\left\{\frac{dS_b}{dt}\right\}^2$, plus the energy taken up by both gears in traveling inward a distance x in developing a force from o to f, $\frac{2fx}{12\times 2}$, at any time during impact equals the kinetic energy in both cars just before impact, $\frac{W_aV_a^2+W_bV_b^2}{2g}$. Whence

$$\frac{W_a}{2g}\left(\frac{dS_a}{dt}\right)^2+\frac{W_b}{2g}\left(\frac{dS_b}{dt}\right)^2+\frac{fx}{12}=\frac{W_aV_a^2+W_bV_b^2}{2g}\ \ldots\ldots\ldots(4)$$

Substituting equation (2) in equation (4)

$$\frac{W_a}{2g}\left(\frac{dS_a}{dt}\right)^2+\frac{W_b}{2g}\left[\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_a}{W_b}\frac{dS_a}{dt}\right]^2+\frac{fx}{12}=\frac{W_aV_a^2+W_bV_b^2}{2g}$$

Dividing by $\frac{W_a}{2g}$ and expanding the second term

$$\left(\frac{dS_a}{dt}\right)^2+\frac{1}{W_aW_b}\left[(W_aV_a+W_bV_b)^2-2W_a(W_aV_a+W_bV_b)\frac{dS_a}{dt}+\left(W_a\frac{dS_a}{dt}\right)^2\right]+\frac{gfx}{6W_a}=\frac{W_aV_a^2+W_bV_b^2}{W_a}$$

Grouping the terms according to the degree of $\frac{dS_a}{dt}$,

$$\left(1+\frac{W_a}{W_b}\right)\left(\frac{dS_a}{dt}\right)^2-2\frac{(W_aV_a+W_bV_b)}{W_b}\frac{dS_a}{dt}=\frac{W_aV_a^2+W_bV_b^2}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_aW_b}-\frac{gfx}{6W_a}$$

Dividing by $\left(1+\frac{W_a}{W_b}\right)$

$$\left(\frac{dS_a}{dt}\right)^2-2\frac{W_aV_a+W_bV_b}{W_a+W_b}\frac{dS_a}{dt}=\frac{W_aV_a^2+W_bV_b^2}{W_a+W_b}\frac{W_b}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_a+W_b}\frac{1}{W_a}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}$$

Completing the terms for solving the second degree equation

$$\left(\frac{dS_a}{dt}\right)^2-2\frac{W_aV_a+W_bV_b}{W_a+W_b}\frac{dS_a}{dt}+\left(\frac{W_aV_a+W_bV_b}{W_a+W_b}\right)^2=\left(\frac{W_aV_a+W_bV_b}{W_a+W_b}\right)^2+\frac{W_aV_a^2+W_bV_b^2}{W_a+W_b}\frac{W_b}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_a+W_b}\frac{1}{W_a}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}$$

Taking the square root and combining terms

$$\frac{dS_a}{dt}-\frac{W_aV_a+W_bV_b}{W_a+W_b}=\sqrt{\frac{W_b^2(V_a^2-2V_aV_b+V_b^2)}{(W_a+W_b)^2}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}}$$

Simplifying:

$$\frac{dS_a}{dt}=\frac{W_aV_a+W_bV_b+\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}}{W_a+W_b}\ \ldots\ldots(5)$$

The next step, as already mentioned, is to convert V_a and V_b into terms of draft gear travel and resistance. To accomplish this, the fact can be used that the difference between the kinetic energy just before impact and the kinetic energy at maximum gear travel for the particular impact, $\frac{W_aV_a^2+W_bV_b^2}{2g}-\frac{W_a+W_b}{2g}\left\{\frac{W_aV_a+W_bV_b}{W_a+W_b}\right\}^2$, equals the energy taken up by the gears at the maximum travel (not necessarily the maximum possible travel of gear) of the given impact $\frac{2F^1s^1}{12\times 2}$, viz.,

$$\frac{W_aV_a^2+W_bV_b^2}{2g}-\frac{(W_aV_a+W_bV_b)^2}{2g(W_a+W_b)}=\frac{F's'}{12}$$

Expanding

$$W_a^2V_a^2+W_aW_bV_b^2+W_aW_bV_a^2+W_b^2V_b^2-W_a^2V_a^2-2W_aW_bV_aV_b-W_b^2V_b^2=(W_a+W_b)\frac{gF's'}{6}$$

That is

$$W_aW_b(V_a^2-2V_aV_b+V_b^2)=\frac{gF's'}{6}(W_a+W_b)\quad(V_a-V_b)^2=\frac{gF's'}{6}\frac{W_a+W_b}{W_aW_b}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Substituting (5) in equation (3)

$$\frac{dx}{dt}=\frac{6}{W_b}\left[(W_a+W_b)\times\frac{W_aV_a+W_bV_b+\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}}{W_a+W_b}-(W_aV_a+W_bV_b)\right]$$

Combining terms

$$\frac{dx}{dt}=\frac{6}{W_b}\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}\ \ldots\ldots\ldots\ldots\ldots(7)$$

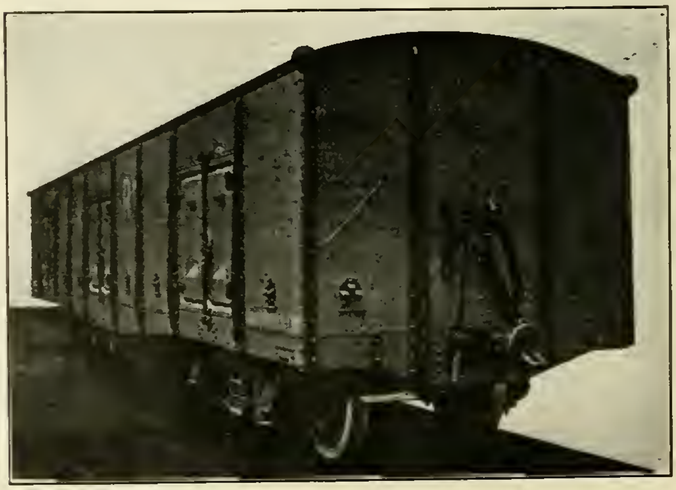
Substituting (6) in (7)

$$\frac{dx}{dt}=\frac{6}{W_b}\sqrt{W_b^2\frac{gF's'}{6}\frac{W_a+W_b}{W_aW_b}-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}$$

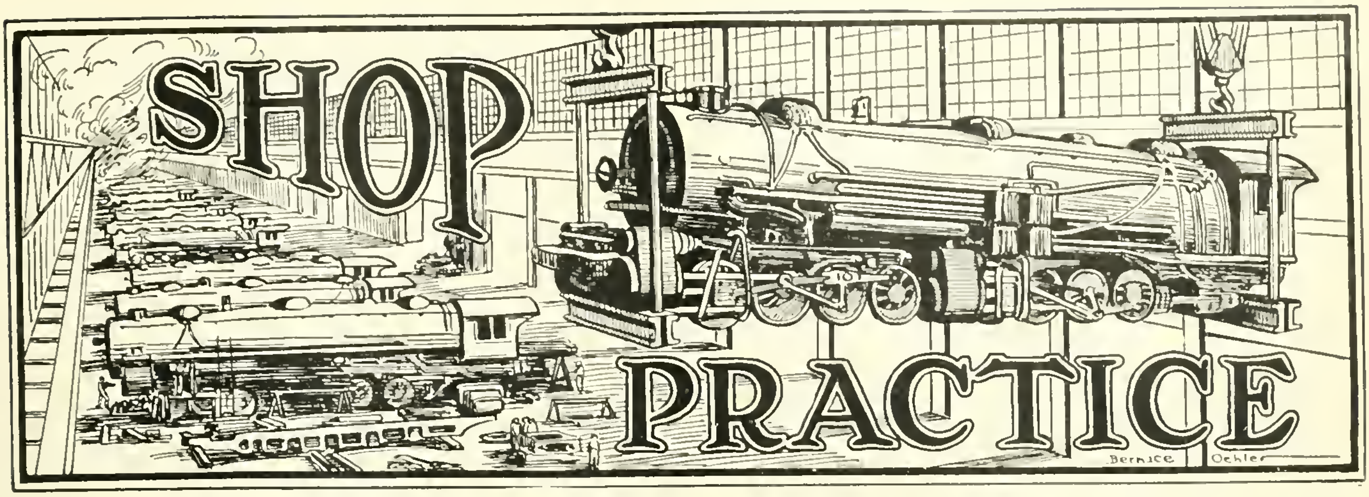
Simplifying

$$\frac{dx}{dt}=\sqrt{\frac{6g(W_a+W_b)}{W_aW_b}(F's'-fx)}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

(The balance of this article, including the conclusions arrived at, will be given in the next issue.)



A 50-Ton All-Steel Gondola in South Africa



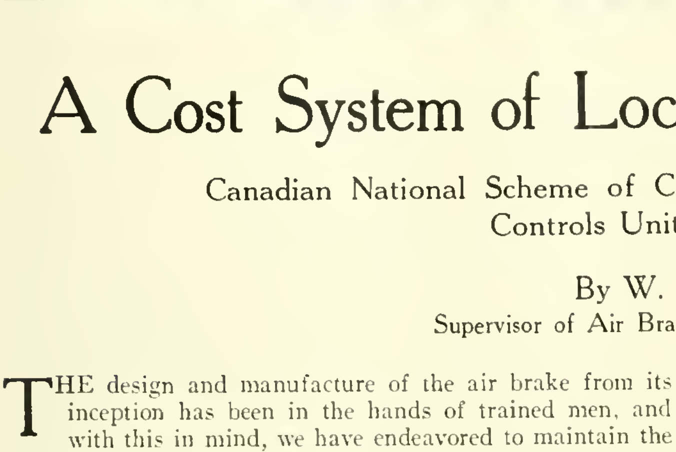
A Cost System of Locomotive Brake Repairs*

Canadian National Scheme of Centralizing This Work Effectively Controls Unit Expenditures

By W. H. Clegg
Supervisor of Air Brakes, Canadian National

THE design and manufacture of the air brake from its inception has been in the hands of trained men, and with this in mind, we have endeavored to maintain the equipment in order to permit of it to function as intended by the designer, rather than to encourage our men to make changes in the design supposed to overcome some difficulties that would not exist with only reasonably good maintenance.

We have inaugurated a comprehensive system of handling locomotive air brake work, which had for its original purpose the minimizing of locomotive failures chargeable to brake parts. The system contemplates that only certain light repairs will be made in engine houses, as outlined in the standard practice cards distributed to all concerned. Parts requiring repairs not authorized at such places are changed, the removed parts being promptly turned over to the stores department for shipment to designated repair points. Permissible repairs to air pumps in engine houses are shown on standard practice card No. 311.† All divisional points are supplied with complete compressor governors, compressors, distributing valves and all other parts enumerated in the forms illustrated.



CANADIAN NATIONAL RAILWAYS

STATEMENT OF STANDING STORE ORDERS FOR AIR BRAKE

MATERIAL REPAIRED AT DURING 192

DESCRIPTION	S. O. No.	No. Rep'd	Labour	Shop Expense	Material	Shop Expense	Total	Unit Cost
Triple Valves	1							
Feed & Red. Valves	2							
Distributing Valves	3							
Signal Valves	4							
Check Valves	5							
Brake Valves	6							
Boiler Check Valves	7							
Air Gauges	8							
Steam Gauges	9							
8½" Pumps	10							
9½" Pumps	11							
11" Pumps	12							
Pump Top Heads	13							
Pump Governors	14							
Inspirators & Injectors	15							
Lubricators	16							
Steam Hose	17							
Air Hose	18							
Signal Hose	19							
Angle Cocks	20							
Cut Out Cocks 1¼"	21							
Cut Out Cocks 1	22							
Cut Out Cocks ¾"	23							
Cut Out & Drain Cocks ½"	24							
Conductor's Valve	25							
Retaining Valves	26							
Release Valves	27							

For Auditor of Stores & Mechanical Accounts

Monthly Statement Furnished by the Auditor for Each Repair Point

Our experience has taught us that light repairs are seldom required when parts are properly installed and thoroughly overhauled at the main repair points. Limiting the engine house repairs has enabled us to effect very large reductions of air brake material in stock at all points other than where the repairs are effected.

For the purpose of illustrating the operation of the system take a No. 5 compressor governor found defective. It is removed complete and delivered to the local storekeeper, together with a signed requisition for one No. 5 compressor governor, which will be a repaired one taken from his stock and charged out to the engine at the unit cost of repairs to pump governors for the preceding month. This enables the engine house staff to apply the complete governor and O. K. the engine. The storekeeper will forward the removed governor to his department at the designated repair point, forwarding by mail a requisition covering one No. 5 compressor governor for repairs, indicating on the requisition the shipping tag number and how the governor was shipped. The receiving section of the stores department at the repair point, upon receipt of the requisition and governor, advise their shipping section to ship one No. 5 compressor governor to the local storekeeper on his requisition No. ——. The receiving section now delivers the defective pump governor to the Air Brake Repair Shop, obtaining the air brake foreman's receipt for it. The governor is duly cleaned, repaired and tested along with all other such valves in for repairs, after which it is delivered to the stores department which receipts for this and other items listed under the same shop order number. The governor is then placed in the stores stock ready for shipment again.

The shipping of all these parts back and forth is an item requiring some little effort and attention, but the result from centralizing this work is most gratifying. It is necessary, of course, that the work at the repair points be well in hand. By this we mean that the stores department must be kept supplied with a sufficient quantity of complete repaired parts with which quickly to make return shipments to division points.

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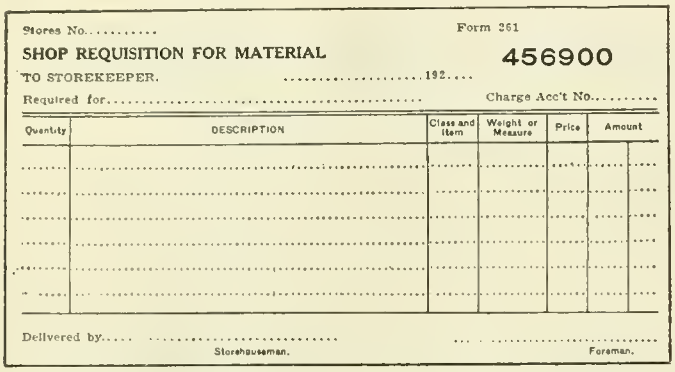
*This is an abstract of a paper read before the Air Brake Association Convention, at Denver, Colo., May 1 to 4, 1923.

†This card contains instructions for washing out air compressors, which is done once every three months, and lists the following permissible repairs: Removing and replacing top and bottom heads, right and left main valve cylinder heads; renewing reversing valve rods; renewing upper steam or lower air cylinder gaskets; renewing air valves or valve cages; maintaining oil cups, strainers and piston rod packing.

To facilitate the shipping of these parts and to simplify the clerical work on the part of the stores and air brake repair departments, our auditor of stores and mechanical accounts issued a standing store order for the repairs of each part of the Westinghouse brake equipment, as shown in the second column of Fig. 6. All labor, material and shop expenses are charged to their respective store orders and computed at the end of each month by the auditor of stores and mechanical accounts, who supplies us with a statement from each repair point of the material repaired on each standing shop order.

Figures from these statements are then taken by the supervisor of air brakes to prepare a comparative monthly statement showing the standing of the various repair points, a copy of which is forwarded to general superintendents of rolling stock, shop superintendents, traveling air brake inspectors and air brake foremen, together with a letter commenting on the items requiring investigation.


Stores No..........

Form 261

SHOP REQUISITION FOR MATERIAL

456900

TO STOREKEEPER. ....192....

Required for.. Charge Acc't No.........

Quantity	DESCRIPTION	Class and Item	Weight or Measure	Price	Amount

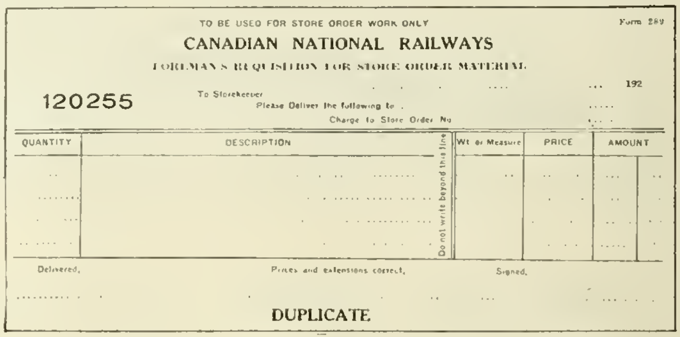
Delivered by..... .... Storehouseman. .... Foreman.

Form 261—Requisition for Complete Parts Applied to Locomotives in the Repair Shops

At the end of each month, the air brake foreman delivers to the stores and mechanical accountant, at the repair point, all his receipts for material delivered to the stores department for that month, all requisitions for complete parts given out to general repair shop for application to repaired engines for that month on Form 261 and also Form 289, showing all material requisitioned during the month, together with Form 274, showing unused material he may have on hand at the end of the month, which will be credited to the respective store orders. This information is required by the auditor when making up his monthly statement of costs on which he shows the quantity of parts repaired on each store order, and from which the unit prices for parts issued the following month are based.

Among the illustrations are shown a copy of the monthly statement for April, 1922, showing the quantity and the unit costs of each part repaired at each repair point. The copy of the quarterly statement for April 1 to June 30, 1922, gives an average that is more representative of our performance than the monthly statement. The semi-annual statement shows condensed data on costs, mileage, brake failures, etc. Copies of this statement for the periods from January 1 to June 30, 1922, and July 1 to December 31, 1922, are presented to show the increase in mileage per repair, reduction of unit costs and reduction of brake failures in the second period as compared with the first period. This statement, not shown, is also compiled for the entire 12 months' period.

It may occur to some that a greater number of complete parts are required to effect repairs under this system. While this may be true, it does not mean that additional new and complete parts must be purchased. This was a matter about which we were in doubt at the time we introduced these methods, but we very soon found that by the time we shipped in to the repair points all the defective, or bad order parts, found lying around our different shops and engine houses, we had an abundance of material to supply the outside points when put in serviceable condition. Furthermore, we also had, generally speaking, a liberal supply of parts to repair these different pieces of the equipment, when we removed all the surplus material in stores stock at all outside points, to the stores at the designated repair point.


TO BE USED FOR STORE ORDER WORK ONLY

Form 289

CANADIAN NATIONAL RAILWAYS

FOREMAN'S REQUISITION FOR STORE ORDER MATERIAL

120255

192

To Storekeeper

Please Deliver the following to

Charge to Store Order No

QUANTITY	DESCRIPTION	Wt or Measure	PRICE	AMOUNT

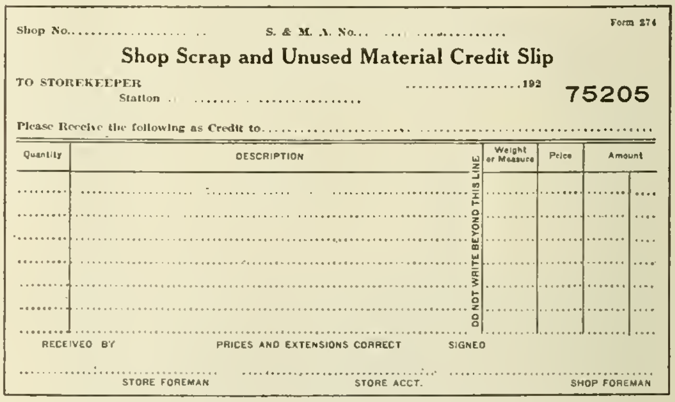
Do not write beyond this line

Delivered, Prices and extensions correct, Signed,

DUPLICATE

Form 289 Covers Material Used on Store Order Work

All requisitions for air brake material from divisional points to district or headquarter stores are subject to the traveling air brake inspector's approval. In addition to this, all storekeepers are provided with a list of parts to be carried in stock at their station. The district or headquarter stores will not ship to outside points any material not included in these lists. This double check on the material makes it impossible for these points to get material other than that required to maintain the equipment in accordance with standard practice cards. It is impossible to establish a satisfactory system unless you also control what particular parts shall be supplied. We are in very close touch with our stores department, and these relations are most helpful to us in our efforts to enforce adherence to our regulations. Occasionally complaints come in with regard to delayed shipments, but generally speaking, our stores department takes care of the situation very well.


Shop No.................... S. & M. A. No.................

Form 274

Shop Scrap and Unused Material Credit Slip

TO STOREKEEPER 192

Station ....

75205

Please Receive the following as Credit to..

Quantity	DESCRIPTION	Weight or Measure	Price	Amount

DO NOT WRITE BEYOND THIS LINE

RECEIVED BY PRICES AND EXTENSIONS CORRECT SIGNED

STORE FOREMAN STORE ACCT. SHOP FOREMAN

On Form 274 Is Listed All Unused Store Order Material In the Shop at the End of the Month

Our traveling inspectors check over the train records for each 24 hours, investigate all brake failures and delays and report their findings. In addition to this, the general master mechanics supply us with a copy of the monthly statement of engine failures, which are checked and recorded each month against the inspector's report. The nature of each brake failure is carefully noted, and action taken as far as possible to prevent a recurrence. Our bureau of statistics supplies a monthly statement of locomotive mileage which forms the basis of our records and permits a comparison of the service results of the various divisions per 100,000 locomotive miles.

The original purpose of all this was to obtain something tangible showing the character and extent of our locomotive brake failures, and the records now show the number to have been reduced from .41 to .25, or less than half of one failure for every 100,000 locomotive miles. A patient study of the failures as they occur has emphasized the need for better methods of installation, and our own shops, as well as

CANADIAN NATIONAL RAILWAYS

STATEMENT SHOWING COST OF REPAIRS TO AIR BRAKE MATERIAL ON STANDING MONTHLY STORE ORDERS AT THE GENERAL SHOPS

APRIL, 1922

DESCRIPTION	Store Order No.	MONCTON		WINNIPEG		TRANSCONA		ST. MALO		LEASIDE		SOUTH EDMONTON		NORTH EDMONTON	
		No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost
Triple Valves	1	432	1.37	824	.89	689	.64	8	1.59	240	.64	563	.88	842	.66
Feed & Red. Velves	2	66	2.64	143	1.22	51	1.52	38	2.80	41	1.55	53	1.04	41	1.93
Distributing Valves	3	..	...	15	13.08	21	5.99	7	4.77	8	2.91	19	5.00	23	2.95
Signal Valves	4	9	1.15	13	.81	13	1.47	11	2.94	5	1.00	1	.95	..	...
Check Velves	5	18	.93	35	.66	23	.54	11	.36	14	1.08	..	...	..	...
Brake Valves	6	19	4.69	48	2.30	32	7.65	12	2.78	12	1.77	4	4.83	3	4.88
Boiler Check Valves	7	6	4.87	..	...	13	37.71	8	4.48	..	...	..	...	1	13.42
Air Gauges	8	23	5.81	52	2.25	46	1.05	12	.77	22	.77	9	1.07	6	1.11
Steam Gauges	9	21	.83	47	2.58	23	1.67	14	.80	7	2.22	12	1.56	4	1.47
8½" C. C. Pumps	10	7	85.68	10	50.16	10	99.74	4	79.86	5	79.90	..	...	8	96.12
9½" Pumps	11	13	52.53	53	28.24	2	34.73	13	66.59	5	79.85	6	40.02	5	61.36
11" Pumps	12	2	86.50	..	...	7	71.63	2	105.78	..	...	..	...	..	...
Pump Top Heads	13	..	...	63	5.79	..	...	24	12.50	..	...	7	6.02	2	21.86
Pump Governors	14	18	3.03	27	3.65	31	5.21	15	5.64	16	5.13	10	4.80	10	4.64
Inspirators & Injectors	15	35	7.34	42	6.61	33	14.57	15	12.90	12	4.47	12	7.30	20	7.79
Lubricators	16	14	7.20	16	3.94	26	9.60	12	8.84	11	3.53	1	5.06	4	10.28
Steam Hose	17	255	3.56	217	3.25	213	3.37	..	...	..	...	..	...	..	...
Air Hose	18	846	1.30	505	1.79	465	1.50	..	...	..	...	..	...	..	...
Signal Hose	19	314	1.75	102	1.59	102	1.81	..	...	..	...	..	...	..	...
Angle Cocks	20	215	1.30	104	.49	212	.42	..	...	..	...	..	...	..	...
Cut Out Cocks 1¼"	21	141	.30	40	.93	..	...	..	...	..	...	..	...	..	...
Cut Out Cocks 1"	22	51	.57	18	.61	..	...	..	...	..	...	..	...	..	...
Cut Out Cocks ¾"	23	54	.60	..	...	..	...	..	...	..	...	..	...	..	...
Cut Out & Drain Cocks ½"	24	17	.25	..	...	..	...	..	...	..	...	..	...	..	...
Conductor's Valves	25	3	.34	..	...	..	...	..	...	..	...	..	...	..	...
Retaining Valves	26	62	.65	6	1.10	..	...	..	...	..	...	..	...	..	...
Release Valves	27	68	.56	100	.38	231	.25	..	...	..	...	..	...	..	...

W. H. CLEGG,
Supervisor of Air Brakes.

REMARKS:

CANADIAN NATIONAL RAILWAYS

QUARTERLY STATEMENT SHOWING AVERAGE UNIT COST OF REPAIRS TO ALL BRAKE MATERIAL FROM APRIL 1st, 1922, TO JUNE 30th, 1922, ON STANDING MONTHLY STORE ORDERS AT THE GENERAL REPAIR SHOPS

DESCRIPTION	Store Order No.	MONCTON		WINNIPEG		TRANSCONA		ST. MALO		LEASIDE		SOUTH EDMONTON		NORTH EDMONTON	
		No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost
Triple Valves	1	1529	1.36	2847	.92	2705	.59	37	1.47	710	.75	2044	.86	2130	.59
Feed & Red. Valves	2	169	3.28	511	1.32	190	1.56	159	2.15	125	1.33	129	2.11	223	2.12
Distributing Valves	3	12	6.06	66	9.43	84	5.73	23	4.32	30	3.43	39	5.98	68	3.75
Signal Valves	4	34	1.87	56	1.38	51	1.64	28	2.68	17	1.52	4	3.72	..	...
Check Valves	5	47	.83	136	.31	83	.57	44	.42	35	.64	1	.89	..	...
Brake Valves	6	59	3.84	137	2.19	121	5.73	45	2.87	34	2.10	9	4.41	11	3.42
Boiler Check Valves	7	18	3.89	..	...	49	24.35	8	4.48	..	...	..	...	5	11.65
Air Gauges	8	92	3.18	221	1.55	274	.80	61	.44	61	.85	20	1.25	30	1.12
Steam Gauges	9	98	1.27	154	1.81	177	1.13	32	.80	28	2.36	19	1.59	20	1.00
8½" C. C. Pumps	10	23	96.58	36	55.76	40	75.26	10	87.58	17	77.65	..	...	18	95.42
9½" Pumps	11	38	66.86	164	31.90	19	34.74	40	72.28	18	51.79	24	26.36	37	47.19
11" Pumps	12	18	56.18	..	...	21	44.30	2	105.78	..	...	..	...	5	77.26
Pump Top Heads	13	4	16.52	76	5.81	12	6.92	79	8.64	3	16.87	13	6.86	26	10.04
Pump Governors	14	66	5.25	122	3.63	90	4.66	52	6.04	38	6.08	27	4.51	36	4.28
Inspirators & Injectors	15	105	10.11	154	7.25	127	12.85	57	10.69	40	8.75	28	5.70	62	6.49
Lubricators	16	47	7.95	70	3.35	84	7.48	30	8.90	25	6.95	3	4.60	86	7.92
Steam Hose	17	817	3.10	592	3.03	445	2.66	..	...	155	2.51	..	...	18	6.12
Air Hose	18	2769	1.47	2498	1.54	955	1.63	..	...	565	1.79	..	...	483	1.73
Signal Hose	19	905	1.62	435	1.44	310	1.38	..	...	195	1.34	..	...	781	1.32
Angle Cocks	20	1275	.80	365	.59	379	.57	..	...	..	...	..	...	100	1.90
Cut Out Cocks 1¼"	21	433	.44	117	.63	72	.63	..	...	..	...	..	...	..	...
Cut Out Cocks 1"	22	122	.54	47	.48	31	.62	..	...	..	...	..	...	..	...
Cut Out Cocks ¾"	23	178	.49	..	...	..	...	..	...	..	...	..	...	..	...
Cut Out & Drain Cocks ½"	24	25	.31	..	...	..	...	..	...	..	...	..	...	..	...
Conductor's Valves	25	3	.34	..	...	..	...	..	...	..	...	..	...	..	...
Retaining Valves	26	103	.64	6	1.10	..	...	..	...	..	...	..	...	..	...
Release Valves	27	195	.49	100	.38	231	.25	..	...	..	...	..	...	..	...

W. H. CLEGG,
Supervisor of Air Brakes.

REMARKS:

CANADIAN NATIONAL RAILWAYS

STATEMENT OF PERFORMANCE AND COST OF AIR BRAKE MATERIAL REPAIRED
FROM JANUARY 1st, TO JUNE 30th, 1922

DESCRIPTION	Store Order No.	No. Repd.	Total Cost of Repairs	Total Engine Miles	Valves Rep'd Per 100,000 Mls.	Cost of Repairs Per 100,000 Mls.	Eng. Miles Per Valve Repair	Unit Cost Per Valve Repair	Brake Failure Per 100,000 Mls.
Triple Valves	1				X	X			
Feed & Red. Valves	2	3058	6,361.68	18,729,891	16.1	33.50	6,125	2.08	
Distributing Valves	3	648	4,106.83	"	3.4	22.00	28,904	6.34	
Signal Valves	4	357	628.23	"	1.8	3.25	52,465	1.76	
Check Valves	5	665	333.09	"	3.6	1.50	28,165	.50	
Brake Valves	6	771	3,161.67	"	4.1	16.75	24,293	4.10	
Boiler Check Valves	7								
Air Gauges	8	1396	1,847.83	"	7.6	10.00	14,133	1.32	
Steam Gauges	9								
8½" C. C. Pumps	10)								
9½" Pumps	11)	1090	54,782.49	"	5.9	297.75	17,181	50.27	.41
11" Pumps	12)								
Pump Top Heads	13	376	2,993.77	"	2.0	16.00	49,814	7.96	
Pump Governors	14	920	4,571.56	"	4.9	24.25	20,539	4.95	
Inspirators & Injectors	15								
Lubricators	16								
Steam Hose	17								
Air Hose	18								
Signal Hose	19								
Angle Cocks	20								
Cut Out Cocks 1¼"	21								
Cut Out Cocks 1"	22								
Cut Out Cocks ¾"	23								
Cut Out & Drain Cocks ½"	24								
Conductor's Valves	25								
Retaining Valves	26								
Release Valves	27								

REMARKS: X Decimal Figures are Approximate.
.43c per Locomotive Mile.

W. H. CLEGG,
Supervisor of Air Brakes.

Canadian locomotive builders, have joined with us heartily in an endeavor to effect improvements.

In dealing with that portion of the subject relating to maintenance cost, it will be interesting to note that while not intentional on the part of the management, a friendly rivalry has developed among the air brake foremen, and they await with keen interest the arrival each month of the comparative cost sheet. The discussion during our periodical meetings finds these gentlemen advancing the most logical reasons for modifying or discontinuing entirely certain practices, as a means of securing further reductions in costs, and mistakes in accounting cannot now easily pass the scrutiny of these men.

It is no longer possible for outside men to abuse air

CANADIAN NATIONAL RAILWAYS

STATEMENT OF PERFORMANCE AND COST OF AIR BRAKE MATERIAL REPAIRED
FROM JULY 1st TO DECEMBER 31st, 1922

DESCRIPTION	Store Order No.	No. Repd.	Total Cost of Repairs	Total Engine Miles	Valves Rep'd Per 100,000 Mls.	Cost of Repairs Per 100,000 Mls.	Eng. Miles Per Valve Repair	Unit Cost Per Valve Repair	Brake Failure Per 100,000 Mls.
Triple Valves	1				X	X			
Feed & Red. Valves	2	3477	5,377.36	24,294,950	14.3	22.25	6,987	1.55	
Distributing Valves	3	785	4,160.66	"	3.8	17.25	30,949	5.30	
Signal Valves	4	352	551.25	"	1.5	2.25	69,020	1.57	
Check Valves	5	632	211,97	"	2.6	.88	38,441	.34	
Brake Valves	6	783	2,074.89	"	3.2	8.50	31,028	2.65	
Boiler Check Valves	7								
Air Gauges	8	1374	1,397.98	"	5.6	5.75	17,682	1.02	
Steam Gauges	9								.25
8½" C. C. Pumps	10)								
9½" Pumps	11)	1010	.46,455.25	"	4.2	191.25	24,053	46.00	
11" Pumps	12)								
Pump Top Heads	13	125	1,271.56	"	.5	5.25	194,359	10.17	
Pump Governors	14	870	3,052.02	"	3.5	12.50	27,925	3.51	
Inspirators & Injectors	15								
Lubricators	16								
Steam Hose	17								
Air Hose	18								
Signal Hose	19								
Angle Cocks	20								
Cut Out Cocks 1¼"	21								
Cut Out Cocks 1"	22								
Cut Out Cocks ¾"	23								
Cut Out & Drain Cocks ½"	24								
Conductor's Valves	25								
Retaining Valves	26								
Release Valves	27								

REMARKS: X Decimal Figures are Approximate.
.27c per Locomotive Mile.

W. H. CLEGG,
Supervisor of Air Brakes.

brake parts by hammering, etc., without damage being noted by the air brake foreman. Since this increases his costs unnecessarily, he naturally enters a strong protest. The same applies to material purchased from manufacturers, or made in the company's own shop. The material must not require extra operations in order to make it serviceable, otherwise the foreman is liable to refuse acceptance, and the shop superintendent can not do otherwise than uphold his decision, if same conforms to reasons and proofs. Under this system the air brake foreman cannot afford to accept inferior material, nor use obsolete machinery, as it may affect both the cost and the quality of his work.

A noteworthy feature came to light during the inception of this work. Records showed repeatedly that the labor charge was much lower in certain shops than in others, while a knowledge of the working conditions indicated that the reverse should be the case. The fact soon developed that the shops referred to as being low in labor costs were using quantities of new material unnecessarily while the bills for new material in the other shops were appreciably lower.

Only a casual glance at this report is necessary to indicate that there is still much to be done; however, we have tried to apply as far as possible the valuable advice submitted in previous papers of this association. The air brake supervisor who fails to apply himself diligently to the task of eliminating waste and developing a repair cost system, is being deprived of a great opportunity for rendering really worth while assistance to the company he serves.

Locomotive Scheduling at the Silvis Shops

Part 5 — Performance Data

New System of Locomotive Scheduling Now Being Installed at the Silvis Shops of the C. R. I. & P.

By L. C. Bowes*, G. E. Sandstrom†, and H. K. Robinson‡

THE former articles have dealt primarily with the functions and routine of the locomotive scheduling system, together with the necessary organization for carrying it on and with predictions as to what the ultimate expectations would be with such a system when carried to 100 per cent completion.

After four months of actual operation, a very gratifying showing has been made, which substantiates the prediction that it would be possible to double the output of the locomotive shop by a systematic and co-ordinated effort of intensive analysis and a study by reason of centralized control and delegated authority.

The accompanying analysis reflects the uniform improvement made, month by month, during the last four months.

By reason of a close analysis of the schedule, it can be stated that the amount of work performed each month, as against the several classes of repair, was of uniform magnitude. In fact, during the last two months shown there was actually performed more work on light repairs for which no credit is shown.

By virtue of existing conditions, the policy adopted was that of maintaining an output and reducing the actual working force during this period. A further analysis, as predicted in previous articles, is based on the possibility of reducing the actual man hours per locomotive to 2,500. This, with a normal force of 1,000 men, would be the equivalent of an output of 75 locomotives per month, all of which would be heavy classified repairs.

A Month	B Monthly output locomotives	C Total man hours per month	D Average man hours per locomotive	E Decrease aver. man hours per locomotive, per cent	F Increased efficiency, per cent	G Equivalent monthly output, locomotives	H Equivalent increased efficiency, per cent
May	26	169,592	6,523	..	..	..	..
June	32	186,606	5,831	11	12	36	38
July	32	179,913	5,622	14	16	37	42
August	32	160,000	4,850	26	34	43	65
September	32	120,360	3,761	43	73	55	111

The following explanatory notes will serve to make the meaning of the above table clear:

Column A: Self explanatory.

Column B: Actual locomotives O.K'd to transportation department during month.

Column C: Actual man hours on classified repairs as reflected by actual analysis of production or work order tickets.

Column D: Average man hours per locomotive, arrived at by dividing "C" by "B."

Column E: Arrived at by dividing "D" for any month by "D" for May and subtracting from 100 per cent.

Column F: Arrived at by dividing "D" of May by "D" of any month and subtracting 100 per cent.

Column G: Arrived at by multiplying "D" of May by "B" of any month and dividing by "D" of the same month. (This is for the four months' analysis period only.)

Column H: Arrived at by dividing "G" of any month by "B" of May and subtracting 100 per cent. (This for the four months' analysis period only.)

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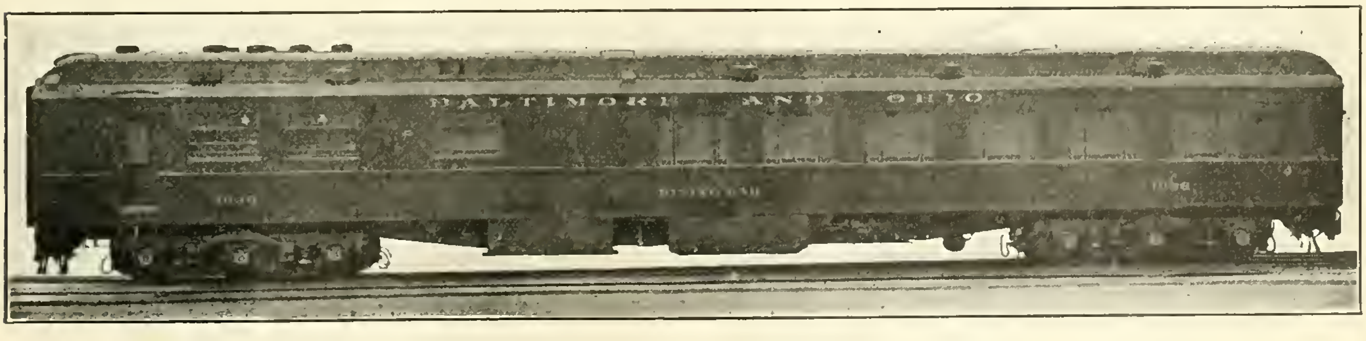
*Production engineer, C. R. I. & P.

†Industrial engineer, Roberts-Pettijohn-Wood Corporation.

‡Special accountant, C. R. I. & P.

* * *



The Two New Baltimore & Ohio Colonial Dining Cars are Named Martha Washington and Mount Vernon

Safety Suggestions of the Atlantic Coast Line

THE General Safety Committee of the Atlantic Coast Line is distributing a folder among mechanical department employees outlining a series of safety suggestions given below which, if always borne in mind, would result in a very noticeable reduction in the number of accidents.

1. Many accidents are due to handling material, to material falling and to men being caught between material. In lifting operations it is important in each movement that the men act in unison, both in taking hold and letting go.

2. When it is necessary to use runways, horses, ladders, scaffolds or other supports, employees should know by personal test, examination, or other sufficient methods, that they are in a safe condition and properly placed before being used.

3. Great care should be taken by men working above not to drop any material unless it is necessary; and then not without first giving due warning to those below.

4. When you complete a job, never leave tools or material overhead.

5. Crane men are forbidden to move load without a signal from the proper man and not to move crane without first sounding gong, nor raise the hook above limit switch.

6. Take no unnecessary chances in passing under a load being moved by crane or other mechanism.

7. In cutting off bolts or rivets, be very careful to see that the heads are not allowed to fly to where other workmen are passing or working. This should be avoided by holding a broom on same or making use of some other approved safety device to prevent injury.

8. Do not grind at emery wheels or operate a machine from which chips are flying without using goggles.

9. Do not use welding or cutting torch without using shield over your eyes.

10. Goggles furnished by the company should be worn at all times when there is danger of flying particles entering the eye. If you are in doubt, consult your foreman.

11. Covers for drop pits, manholes and other openings should be kept in place when not in use.

12. Do not attempt to operate a machine unless you are *thoroughly qualified* in its operation. Do not work with any machine unless authorized by the foreman in charge.

13. Do not file right-handed on lathe as it brings operator too close to chuck or carrier.

14. Do not clean and oil machinery while in motion.

15. Do not remove guards from machinery for the sake of convenience. Machine should not be operated without guards in proper place.

16. Tools found defective should be reported to foreman in charge or turned in at toolroom.

17. In handling material at the steam hammer, always stand at the side of the forging or piece you are holding and always use tongs.

18. Do not jack a car without first blocking the wheels.

19. Do not use anything but regular jack handles when operating jacks.

20. Before moving an engine, walk around and examine it and ring the bell as a warning.

21. Do not go under a car or between cars for the purpose of making inspection or repairs without first knowing that you are fully protected.

22. Do not wear long, loose sleeves or gloves around revolving machinery. To insure safety, sleeves should be short and tight fitting.

23. Do not break air hose on cars with stopcocks open and train line charged. Stopcocks must be closed before uncoupling hose.

24. Special attention should be given to boards containing protruding nails and they should not be placed so they will be a source of injury. Nails should be turned down when possible.

25. Do you know there is nothing gained by taking chances and the safety device is a careful man?

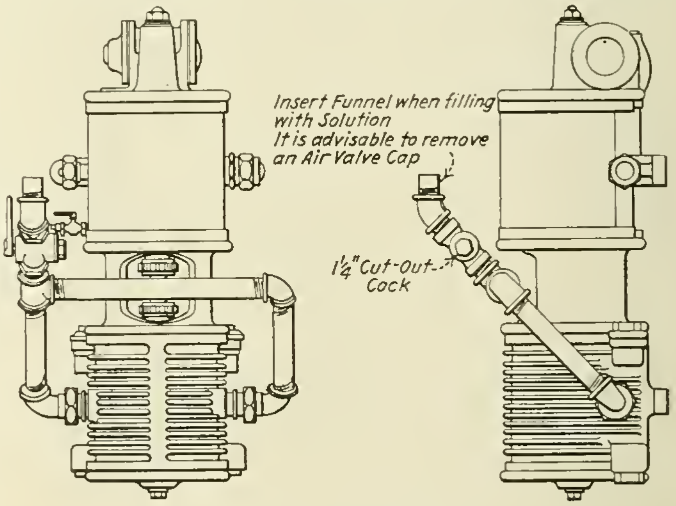
26. Will you do your work in a safe and careful manner and try to avoid injury to yourself and others?

Canadian National Air Pump Washout Arrangement

THE drawing shows a simple arrangement of pipe connections which is used by the Canadian National for washing out the compressor cylinder of locomotive air pumps. With this device attached to the pump and the air cylinder filled with the cleaning solution, no outside supply of solution is necessary.

Before this by-pass arrangement was developed experiments were made with several designs of air pump washout devices and with solutions of varying strengths and mixtures. The commonly used barrel arrangement with suitable pipe connections leading to the air pump cylinders, requires a large quantity of solution and the churning to which it is subjected when the pump is being washed out causes the soapy ingredients introduced to prevent the cutting of the cylinder walls, valves and seats to separate in a foamy mass which floats on the surface of the solution in the barrel, so that its value is lost. For the same reason other types of washout equipment using open liquid containers, whether located on the running board or attached to the pump, were found to be unsatisfactory.

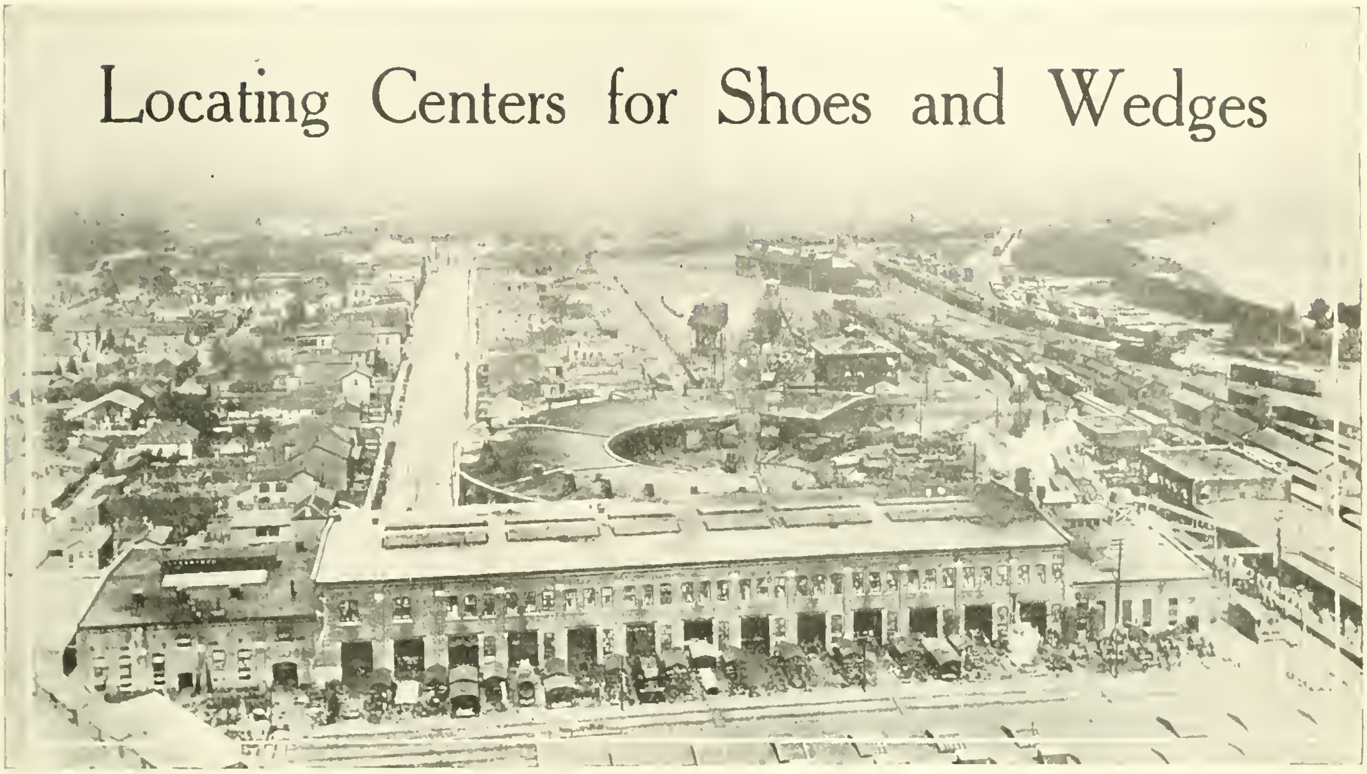
With the arrangement shown in the drawing the plug cock in the filling connection is opened and the air cylinder filled with the cleaning solution, one of the upper air valve caps being removed so that the solution will readily flow into the cylinder. Then, with the air valve cap replaced and the filling cock of the washout device closed, the pump is operated at about 20 strokes per minute either by steam from the locomotive or the roundhouse blower line. When the cleaning is completed the washout solution is drawn off and clean water worked through the pump in the same way.


Insert Funnel when filling with Solution
It is advisable to remove an Air Valve Cap
1¼" Cut-Out Cock

By-Pass Arrangement for Washing Out Air Pumps

Experience on the Canadian National has led to the use of a solution of moderate strength, circulated through the pump for about four hours, rather than a solution of greater strength used for a shorter time. The solution used on the Canadian National consists of six cans of lye and one-half pound of soft soap dissolved in a pail of hot water.

Locating Centers for Shoes and Wedges



General View of the Burlington Shops at Hannibal, Mo.

New Method for Securing Main Centers Ensures Correct Alinement of Engine Truck, Drivers and Trailers to Prevent Wheel Cutting[*]

By T. E. Paradise

Master Mechanic, C. B. & Q., Hannibal, Mo.

THE proper locating of centers for the laying off of shoes and wedges is one of the most important tasks in connection with the repair work of the locomotive, for the performance of the locomotive will depend, to a great extent, upon the accuracy with which the shoes and wedges are alined.

The work of laying out and fitting shoes and wedges has usually been handled by a few individual mechanics in most locomotive repair shops, as the average mechanics of today have not been trained, neither do they take sufficient interest to master the problems that are confronted in the handling of this work, and unless they are ambitious and willing to exert themselves they will not secure the knowledge of the most important points. One of the particular reasons why so few mechanics are able properly to handle this work is the assignment of it to individual men who grudgingly part with any information in regard to the handling; this has made the work appear to the younger and inexperienced mechanic as mysterious or confusing.

The present methods that are used in practically all modern shops vary slightly from the practices followed in the last twenty years, during which time a number of changes in the design of the locomotive have taken place. The increased size of the locomotive has extended the wheel base, and has made it of the utmost importance that the alinement of drivers, engine truck and trailers be perfect. A failure properly to perform this work causes a large amount of maintenance work in the roundhouses, due to changing tires, and also shortens the life of rails, as the wearing of tires means a corresponding wear on the track.

From my observation of the handling of locomotives in roundhouses, I have found that there is a constant changing of tires, due to the cutting of flanges, a study of which has brought out the fact that the cause of the greater portion of these cut tires is the improper alinement of the engine truck and the trailer with the drivers. The cutting of driving wheel tires in the operation of locomotives is causing roundhouse maintenance forces to carry an unnecessary expense and burden, due, in the majority of cases, to the incorrect method used when locomotives are given general repairs.

The prevailing practice in securing the main centers from which shoes and wedges are laid off is responsible for the greater number of cut flanges, due to these centers being located from the cylinders independently, and not in conjunction with the engine truck and trailers. In the location of these centers a number of methods are used which are responsible for the cutting of tires, and not the curvature of the track over which the locomotive operates, unless it is operated continuously on a sharp curve—the locomotive headed while going in one direction and making the reverse movement backing up, as a switch locomotive operating in yards and switching over leads, a condition of operation which reduces the life of tires on switch locomotives over 50 per cent. A considerable amount of tire wear can be reduced by oiling the inside face of the ball of the rail on the outside rails of curves, which will not only save the tires, but will also save the rails, as when rails become worn to any extent, the tires are worn much more rapidly.

The methods used in the roundhouse are responsible for a large number of tires being cut, due to improper maintenance, such as allowing the engine truck and trailers to become rigid, thereby creating a long wheel base, which generally cuts engine trucks and front drivers, or trailers and rear drivers; also allowing the locomotive to become out of plumb, which wears three point hangers on engine trucks unevenly, and carries the engine to one side.

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[*] Paper submitted in Erecting Shop Competition.

Throwing Drivers Not Advisable

The general practice to overcome this is to throw the drivers on one side either forward or back, to overcome the cutting. This involves a considerable amount of work and does not in all cases prevent the driving flanges from cutting, as a road locomotive is equipped with an engine truck which guides the locomotive, controls the alinement, and by its position carries the locomotive in correct or incorrect location in reference to the main drivers. In throwing the driving wheels either forward or back, this may aline the drivers with the engine truck, but it creates a change in the driving wheels laterally, and while it may prevent further cutting of the driver that is cutting, will cause other drivers to cut and will throw the entire engine out of alinement.

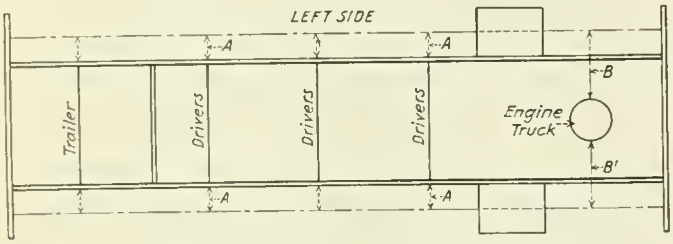


Fig. 1—Top View of Main and Trailer Frames Showing Front Truck Center Casting, Drivers and Trailers

This is clearly shown in Fig. 2, which shows lines set horizontally the length of the frame, an equal distance *A* from the frame at the front driver and the rear driver on both sides of the locomotive. The measurements from *C* and *D* from these lines to the engine truck center casting show the center casting to be out to one side, the distance *C* being greater than *D*. This condition will cause the drivers on the left side to cut, therefore, in the method of throwing the drivers, the right side will be thrown back, which will carry the main center of each driver back the distance the drivers were thrown. This would change the angle between the driving axles and the two lines parallel with the frame.

A study of Fig. 2 will show that this method may prevent further cutting of a certain flange on a locomotive without a trailer, but will create a very bad condition on a locomotive with a trailer. By moving the line on the right side away from the locomotive until it is an equal distance from the center casting as that on the left side, measurements then made to the frame from this line at each jaw will show that a radical change must be made in the thickness of the hub plates on the drivers. To keep the drivers in line it would be necessary to increase the hub plates on the right side, which is not practical. The center casting must be moved to a central position of the lines as shown in Fig. 1 where the distances *B* and *B'* are equal. This demonstrates that the method of throwing the drivers either ahead or back cannot be used as a preventive for tires cutting when locomotives are equipped with engine truck and trailer, as the engine truck and trailer are responsible for the cutting of the flanges, and occasionally it is found that the incorrect thickness of hub plates is responsible for the cutting of tires. Therefore, you cannot rectify the defective location of engine truck or trailer by applying the remedy to the drivers.

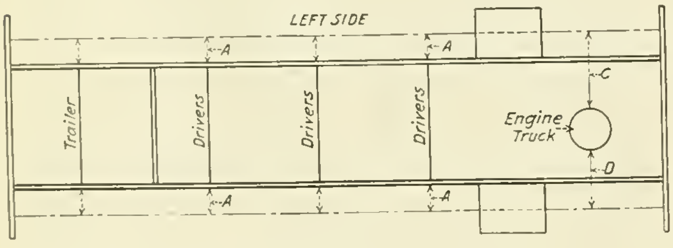


Fig. 2—To Keep Drivers in Line It Would Be Necessary to Increase Hub Plates on Right Side Which Is Not Practical. Center Casting Must Be Moved to Central Position

Adjusting Three-Point Truck Hangers

By changing the alinement of the three-point hangers, a locomotive can be carried away from the driving flanges on either side, and prevent further cutting. This can be done by adding a liner or material with an acetylene torch, to the inside bearing faces of the hangers on one side, and to the outside bearing faces of the other hangers. This will carry the locomotive to the side where the material has been added to the outside bearing faces of the hanger, as shown in Fig. 3. In this figure the center casting and the three-point hanger are in position. Material added to faces marked *R, R'* will carry the locomotive to the right side and overcome cutting of tires on the left side. To correct tire cutting on the right side material should be added to the faces marked *L, L'*. The amount to be added depends upon the length of the hanger. If the length is twice the width, each ⅛ in. of material added carries the center casting ¼ in. laterally.

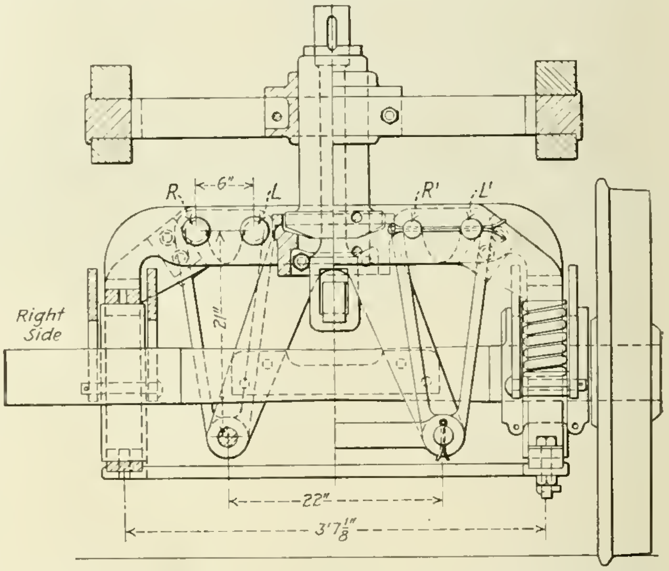


Fig. 3—Material Added to Faces R and R' of Three-Point Hanger Will Carry the Locomotive to the Right Side and Reduce Cutting on the Left Side

If the proper methods are used in handling when locomotives receive general repairs, it will reduce the burden on roundhouse forces and enable them to make really necessary repairs. The changing of tires is an unnecessary repair, because it is avoidable, except when long wheel base locomotives are operated on sharp curves, or when rails on curves are badly worn; but such cases are comparatively few.

Locating Main Centers

The method used for the location of the main centers must be such that the location of the engine truck center, and any difference in thickness of hub plates on drivers and trailer trucks can be ascertained without a transfer being made of any of these points from any fixture, such as engine truck center pin or cylinders, and they must be located through one medium. To do this, two lines should be set parallel to main frames, as shown in Fig. 4 (one on each side of the main frames), extending from the front beam to the rear of the trailer frame, extending through cylinders, and set a given distance from the frame at the front jaw and the same distance from the frame at the back jaw. A straight-edge is then placed through both main jaws against the shoe faces, and adjusted at right angles to the two parallel lines. By using a square, the blade maintained perpendicular by a parallel strip on top of the frame with the lower edge in contact with the straight-edge, a line is then scribed on the side of each frame, which locates the point from which the main centers can be secured.

The center casting is then located by measuring from the line on each side at the front end. It is of the utmost importance that the center casting be in the center and in direct line with the drivers, as it is the guide to the locomotive, and if not located with the drivers, will carry the locomotive to one side or the other. This is responsible for more sharp flanges than any other defect.

If the locomotive has three, four or more sets of drivers, the distance from the line to each jaw should be measured to develop any distortion of the frame, and to secure the difference in thickness of the hub plates which such distortion will cause.

The frames are often distorted by welding while in place, which is a common practice, and is the cause of one tire cutting when drivers, engine truck, and trailers are in line. It is also necessary to measure to each trailer frame from the line at the trailer jaw to secure the difference in thickness of hub plates, so that trailer wheels will be in line with the drivers.

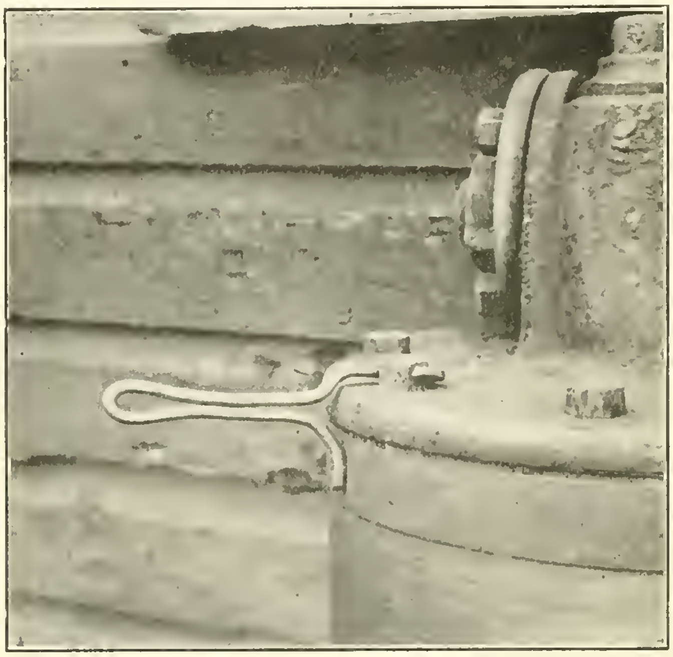
The engine truck center casting must be in the center after the engine truck has been built up, and the engine truck should be measured so that it positively is known that the engine truck center casting is in the direct center between the flanges of the wheels. This can be measured directly on a single axle truck, and on a double axle truck a straight edge can be placed along the throat of the flanges and the measurement taken to the center casting. It should not be taken for granted that the casting is in the center, but it should be developed by accurate measurement after the truck has been built up.

The elimination of sharp flanges will not only relieve an excessive burden from the maintenance forces in the roundhouse, but will reduce the wheel work in the back shop, in wheel gangs, and on wheel lathes. It will extend the life of tires, as a flange worn to gage requires the removal of from 3/8 in. to 1/2 in. of metal to enable the flange to be brought up to standard. This reduces the life of the tire involved very rapidly, and makes it necessary to reduce all the other tires in the set the same amount. It will also reduce the wear on rails.

Heel Wrench for Jacket Bands

By F. W. Bentley, Jr.

The one piece jacket band is sometimes decidedly unhandy to hold in place while putting in the band screw, more especially so when the band happens to be located on an air pump upon an engine. Particularly is it inconvenient on a hot engine where working quarters are cramped and with a considerable number of other conditions frequently present to make the job a disagreeable one. The accompanying illustration shows a very handy heel wrench with which the slack of the band against the jacket can be held after the hole has been drifted into place for the screw. The hook and heel hold the band quite firmly with but little pressure, leaving the other hand free to insert the screw. A wrench of this type can easily be made by anyone from a piece of 1/4-in. steel wire bent into a shape to fit the size of air pump on which it is to be used. A total length of from 6 in. to 7 in. has been found to give a convenient grip.



A Handy Little Tool for Use in Applying Jacket Bands

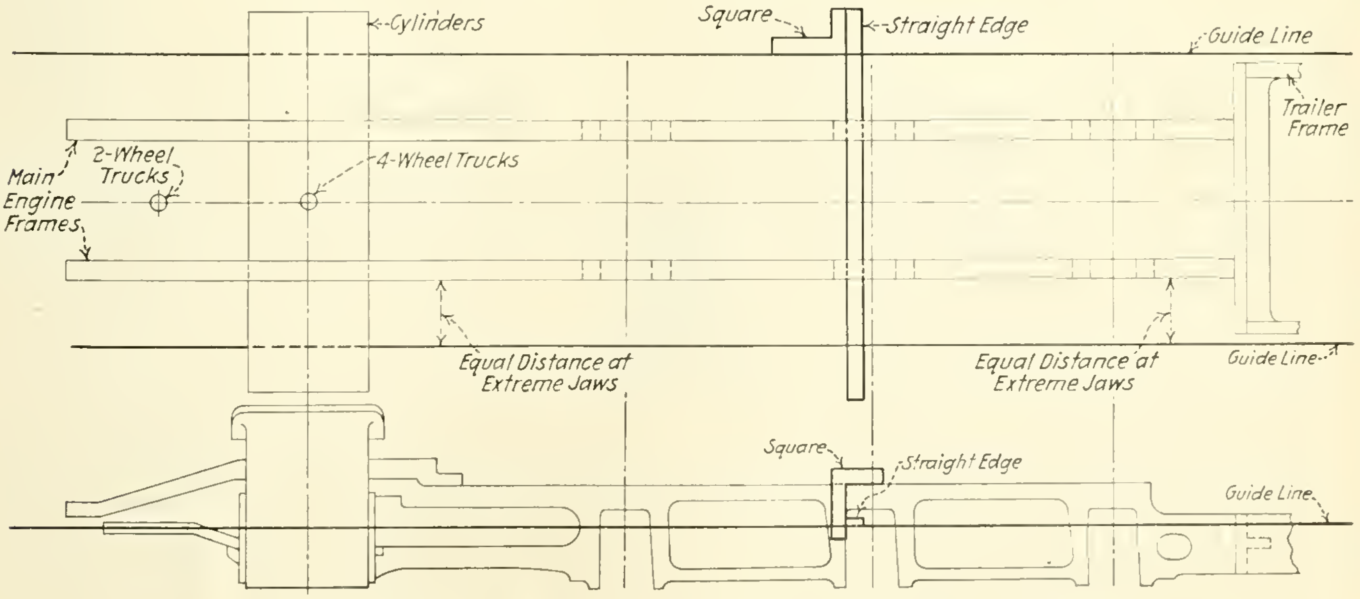


Fig. 4—Method of Locating Main Centers for Laying Out Shoes and Wedges

Babbitting Crosshead Shoes

Owing to the large number of crosshead shoes which have to be babbitted in the average railroad shop in the course of a year, a great deal of attention has been given to machines and devices for performing the babbitting operation. One of the most effective equipments yet developed is that shown in the illustrations, used in the Scranton shops of the Delaware, Lackawanna & Western. The device illustrated in Fig. 1 is for babbitting shoes without removal from the crossheads, while that shown in Figs. 2 and 3 is intended for babbitting new crosshead shoes, or those which have had to be removed on account of loose or defective bolts. The particular feature of both of these devices is the accuracy of the work done with them and the consequent saving of time through the elimination of subsequent machining.

Referring to Fig. 1, the construction and operation of the crosshead babbitting device will be evident. Different sizes of crossheads can be accommodated, the range being from 12 in. to 21 in. between the faces of the crosshead shoes. The shoe width can vary from 5 in. to 6½ in. The device consists of a cast-iron base plate E provided with vee-ways along which the uprights MM are adjustable together or apart by means of an adjusting screw and handles HH. Adjustment for the width of the right crosshead shoe is obtained by means of rack N and pinion T which operate the taper wedges WW. A similar rack and pinion operate adjustable wedges to suit the width of the left crosshead shoe.

In operation, the crosshead to be babbitted is up ended on the crosshead supporting rod and bushing P. Handles HH are turned until the working faces of uprights MM are the same distance apart as the guides, *plus* a slight additional amount required for running clearance. The wedges WW are then adjusted to the thickness of the guides *plus* the necessary running clearance. Clay is applied at the bottoms and around the sides of the crosshead shoes, babbitt being poured in from the top.

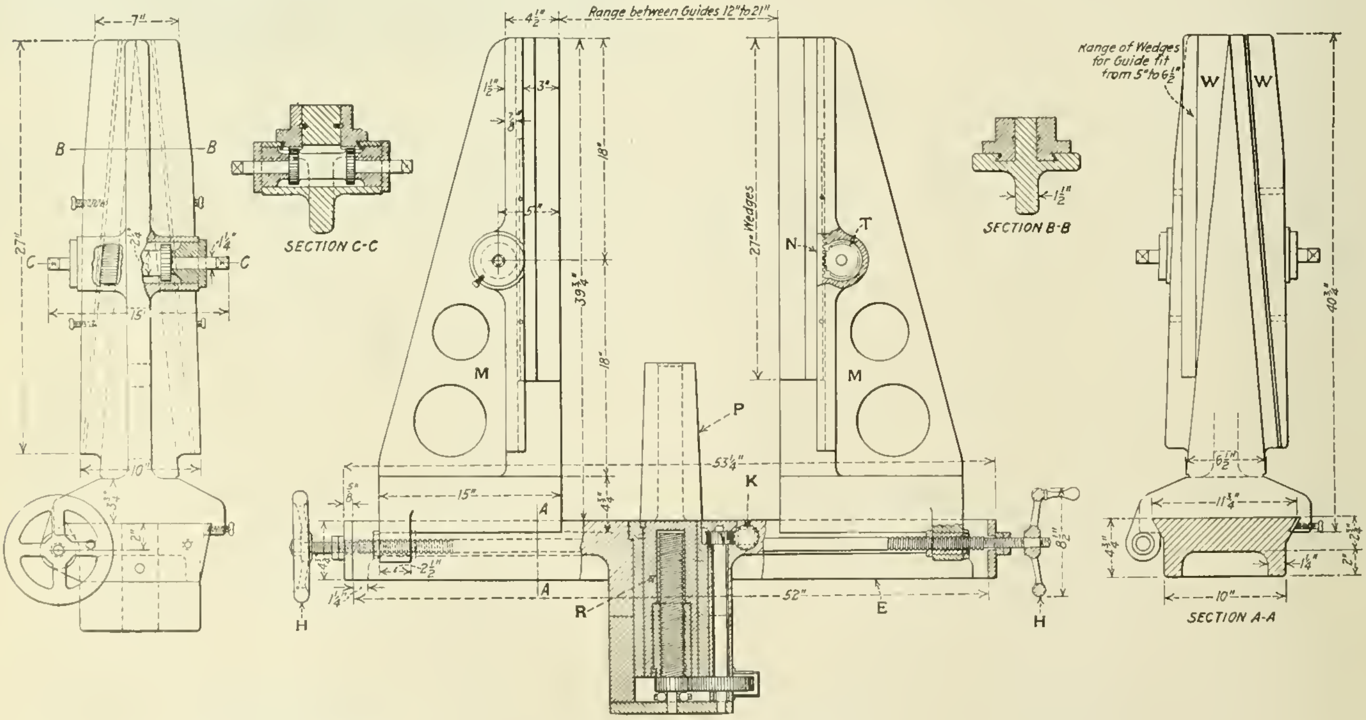


Fig. 1—Device Used at the Scranton Shops of the D. L. & W. for Babbitting Crosshead Shoes Without Removal from the Crossheads

Power to remove the crosshead from the device after the babbitt is poured is provided by means of the jacking arrangement shown in cross section at the bottom. By means of a handle applied to the squared end of shaft K, a powerful lifting action is applied to crosshead lifting rod R, bushing P and the crosshead, forcing the latter out of the device. A particularly good job is obtained by this method of babbitting crossheads and by means of the two adjustments mentioned, just the proper allowance for play can be made so that no subsequent machining is required.

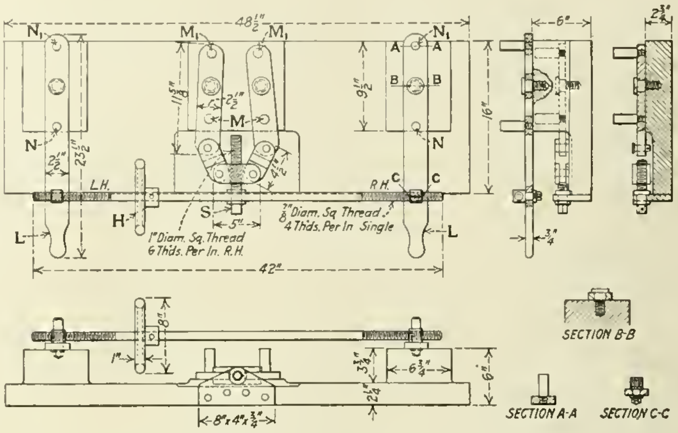

N₁
M₁
48½"
N
L.H.
R.H.
A
B
C
H
S
L
5"
42"
16"
⅞" Diam. Sq. Thread 4 Thds. Per In. Single
1" Diam. Sq. Thread 6 Thds. Per In. R.H.
6"
SECTION B-B
SECTION A-A
SECTION C-C

Fig. 2—Crosshead Shoe Babbitting Device—Bottom Section

For babbitting separate crosshead shoes, the device illustrated in Figs. 2 and 3 is used to advantage. Fig. 2 shows the bottom section in which the crosshead shoes are placed, and Fig. 3 the top section which, when set for the proper clearance, forms the upper part of the mold. Referring to Fig. 2, the bottom section is constructed as shown of cast-iron. The crosshead shoe to be babbitted is placed on the four 1-in. pins MMM_1M_1 with the guide bearing surface upward. Turning screw S (provided with a squared end as shown) to the left will then move the toggle levers in such a way as to make pins MM and M_1M_1 grip the shoe at the two surfaces which extend between the crosshead cheeks. The shoe will thus be held central and level. The top section (Fig. 3) is then adjusted to the width of the guide *plus* running clearance by means of taper parts T and T_1 controlled by a right and left screw and wheel *W*. The top section is placed over the crosshead shoe resting on levers *LL* and between pins NN and N_1N_1, to grip the sides of the top section, holding it central with the shoe and at the proper height. The openings at the ends of the shoes are plugged with clay and the babbitt poured, in this case also giving a smooth, accurate job which does not require subsequent machining.

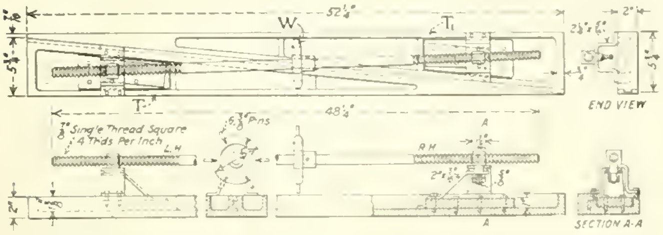


Fig. 3—Crosshead Shoe Babbitting Device—Top Section

Scrap Reclamation*

By L. C. H. Weidman

Railway Service and Supply Corporation, Beech Grove, Ind.

The rolling of scrap iron and axles at Beech Grove is done on an Ajax Type B reclaiming mill in the following manner. Iron rods from ½ in. to 1¼ in. in diameter are cut in lengths 24 in., 28 in., 30 in. and 36 in. long, straightened at the scrap yards and delivered to storage yard at the forge shop. Iron arch bars, transom plates, and other flat pieces of iron are sent to the forge shop where they are sheared up in lengths 4¾ in. long and then sent to the scrap bin at the mill where they are made into bundles about 4¾ in. square, 24 in., 28 in., 30 in. and 36 in. long. These bundles are made by laying the bottom layer of rods the length of the bundle. Next there are two layers of flat scrap laid on the rods with the joints broken. The top is then made of rods the same as the bottom. The bundles are then tied together with two pieces of No. 8 iron wire. The object of having these bundles various lengths is to keep the rods rolled the length of our straightening bed.

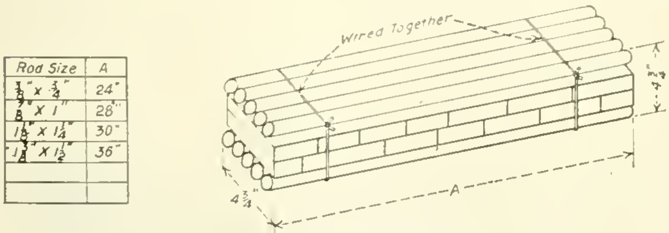


Fig. 11—Method of Bundling Scrap

A sketch of a bundle and table of sizes of iron rolled from the different lengths of bundles are shown in Fig. 11. These bundles are put into the furnace and brought up to a welding heat, passed through the roughing and finishing rolls and then go to straightening bed to cool.

We have two four-door furnaces, one on each side of the mill. In charging we generally charge 24 bundles to each furnace. Since the first of the year we have been working two shifts at the mill, 12 hours to each shift, 10 men to each gang as follows: Roller, heater helper, rougher-down, rougher-up, hooker-up, roller helper, straightener, and two bundlers. These men work piece work and are paid 42 cents a 100 lb. for all sizes from ⅝ in. round up to 2 in. round inclusive.

We also reclaim steel in the following way. All scrap steel rods from 1¼ in. up to 2½ in. are sheared in lengths 4 ft. to 6 ft. long. These are piled at the scrap dock until a car-load has accumulated. They are then sent to the forge shop and rolled in steel bars from ½ in. to 1¼ in. Ends from steel axles and billets that are too small for other forgings, are forged to 4½ in. square, 20 in. to 30 in. long and rolled in steel bars from 1⅜ in. to 2 in. We also take all the surplus 4¼ in. by 8 in. iron axles, cut them into three pieces and roll them into iron bars from 1½ in. to 2 in. Tire steel is also rolled to make superheater bolts and pinch bars.

The following is the monthly report for three months showing the cost of operation, the iron rolled, and the saving made:

March, 1923

Scrap to furnace, 764,250 lb. at $22.00 N. T.	$8,406.75
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charge, direct	4,102.98
551 fuel hours at .5625 per hour	309.94
551 power hours at .30 per hour	165.30
Supervision 5.84 per cent of direct labor	231.60
	$13,697.25

Finished Product

Pounds	Description	Price	Amount
191,950	⅝ in. round iron	$2.90	$5,566.55
86,150	¾ in. round iron	2.85	2,455.28
85,250	⅞ in. round iron	2.85	2,429.63
130,800	1⅝ in. round iron	2.80	3,662.40
103,900	1¾ in. round iron	2.80	2,909.20
54,300	1⅞ in. round iron	2.80	1,520.40
53,300	2 in. round iron	2.90	1,545.70
			$20,089.16

Net profit month of March, 1923	$6,391.91
Net profit since April 1, 1918	$74,279.53

April, 1923

Scrap to furnace 604,900 lb. at $22.00 N. T.	$6,895.86
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charges, direct	3,169.03
429 fuel hours at .5625 per hour	241.31
429 power hours at .30 per hour	128.70
Supervision 5.84 per cent of direct labor	185.07
	$11,100.65

Finished Product

Pounds	Description	Price per cwt.	Amount
184,300	¾ in. round iron	$2.825	$5,206.48
35,650	⅞ in. round iron	2.825	1,007.11
180,950	1⅛ in. round iron	2.775	5,021.36
56,050	1¼ in. round iron	2.775	1,555.39
61,950	1⅜ in. round iron	2.775	1,719.11
33,250	1½ in. round iron	2.775	922.69
			$15,432.14

Net profit for month of April, 1923	$4,331.49
Net profit since April 1, 1918	$78,611.02

May, 1923

Scrap to furnace 571,300 lb. at $17.95 N. T.	$5,127.42
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charges, direct	2,975.09
478½ fuel hours at .5625 per hour	269.16
478½ power hours at .30 per hour	143.55
Supervision 5.84 per cent of direct labor	173.74
	$9,169.64

Finished Product

Pounds	Description	Price per cwt.	Amount
222,400	¾ in. round iron	$2.825	$6,282.80
107,350	⅞ in. round iron	2.825	3,032.64
120,350	1 in. round iron	2.775	3,339.71
29,100	1⅛ in. round iron	2.775	807.53
47,250	1¼ in. round iron	2.775	1,311.19
			$14,773.87

Net profit for month of May, 1923	$5,604.23
Net profit since April 1, 1918	$84,215.25

The Missouri Pacific has increased its average miles per car per day from 20.84 in April to 31.98 in August. During August the road also established another record by loading locally and receiving from connections 130,810 cars compared with a previous record of 125,347 cars in October, 1916.

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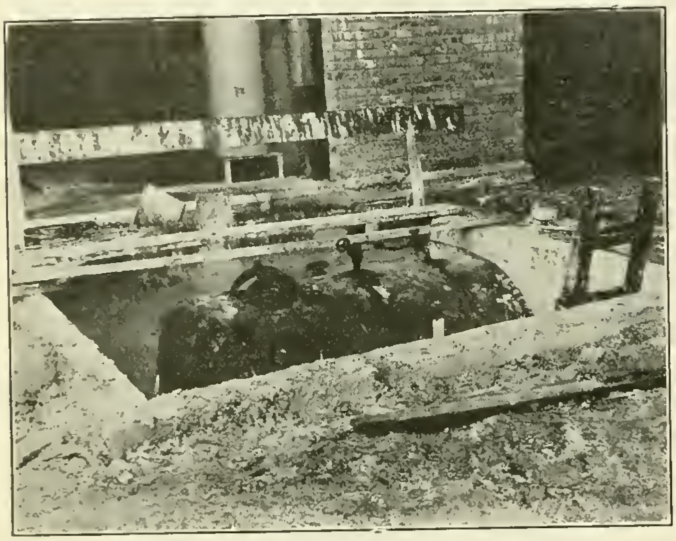
*Abstract of a paper presented at the annual convention of the Railroad Master Blacksmiths' Association, Chicago, August 21, 1923.

Acetylene Sludge Ejector

A MEANS for easily disposing of the sludge or residue from an Oxweld acetylene generator has just been installed at the Pere Marquette shops, Grand Rapids, Mich. Originally the sludge was drained from the generators into a concrete cistern just outside the generator building. The cistern is 8 ft. square and 6 ft. deep with an overflow 8 in. square, located about 18 in. from the top. Periodically the sludge was bailed or dug from the cistern and carried away in wheelbarrows over several tracks to a point about 150 ft. away where it was dumped. Aside from the labor required to move the sludge, the overflow for carrying away the excess of water, frequently became clogged and caused trouble.

A cylindrical tank, formerly in use for oil storage was found which was about 6 ft. long and 5 ft. in diameter and was placed in the cistern. The 2-in. drain from the generators was fitted with a gate valve and connected to the bottom of the tank and carried out under the tracks to the dump. A ¾-in. connection was also brought to the top of the tank from the air line and a relief valve provided at the top of the tank. This valve is normally open. When the tank is nearly full of the sludge, the relief valve and the gate valve in the drain are closed. The air is turned on and the sludge is blown out through the outlet in most effective fashion. A water connection is also provided for occasional flushing the tank and the outlet pipe.


Sluge Ejector Used at Pere Marquette Shops

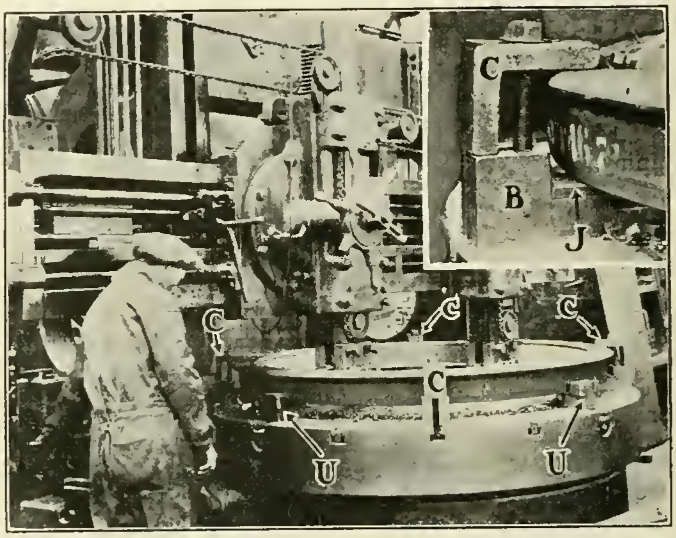
Boring Mill Clamps

THE set of boring mill clamps, shown in the illustration, is designed especially to hold driving wheel tires while being bored for the fit on wheel centers. These clamps are also sometimes used for holding boiler front rings and are notable for the ease with which they are adjusted and the rigid grip which they provide on the parts being turned or bored.

The boring mill illustrated is provided with four universal chuck jaws (two of which are shown at *U U*) for centering the driving wheel tire quickly and accurately. These jaws were originally designed to hold the tire against slipping under heavy cuts but proved inadequate for this purpose, and, realizing the danger of slipping, the operator was compelled to use relatively low speeds and small feeds.

Makeshift clamps applied in addition to the four universal vise jaws also proved ineffective and as a result four special clamps *CCCC* have been provided as illustrated between the universal chuck jaws. They practically eliminate all possibility of the tire or boiler front ring breaking away from the table under the heaviest cuts which the machine can take. Since the installation of these clamps, the boring mill table has been speeded up as fast as it can go, namely, 2 r.p.m. with the controller handle at the last notch. The tire shown on the boring mill table is 56 in. in diameter, so that at a speed of 2 r.p.m., the surface speed of the cutting tool is about 34½ ft. per min. This is considerably in excess of what could be obtained previous to the use of these auxiliary clamps.

While no drawing of the clamp is available, a good idea of its proportions and construction can be obtained from the insert in the upper right corner of the illustration. The tire rests on a forged steel base piece *B* provided with two steps as shown to take tires of varying diameter. The substantial right-angle clamp *C* rests on the tire and base piece *B*, both the clamping unit and tire being held firmly to the boring mill table by a large T-head bolt. The tire rests directly on a hardened steel jaw *J*, provided with teeth for driving in a clockwise direction. It is obvious that a rigid, reliable drive is provided to the driving wheel tire by means of this clamping arrangement.



Special Clamps Provide a Rigid, Reliable Drive

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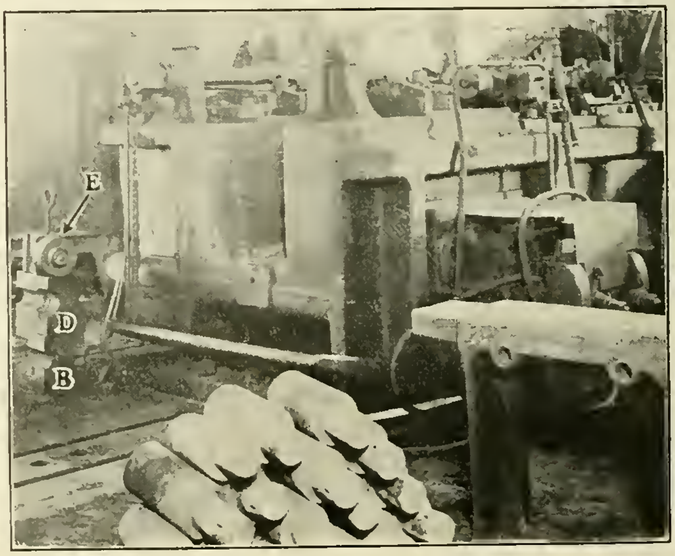

Wrist Pins with Threaded Ends Roughed Out on Turret Lathe and Hole for ¼-In. Flat Cotters Are Punched in One Heat and One Operation by Dies B, D and E in the 3-In. Forging Machine Illustrated—Billerica Shops of the Boston & Maine.

Steel Treaters' Convention at Pittsburgh

Fifth Annual Convention Notable for Record Attendance and Exhibitions; Live Technical Sessions

THE American Society for Steel Treating held its fifth annual convention at Pittsburgh, Pa., October 8 to 12 inclusive, and in attendance, interest and size of the exhibition this convention was far ahead of any previously held. The registered attendance was about 1,500 of a total membership of over 2,700. Great interest was shown in the technical sessions which were well attended and followed by valuable discussion of theoretical and practical points brought out in the papers. Special sessions were held on lathe tools and steel hardness, carburizing, welding and tool tempering, heat treated forgings, hardness testing, and general subjects with a special roundtable meeting on standards.

The following officers were elected for the ensuing year: President, G. K. Burgess, Bureau of Standards, Washington; second vice-president, R. M. Bird, Bethlehem Steel Company, Bethlehem, Pa.; treasurer, Dr. Zay Jeffries, Aluminum Company of America, Cleveland; director for two years, J. F. Harper, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

One of the most interesting of the sessions was that on lathe tools and steel hardness in which the members listened to papers by prominent authorities on lathe tool performance. One of these papers of particular interest to railroad machine shopmen was on "The Effect of Heat Treatment on Lathe Tool Performance and Some Other Properties of High Speed Steels" by H. J. French, Jerome Strauss and T. G. Digges.* This complete paper will be found in the September Transactions of the American Society for Steel Treating. The conclusions drawn in the paper are presented in full below.

Conclusions Regarding Effect of Heat Treatment on Lathe Tools

One of the outstanding features developed in this investigation is the importance of the time factor in the heat treatment of high-speed steels. Special emphasis is placed on this as the customary methods of treatment adopted by the industry in general include accurate control of temperatures in hardening but leave the time to the judgment of the operator. While excellent results have been obtained in many respects under such conditions it is improbable that anyone can so regulate operations day after day, by observing the appearance of tools or "sweating" produced in hardening, that desired uniformity in results can be obtained in all cases. Accurate control of both time and temperature with suitable instruments is necessary to guarantee consistent results.

The tests made also throw interesting light upon several factors to be considered in the selection of steels for specific service. It has been shown that high-tungsten steels require higher hardening heats to produce maximum endurance than do the steels low in tungsten and that the addition of cobalt raises the required hardening temperature in both types and thus increases the oxidation obtained in heat treatment. However, the former are not as brittle as the latter.

When brittleness is to be avoided but oxidation is unimportant the high tungsten-cobalt steel has a decided advantage over the other three for its endurance is much greater than the two steels without cobalt and it is not nearly as brittle as the low tungsten-cobalt type which has only slightly better average endurance at the highest cutting speeds.

The low-tungsten steels with or without cobalt additions are to be preferred when brittleness is unimportant and the tool can be well supported but severe oxidation is to be avoided. While the low tungsten-cobalt steel *A* in the Table requires a somewhat higher temperature than the steel *C*, which is cobalt-free, its endurance is somewhat greater. However, when the hardening temperature for the low tungsten-cobalt steel *A* is reduced to that recommended for the low tungsten-high vanadium steel *C* both have more nearly comparable endurance. This is indicated in the diagram and substantiated in tests contained in a previous report.

It is more difficult to point out decided advantages for any one of the four steels when maximum tool endurance and minimum oxidation and brittleness are all required. The choice, under such conditions, would depend upon the relative importance of, and quite probably be a compromise between the several factors considered.

There is evidently no one steel which meets all requirements of service for each has special advantages and disadvantages. The addition of cobalt to high-speed steels permits the use of higher hardening heats and so imparts a greater cutting capacity but does not change the characteristics of the two basic types, namely, low tungsten-high vanadium and high tungsten-low vanadium steels.

The endurance of high-speed steels subjected to the severe service described in the first two sets of tests was affected to a relatively small degree by variations in tempering subequent to hardening. The frictional temperatures produced were not less than 1,400 deg. F. which is higher than that required to decompose the martensitic groundmass of the hardened steel. The degree of red hardness was therefore considered a function of the quantity and characteristics of the constituents formed at the high heats used in hardening (2,200 to 2,500 deg. F.), as indicated by thermal analysis, and largely independent of the properties of the groundmass.

If this is so the question naturally arises why tools which will cut under frictional temperatures of 1,400 deg. F. would be entirely ruined if first tempered at this same temperature. While no final answer can be given, there are a number of important differences between tempering a tool and subjecting it to service at such high temperatures. In the first place the ordinary method of tempering consists in exposing the hardened steel to this temperature for a longer time than any of the tools would cut. Also it is well known that pressure as well as temperature markedly affects many atomic or molecular reactions. Temperature alone is applied to the

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*The authors of the paper are H. J. French, physicist, Bureau of Standards, Washington; Jerome Strauss, material engineer, United States Naval Gun Factory, Washington; T. G. Digges, assistant physicist, Bureau of Standards, Washington.

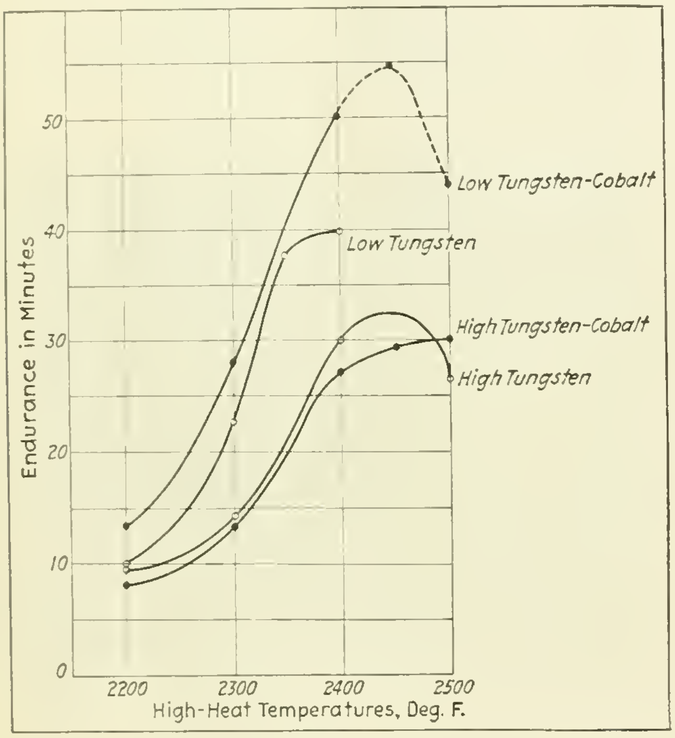
CHEMICAL COMPOSITION OF THE HIGH-SPEED STEELS TESTED AND PRELIMINARY ANNEALING TREATMENTS USED

Steel No.	Type of Steel	Chemical composition, per cent										Annealing treatment used
		C	Cr	W	V	Co	Mn	P	S	Si	Ni	
	Steels used in lathe tests											
A	Low tungsten-cobalt	0.65	4.00	13.92	1.49	3.63	0.44	0.013	0.019	0.17	0.06	1,600 deg. F.—3 hr.—furnace cool
B	High tungsten-cobalt	0.68	3.67	17.97	0.73	3.06	0.42	0.013	0.016	0.15	0.04	1,600 deg. F.—3 hr.—furnace cool
C	Low tungsten-low vanadium	0.68	4.37	13.91	1.64	0.09	0.42	0.022	0.013	0.16	0.12	1,600 deg. F.—2 hr.—furnace cool
D	High tungsten-low vanadium	0.64	3.93	18.33	0.85	None	0.39	0.017	0.017	0.06	None	1,600 deg. F.—3 hr.—furnace cool
	Steels used in transverse tests and for observations on dimensional changes, etc.											
Z	Low tungsten-high vanadium	0.74	4.05	12.58	1.67	None	0.27	0.029	0.018	0.09	Trace	1,600 deg. F.—2 hr.—furnace cool
CC	High tunsten-cobalt	0.68	3.47	18.46	1.01	3.48	0.11	0.014	0.015	0.05	None	1,600 deg. F.—2 hr.—furnace cool
H	High tungsten-low vanadium	0.62	3.92	17.67	0.70	None	0.28	0.015	0.020	0.12	Trace	1,600 deg. F.—2 hr.—furnace cool
A 34	"Die steel"	0.56	2.21	13.80	0.98	....	0.42	....	....	0.20	....	Tested after various preliminary treatments.

steel in tempering whereas in cutting metals both high temperature and pressure are obtained. It is therefore conceivable that the pressure tends to retard the reactions which would take place at a given temperature and so tend to prevent complete reversal of the changes produced in the hardening or at least make them take place so slowly that the tools will cut for a definite length of time at such high heats before failure occurs.

The principal conclusions to be drawn from the described tests may be summarized as follows:

(1) The endurance of high-speed steels is affected to a marked degree by the high heat temperature used in hardening and rises rapidly with increase above 2,200 deg. F. However, a point is finally reached where a further temperature rise is no longer attended by a commensurate increase in the endurance and if high enough heats are employed a decrease will be observed coincident with a partial melting of the steel. Under otherwise fixed conditions there is therefore a high heat temperature which results in maximum endurance but this varies with composition. It is higher in the 18 per cent tungsten than in the 13 per cent tungsten steels and is raised in both types by the addition of 3 to 5 per cent cobalt.



Effect of High Heat Temperature on Endurance of Four High-Speed Tool Steels

(2) The best hardening temperatures for the four main types of high-speed steel, to be used as lathe tools under severe service, are considered to be about as follows:

2,350 deg. F. for low tungsten-high vanadium steel
2,400 deg. F. for high tungsten-low vanadium and low tungsten-cobalt steels
2,450 deg. F. for high tungsten-cobalt steel

These temperatures are a compromise between several factors including tool endurance and brittleness.

(3) The endurance of high-speed steels is likewise dependent upon and, within limits, increases with the time at high heat. In tests made with high tungsten-low vanadium steel, tools held 3 min. at 2280 deg. F. had superior endurance to those held 50 sec. at 2,400 deg. F. but were not as good as those subjected to the latter temperature for 1½ min. Therefore for consistent results both time and temperature should be controlled by suitable instruments.

(4) High-speed steels subjected to the severe service described were found to have endurance characteristic of the high temperature treatment used in hardening and this was not modified to any great degree by any subsequent tempering up to and including 1,100 deg. F. However, the higher the tempering temperatures the tougher did the steel become. The most important reason for tempering, in this case, is not increased endurance but decrease in brittleness.

(5) Length shrinkage, or expansion, may be produced in hardening a high-speed steel from a given temperature, if this is not too high, by varying the treatment prior to hardening. This includes both preliminary annealing and the manner of heating for hardening. However, the higher the quenching temperature and the time at high heat, within limits ordinarily encountered in commercial heat treatment, the greater will be the expansion or, under certain conditions, the less will be the shrinkage. Likewise tempering subsequent to hardening may be used to reduce original length shrinkage or expansion but the final length will approximate the original only in certain cases. The tempering which will produce this ideal condition will vary widely in a given steel depending upon the previous history of the samples but in no case is it possible to completely compensate for hardening changes in two dimensions.

(6) In a series of tests on nickel steel forgings in which the cutting speed was varied from about 45 to 70 ft. per min. high-speed steels containing about 3.5 per cent cobalt had much greater endurance than the plain chromium-tungsten-vanadium steels. Under the most severe service the low tungsten-cobalt type was superior to the high tungsten-cobalt steel but at the lowest speeds both had comparable endurance. Comparisons of the four steels tested when based on the breakdown test, showed the following order of superiority:

	Per cent
Low tungsten-cobalt steel	98
High tungsten-cobalt steel	90
Low tungsten-high vanadium steel	68
High tungsten-low vanadium steel	47

(7) Low-tungsten steels, with or without cobalt additions are more sensitive to heat treatment than the high-tungsten types. They are more brittle when hardened for maximum endurance but require lower hardening temperatures than do the corresponding high-tungsten steels. These features, in addition to comparisons of endurance, must be considered in selecting steels for particular service. No one type of high-speed steel meets all requirements but each has its advantages and disadvantages.

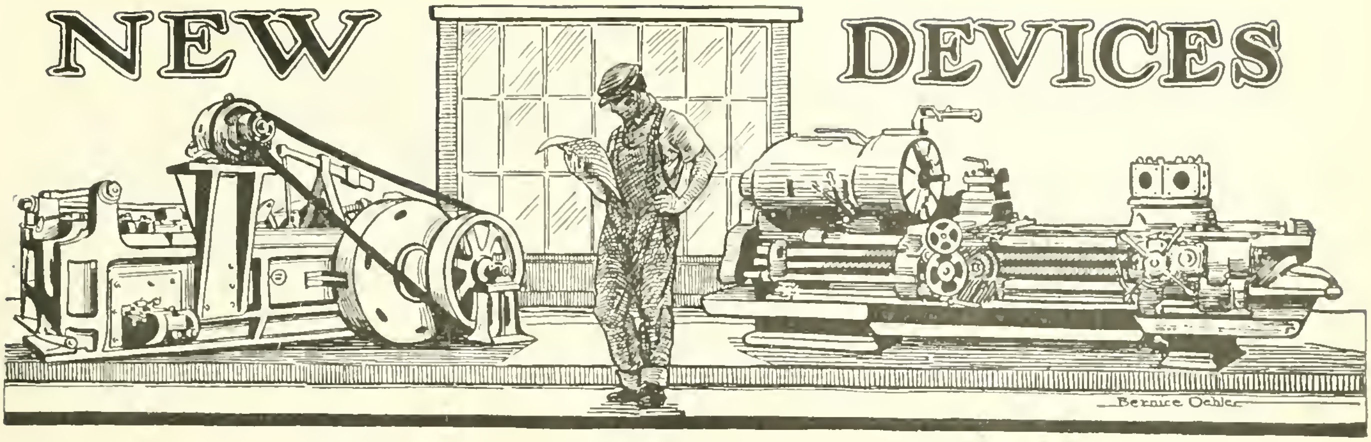
(8) Both the "Breakdown" and "Taylor" tests have limitations and cannot wholly replace the method of using tools in the shop to determine just what they will do. However, much worthwhile information of practical value can be obtained in relatively short time by careful interpretation and correct application of results obtained by either test.

(9) In normal shop practice so-called "flaky" steel may be produced through the hardening of long lengths of lathe, planer and shaper tools followed by dressing operations in which only part of the previously hardened steel is heated to annealing temperatures which would ordinarily prevent its occurrence. As "flaked" steel is brittle and showed a tendency toward erratic results its production is to be avoided.

(10) Prevention of "flaky" fractures in ordinary high-speed steel in heat treatment is much more simple than elimination and may be accomplished by annealing between successive hardening treatments. In no case, when once produced, was complete elimination effected by annealing alone though certain complicated treatments left mere traces of this structure upon rehardening. However, combined forging and annealing completely removed severe "flake" in all steels tested. In general the greater the reduction in forging the lower was the annealing temperature required for a cure (within limits).

(11) High tungsten-low vanadium steels offered the greatest resistance to the formation of "flake" and likewise to its elimination when once produced.

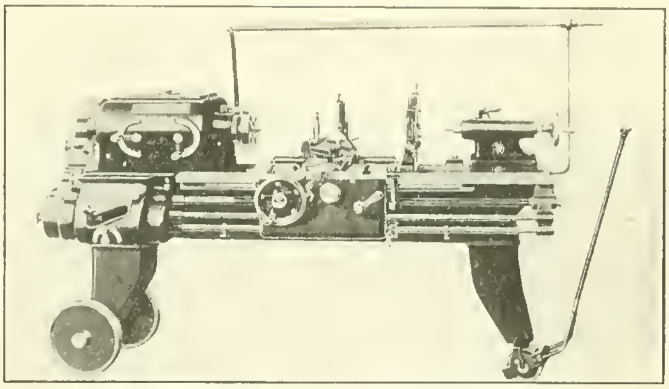
NEW DEVICES



Portable Geared Head Lathe

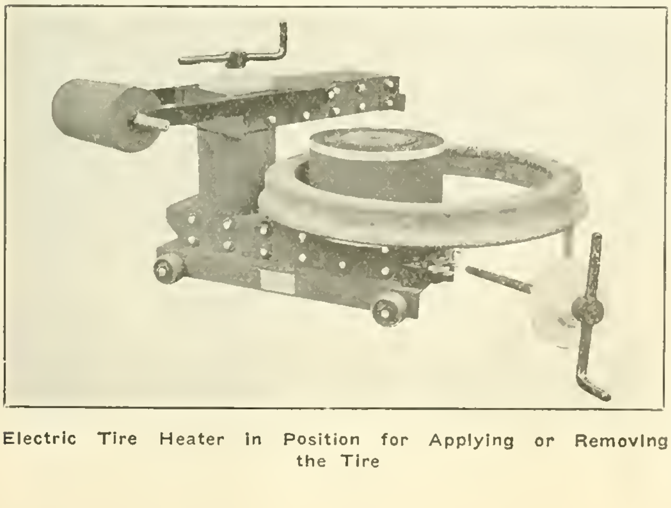
A 15-IN. portable geared head lathe that can be transported to any place in the shop has been placed upon the market by the Rockford Tool Company, Rockford, Ill. This lathe is patterned after the 14-in. Sundstrand tool room lathe manufactured by the same company, except that the motor is mounted directly on the headstock. The machine is mounted on three solid iron wheels, as shown in the illustration, two under the headstock end and one under the tailstock. It is convenient to operate. In its design special attention was devoted to reducing the number of controlling levers.

The bed is 13½ in. wide and well braced. The distance between centers, when the tailstock is flush with the end of the bed, is 32 in. The swing over the carriage is 8¾ in. The carriage has a full length bearing surface on the bed, which is cross-grooved for oil channels. The ends are provided with bronze vee wipers with felt inserted for cleaning and oiling the vees. The feeds are from 6 to 368 per in. The tool post takes a tool from ½ in. to 1 in. The driving shaft pulley is 10 in. by 3¼ in. and the standard driving pulley speed is 350 r.p.m. There are 12 spindle speeds available. The net weight of the lathe with a 6-ft. bed is approximately 2,250 lb.


Sundstrand Portable Geared Head Lathe

Swiss Portable Electric Tire Heater

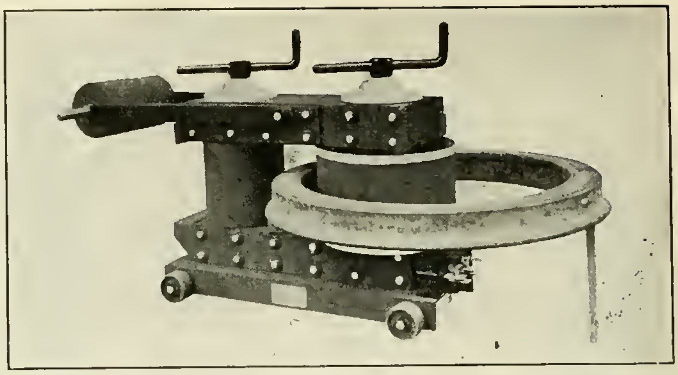
A SPECIAL portable transformer for heating wheel tires electrically has been developed by the Ateliers De Construction Oerlikon, Oerlikon, Switzerland. The apparatus is suitable for the heating of tires, gears, shrink rings, etc.; which work is generally done in an oil fire and occasionally by means of a gas, coal or coke fire, the tire or gear being heated until its diameter is expanded sufficiently to permit the shrinking of the same onto the wheel center. A disadvantage of the usual method as compared with electric heating is the lack of cleanliness, uniformity of heating and exact and proper heat control. The electrical apparatus has the added advantage that a single machine can be used to heat tires of any diameter.


Electric Tire Heater in Position for Applying or Removing the Tire

The device consists essentially of a transformer with a single primary winding. The transformer core has two vertical legs, a permanently connected yoke at the bottom which is mounted on four small wheels, and an upper movable yoke which can be pivoted on either one of the two vertical legs. The primary coil is placed around one of the vertical legs.

When a locomotive tire is to be heated, the movable yoke is swung to one side as shown in Fig. 1, and the tire is placed around one of the vertical legs. The movable yoke is then swung into position as shown in Fig. 2 and the two screw clamps placed in the position shown and tightened so as to effectively close the magnetic circuit. Single-phase alternating current is then connected to the primary coil, the tire then becomes a short-circuited secondary with a single-turn coil and a heavy short circuit current flows through the locomotive tire and heats it. The heating is uniform and can be regulated between wide limits by means of taps on the primary windings. Objects which have a diameter smaller than that of the primary coil can be heated by placing them around the other vertical leg of the transformer. To accomplish this, the counterweight is lifted over the two tightening screws to the opposite side of the movable yoke from that shown in the illustrations and the left hand screw is removed instead of the one on the right hand.

A 72-in. locomotive tire weighing 1,230 lb. can be raised from a temperature of 63 deg. F. to a temperature of 246 deg. F. in 20 min. This difference in temperature causes an expansion of about 1/10 in. in the diameter of the tire and the power consumption for doing the work is 12.2 kw. hr.

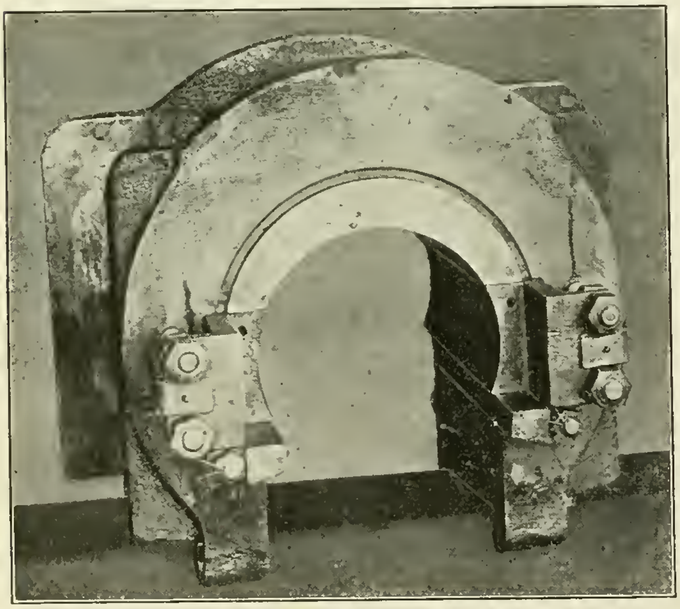


Locomotive Tire on Electric Heater in Position for Heating Tire

Service Tests of Adjustable Driving Box

THE locomotive driving box with adjustable bearings illustrated was designed by J. Murrin, superintendent of shops, and E. J. Brewster, general foreman, Chicago & North Western, and is now manufactured and sold by the Gill Railway Supply Company, Peoria, Ill. This box was described on page 685 of the December, 1922, *Railway Mechanical Engineer.*

A point insufficiently emphasized in the original article is that in service the driving box brass wears faster at the hub than at the inner end. It is not unusual to find a difference of 1/16 in. in calipering the outer and inner diameters of the main bearing. When the old type of bearing gets into this condition, it must be rebored or renewed. With the adjustable type bearing this condition can be remedied by removing the quarter brasses and taking a cut off the back of each of them. If the bearing is 1/16 in. too wide on one end, a 1/32 in. cut, tapering down to zero, is taken off each quarter bearing. These quarter bearings are then reapplied and the same main bearing used.

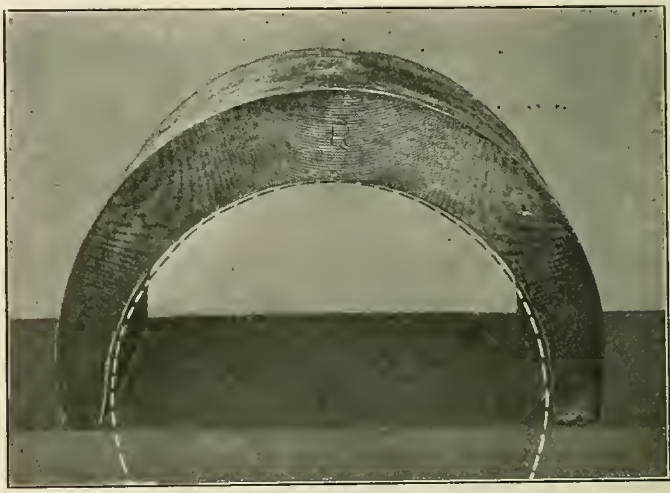


Two Narrow Wedges Operating Vertically Keep the Crown and Quarter Brasses Tight and Two Wide Wedges Take Up Wear on Quarter Brasses and Resist Thrust

The first box of this design was applied to the left main journal of a Pacific type passenger locomotive, the right main journal being equipped with an old style box at the same time, in October, 1920. Since then the new type brasses have been in service a total of 126,333 miles without renewal, the old style box requiring four new main brasses in the same time. The locomotive makes approximately 25,000 miles between adjustments of the quarter brasses. This form of construction has proved its economy and serviceability by the increased number of applications and at present, there are 155 locomotives equipped with the new style box, with additional installations constantly being made.

While the mechanical features of this box are easy to grasp and the simple construction is an important advantage in its favor, its main claim for extensive adoption on locomotives lies in the economy it promotes. It is said to save between 75 per cent and 90 per cent of the material and labor cost of driving box bearing repairs, also greatly reducing the cost when a bearing must be entirely replaced. The brass fit on this box can be bored on a boring mill in place of being slotted, which is a simpler process, more economical and more accurate. The hub liner can be bored at the same setting. The adjusting wedges and retaining keys on these boxes are interchangeable for all types of locomotives.

Bearing adjustments with this driving box are made easily so there is no need of bearings running with a destructive "pound." This pound is not only hard upon the bearings but causes severe jars and vibrations on the whole locomotive structure. While these bearings are comparatively new in locomotive service, quarter brasses have been used for many years on stationary engines for taking up thrust.



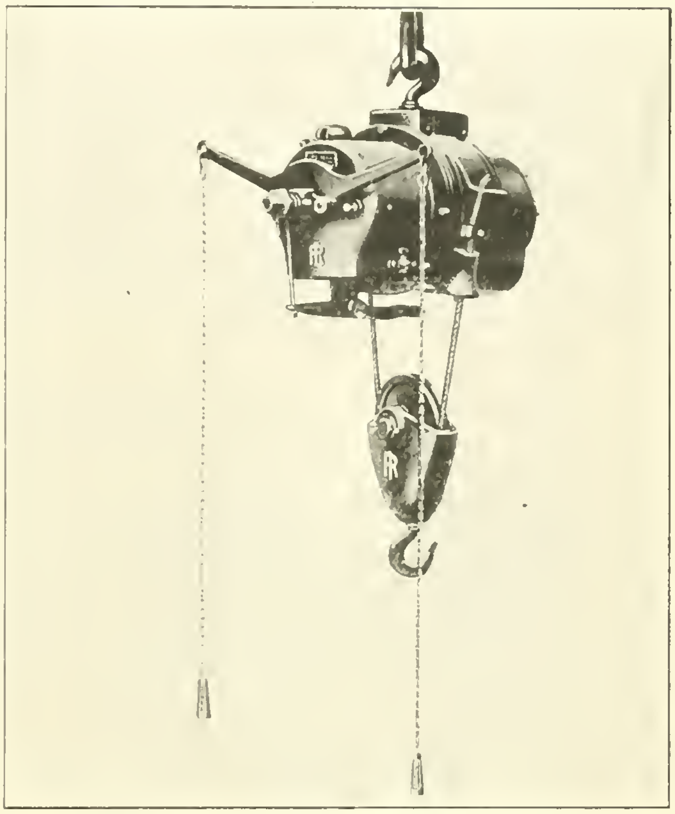
This Bearing Was Worn 3/32-in. Wide at the Bottom Axle Position Shown by Dotted Line

Air Motor Hoist of 500 Lb. Capacity

An air motor hoist of new design, of small size and capacity, is now being manufactured by the Ingersoll-Rand Company, New York. It can lift 500 lb. at the rate of 50 ft. per min. with an air pressure of 80 lb. per sq. in., to a maximum height of 15 ft. It has a net weight of 150 lb. and can operate on an air pressure of from 60 to 100 lb. per sq. in. This hoist is suited for a wide range of service where rapid and economical lifting in the handling of small tools, too heavy for one man to deal with, is desired. It is equipped with an automatic brake which holds the load positively. It works independently of the air supply, thus providing a necessary safety feature in case the air should be disconnected or fail.

A balanced, three-cylinder air motor is used, which operates in either direction and without vibration at any speed or load within the rated capacity of the machine. The hoist differs entirely from direct-acting cylinder hoists and lifts. The latter consist essentially of only the plunger and a case. The Ingersoll-Rand air hoist is equipped with an air motor, which is geared through a mechanical train to a hoisting drum. The throttle graduation hoist insures instant and complete control of the hoist at any speed. A safety stop lever is provided, which closes the throttle and stops the motor whenever the load is raised to the top of the hoist lift.

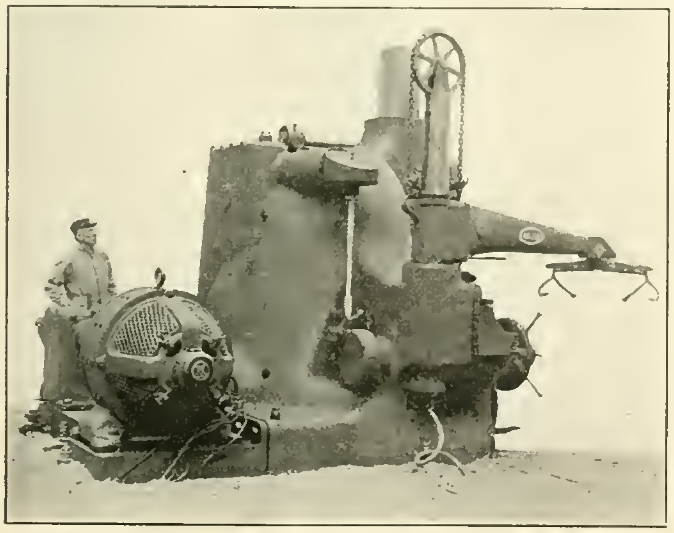
The brake consists of a disk attached to the shaft of the motor, and a brake plunger with a friction face, which is held in contact with the disk by means of springs whenever the hoist is not in operation. It is entirely automatic in its action and therefore requires no attention whatever from the operator of the hoist.



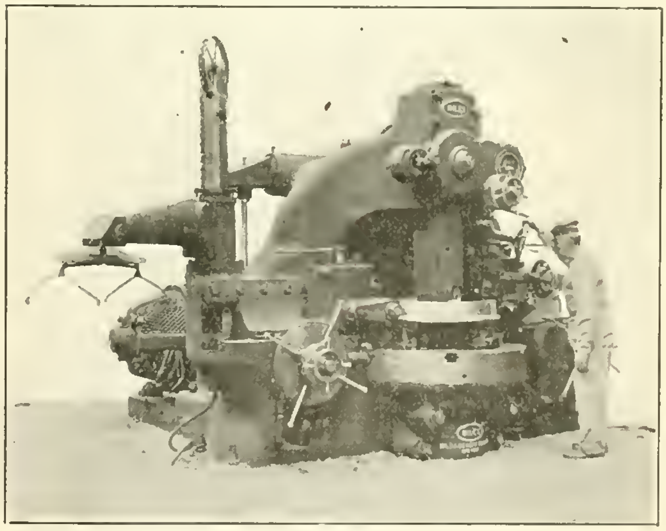
Front View of Ingersoll-Rand Air Motor Hoist

A Vertical Car Wheel Lathe

A newly developed machine tool has recently been brought out by the Niles-Bement-Pond Company, New York, for the purpose of machining rolled or forged steel car wheels. The principal object in designing this machine was to replace a number of the ordinary types of general machine tools heretofore employed in the manufacture of car wheels and thereby speed up production. This machine, styled a vertical car wheel lathe, receives the wheels as they come from the hot working operation. The operations accomplished consist of turning the contour of tread and flange, facing the hub and end on one side, bossing eccentric hubs where such exist, undercutting the rim and scribing the wear line. All these operations are handled simultaneously, with the exception of the last, which is postponed until the wheel is finished. The capacity ranges from 33-in. to 42-in. wheel diameters.



Rear View of Niles-Bement-Pond Vertical Car Wheel Lathe



Vertical Car Wheel Lathe with Wheel in Position for Turning

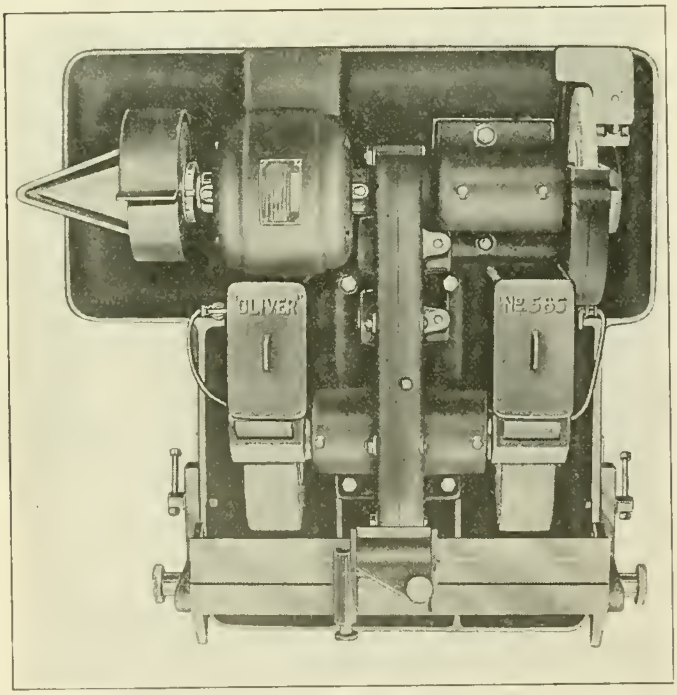
Some of the operations that the lathe handles are the same as those ordinarily accomplished on the standard car wheel lathe. The horizontal rotary table and the long square steel bar, adjustable vertically, bear out this rough similarity. The absence of any analogy to a cross-rail is, however, a marked departure. The square tool bar is adjustable vertically in the main housing and carries a toolholder with inserted blades which face off the hub and boss eccentric hubs. A special motor provides this bar with power down-feed and power traverse in both directions.

The main right-hand side head rough turns the flange and tread. It is provided with a power-feed. It carries an auxiliary tool head in which are fitted the tools which face and round the rim and undercut it, and another tool that later scribes the wear line. The tools have cross and vertical hand adjustment. The left-hand side head makes the finishing cut on both flange and tread and it is provided with vertical hand adjustment and power cross feed. The feeds to all heads are independent of each other and all have automatic trips which disengage the feeds at any predetermined point. The main driving gear is a cut spur gear with a 12-in. face twice the diameter of the table. A variable speed motor with a three to one range is direct-connected to the machine. All shaft bearings are provided with sight feed oilers. Handling and set-up time is minimized by the combination of a pneumatic crane with pneumatically operated center jaws which expand inside the center hole of the wheels, and three serrated, quick-acting driver dogs which support and drive the wheel on the table. A roller on the left-hand side head brought into contact with the wheel before chucking serves to center the wheel in place.

Variety Oilstone Tool Grinder

A NEW metal variety oilstone tool grinder to meet the needs of all kinds of woodworking shops where a small grinder is required for rapidly grinding and sharpening various woodworking tools has been recently placed on the market by the Oliver Machinery Company, Grand Rapids, Mich. The machine is mounted on a cast-iron column with a broad flanged base. It can be transported to any place desired, as it is unnecessary to bolt the machine to the floor.

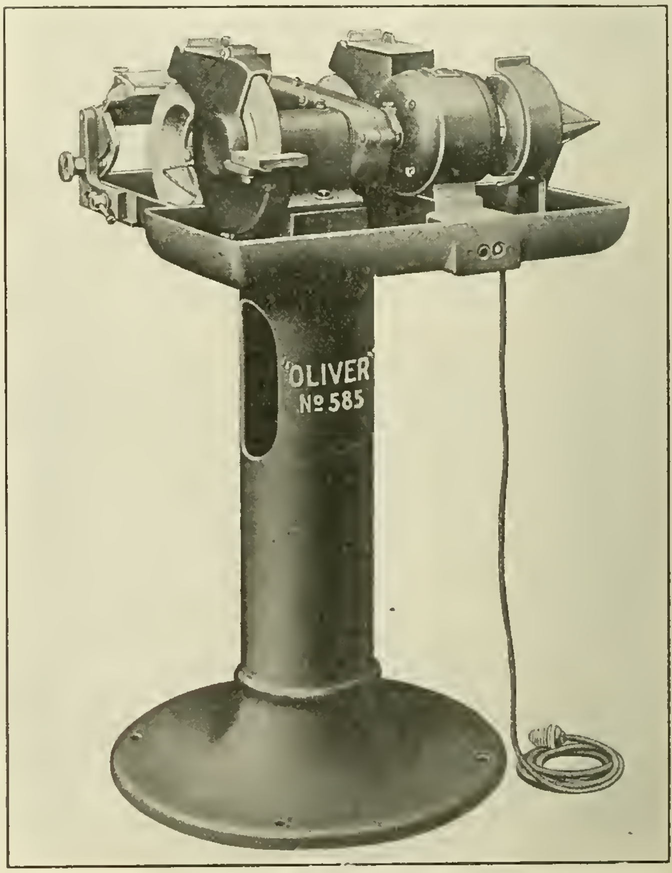
The machine is equipped with two oilstone wheels that are kept constantly saturated with kerosene or other oil, which flows by capillary action and centrifugal force from the center of the stones to the outer surface, thus keeping the pores free cutting. The oilstone wheels are of the cup type and run on ball bearings. One is a coarse grain wheel for rapid abrasion and the other is of a fine grain for putting a smooth, keen edge on the tool. These wheels are 8 in. in diameter with a 2-in. face and run at a speed of 300 r.p.m. Both of the wheels are well guarded. They are arranged with a table which acts as a tool rest. Plane bits, chisels and similar tools can be ground by fastening them in the toolholder, which has a micrometer feed.



Top View of Oilstone Tool Grinder

Directly mounted on the motor shaft is a cone and a leather stropping wheel, 6 in. in diameter with a 2-in. face, which runs at a speed of 1,800 r.p.m. The cone is useful for the inside of curved edges, irregular shaped tools, etc. On the other end of the same shaft is a general utility grinding wheel with an adjustable tool rest.

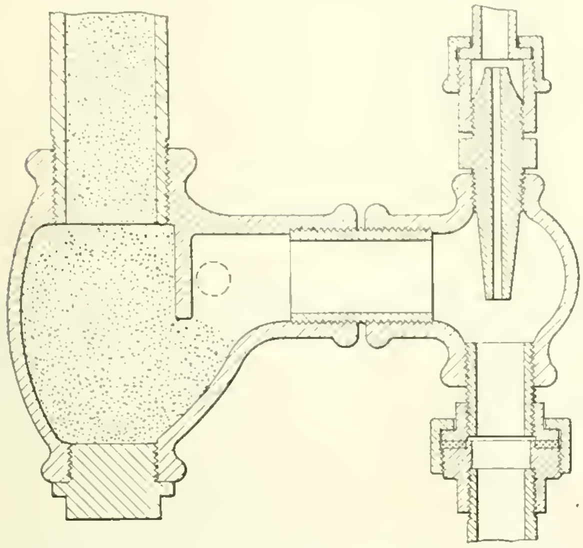
The machine is so arranged that four operators can use it at one time. All gears and bearings are fully enclosed with cast-iron covers. The motor is fully enclosed, operates at 1,800 r.p.m., either alternating or direct current, 110 or 220 volt, and may be run from an ordinary lamp socket.



Oliver Variety Oilstone Tool Grinder

The Pratte Vacuum Locomotive Air Sander

A LOCOMOTIVE sander operated in somewhat the same manner as an injector or vacuum pump is being manufactured by the Pratte Vacuum Air Sander Company, Denver, Col. It is simple in construction and can be applied to any sand box. The construction permits it to handle very coarse gravel or the finest sand. Moisture in the air pipes appears to have no ill-effect on its successful operation, and unlike most sanders it can throw from a few grains of sand to the full capacity of the pipe.

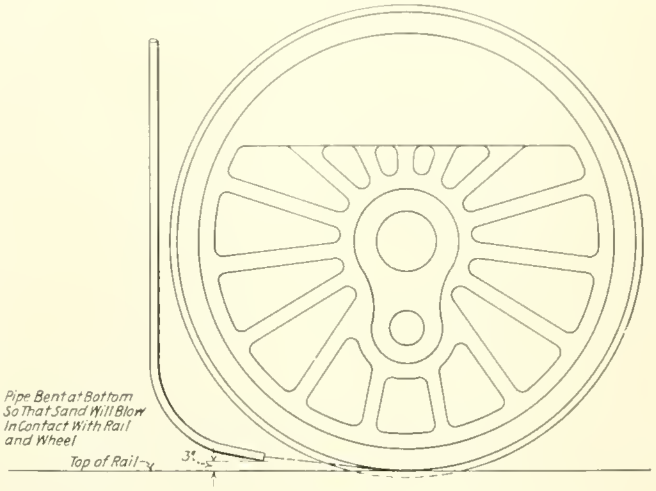


Sectional View of the Pratte Sander Showing the Relation of the Trap and Ejector Nozzle

The sand from the box drops into the trap of the sander by gravity. Thence it is drawn into the delivery pipes by air passing through air nozzles located in the top of the vacuum chambers. A force sufficient to deliver sand anywhere required is created by vaccum and by taking in air through the vacuum holes in the body of the sander. The force at which the sand travels leaves practically no sand in the long runs of horizontal pipe when the air valves are closed. This eliminates stopping up by accumulating sand.

The atmosphere pipes, screwed into the body of the sander, are only used to keep snow or rain from coming in contact with the sand. The 1-in. plug in the bottom of the device is for removing rock, waste or other substances that may not be drawn through into the delivery pipes.

A rod is passed through the body of the sander into the box to loosen the sand when it becomes baked and hard. By regulation of the air valve, considerable sand can be saved and in times of severe weather it prevents the ends of the delivery pipe from being stopped up with snow and ice.

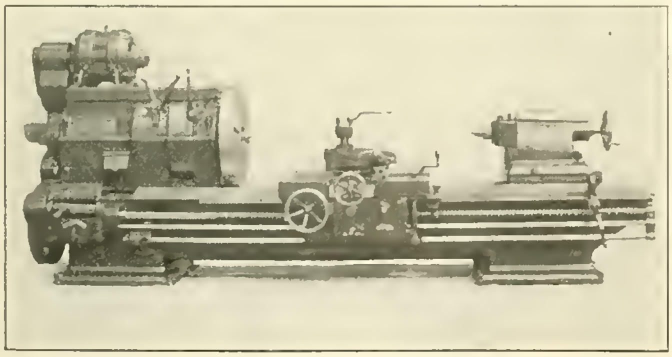

Pipe Bent at Bottom So That Sand Will Blow In Contact With Rail and Wheel
Top of Rail
3"

Relation of the Sand Pipe to the Driving Wheel and Rail

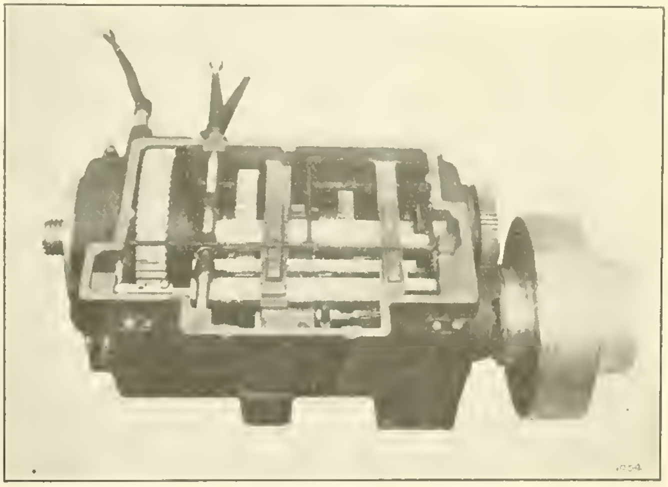
Improved Heavy Duty Lathes

THE R. K. Le Bond Machine Tool Company, Cincinnati, Ohio, has recently placed on the market an engine lathe in which has been incorporated a number of new features. The lathes of the new design range in sizes from 25 to 36 in. Special attention has been given in the design to provide rigidity of all parts with the increase in driving power. The lathe has 16 spindle speeds, selective in geometric progression, obtained with two levers.

All the gears are of chrome nickel alloy, heat treated and hardened, with stub form teeth. They are provided with multiple keyways which are broached from the solid metal. The shafts have multiple hobbed splines. There is a separate feeding rod for driving feeds, and provision has been made for cutting the special coarse leads or metric threads by applying gears at the end of the box.



Front View of the LeBlond 30-Inch Lathe



Interior View of Headstock of LeBlond 30-Inch. Lathe

The head stock is of massive construction and is automatically oiled, the lubricant being pumped to all of the bearings and the gears running in an oil bath. The motor is mounted on top of the head stock and the drive is transmitted through a motor pinion and intermediate gear to the broad faced gear that replaces the driving pulley. The full number of mechanical speed changes are retained in the head stock. The manufacturers also offer this lathe with double motor drive, in which case the motor is mounted on a plate attached to the base of the lathe. By this method the drive is transmitted through a high speed, endless, double leather belt to the driving pulley. A tightener pulley, mounted on roller bearings, is provided to increase the contact area of the belt on the pulleys.

The weight of the lathe, with a 10-in. bed, is 13,200 lbs. The distance between centers is 2 ft. 10 in., with a steady rest capacity of 10½ in. The driving pulley runs at a constant speed of 500 r.p.m., and has a multiple disk clutch and brake running in oil. The spindle, which is 4¾ in. in diameter by 3¾ in. long, is started and stopped from the front of the headstock. In order to provide for the requirements of special work, a turret can be applied to the carriage. A turret tool post and a taper attachment are also among the attachments available.

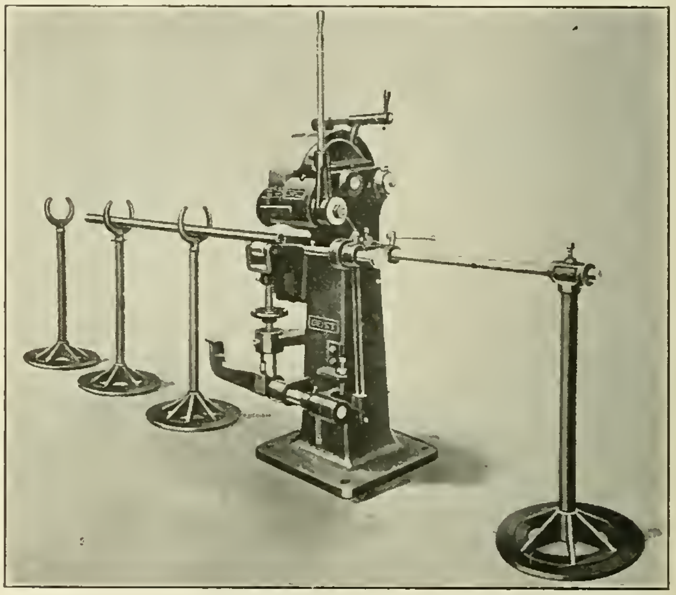
A Heavy Duty Roller Pipe Cutter

A PIPE cutter, in which is embodied a number of important features found to be essential for heavy duty, has been placed on the market by the Geist Manufacturing Company, Waynesboro, Pa. The machine is made only in the No. 2 size and is compact and rigid in design. All spindles and shafts are ground and run in bronze bushed bearings. The gears are enclosed, but are accessible at all times.

The cutter is made from tool steel and heat treated to give maximum wearing qualities. It can be reground when dull. The cutter shaft bearing is provided with an adjustable cap on the cutter side for taking up any wear which may occur.

The rollers, made from tempered tool steel, are carried in roller bearings and can be adjusted to the different sizes of pipe. This adjustment is obtained by means of a hand wheel located just below the rollers. The lever and the pedal can be positioned to suit the operator. Their movements are limited by an adjustable stop. A small cage of rollers for ⅛-in. to ⅜-in. pipe can be attached to the large cage without removing the regular rollers. The cage which supports the rollers is elevated to the cutter by a cam operated jointly by a pedal and a lever. The sliding surfaces of the cage are protected from scale and dirt by flexible guards.

The length gage is adjustable to different sizes and lengths of pipe. It will gage lengths of pipe up to and including four feet. Parts coming in contact with the revolving pipe are hardened to resist wear. The gage arm is a heavy casting.



View Showing Geist Roller Pipe Cutter With Pipe in Position

Tests of Corrosion-Proof Cement

EXPERIMENTAL investigation conducted by G. F. Gebhardt, consulting engineer, Chicago, of the corrosion-proof cement made by Robert M. Lucas Company, Chicago, brought out a number of important facts pertaining to the properties of this material. The tests were planned to show the action of the material under all conditions of service likely to be met in railway practice. They were grouped under three general headings; namely, chemical, physical, and electrical. Tests also were made with other cements for the purpose of comparison.

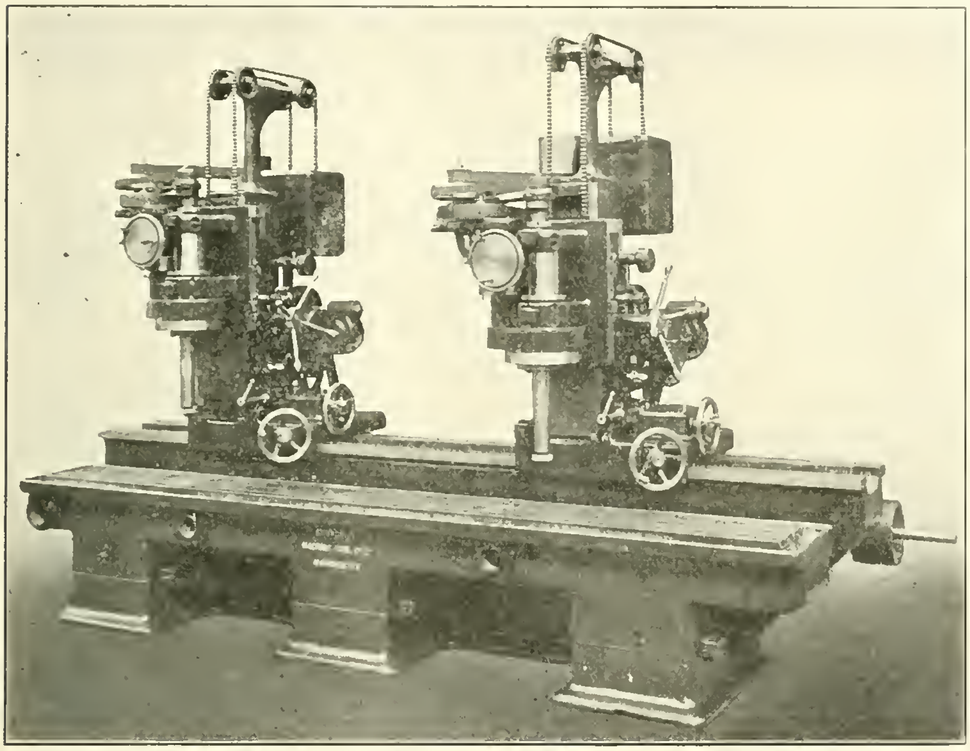
The chemical tests continued without interruption for more than a month. The object was to determine the resisting qualities of this cement as a protective coating against acids, alkalies and gases, hot or cold. The results showed that the stronger acids had some action on it, but the resisting qualities were good. Weak acids and alkalies, moisture, smoke, furnace gases and fumes had practically no effect. Physical tests were run for the purpose of determining the behavior of the material under alternate heating and cooling, and also its value as a heat insulator. An iron plate, ⅛ in. thick, was covered with Lucas cement and allowed to dry thoroughly. It was then heated to a temperature of 140 deg. F. during the day and allowed to cool to 65 deg. F. during the night. This treatment was continued for 30 days and the coating watched closely for warping, curling, or cracking. Nothing of the sort was noted, the material remaining in the same condition as when applied.

Heat conductivity tests were made on an iron plate, first bare and then covered with Lucas cement. The test outfit used was the hot box conductometer, commonly known as the "postal" box. The results of these tests showed that a coating of Lucas cement 1/16 in. thick on an iron plate will reduce the heat flow through it by 36 per cent. This is an important factor wherever it is desired to reduce the flow of heat into a car having metal sides, ends or roof. The cement tends to keep the surface at a higher temperature and condensation, or sweating, is generally reduced.

In the electrical tests, it was shown that the cement had no measurable galvanic action with metals. This test was run to show whether local actions due to the galvanic or battery action, which sometimes occurs between different parts of a structure, especially in the presence of moisture, can be minimized. The corrosion tests showed that there was a high resistance to electrolytic action.

Double-Spindle Vertical Hole-Grinding Machine

ONE of the interesting machines developed for railroad shop use by the Churchill Machine Tool Co., Ltd., Manchester, England, is the double-spindle vertical hole grinder illustrated. This machine corresponds with the duplex rod boring machine, familiar in American railroad shops and, like it, is used on rod work, being adapted to truing holes which have become elongated and out-of-round in service. The grinder is especially adapted for this work because it trues the holes quickly, accurately and with the removal of the least possible amount of metal.



Churchill Model U H Double-Spindle Hole Grinder Adapted for Rod Work

The machine illustrated is provided with two spindles having planetary motion and will grind holes up to 12 in. long. The machine is by no means limited to rod work, however, since each head can be independently operated for other grinding work. The grinding heads are each provided with hand adjustment, both lateral and transverse for positioning the spindles. The grinding wheel spindles are provided with planetary motion, adjustable while grinding is proceeding. Each spindle head has automatic vertical reciprocating travel on the column, adjustable for length of stroke.

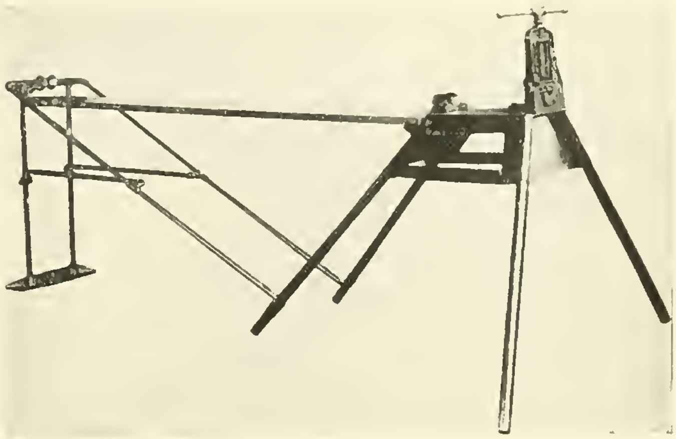
The eccentric stroke of the grinding spindles is from zero to 1¾ in. The maximum diameter of the hole to be ground is, therefore, the wheel diameter plus 1¾ in. The automatic vertical traverse of the spindle head is 12 in. and the cross adjustment 6 in. The maximum distance between spindle centers is 140 in. which can be made longer if required. The minimum distance between spindle centers is 33 in. The working surface of the table is 144 in. by 12 in. With belt drive from a countershaft, 14-in. pulleys are used with 3½ in. belt. A countershaft speed of 460 r.p.m. is recommended. With motor drive a 7½-hp. constant speed motor, running at 650 to 750 r.p.m., is recommended. The approximate net weight of this double-spindle hole-grinding machine is 13,440 lb.

A Portable Vise Stand and Pipe Bending Tool

A PORTABLE vise stand and pipe bender has been developed by H. B. Martin & Sons, Owensboro, Ky., which is built of No. 16 sheet iron, riveted in place and braced at the corners with angle irons, which serve also as sockets for the four supporting legs.

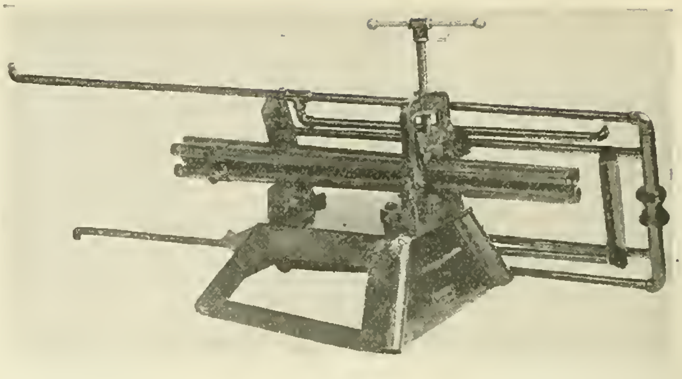
The legs are steel tubing, long and strong enough to support the frame at a convenient height for use and at the same time extend outward sufficiently to brace the stand against upsetting, tilting or skidding without requiring other support, whether upon a floor, sidewalk or the ground. The stand is equipped either with a hinge or chain vise, as desired, which is fixed rigidly to the top of the frame at one end in such a position that short nipples can be threaded without injury to the hands. At the end of the frame a device is provided which serves both as a guide and a rest for pipe while it is being cut or threaded and as a means of bending pipe or conduits from ⅛ in. to ¾ in. in diameter. The latter device is always ready for instant use without adjustment and is said to enable bends to be made not only free from kinks but at the exact point in the pipe where they are wanted.

When it is desired to dismantle the equipment the legs are simply pulled out of the sockets and fastened in the vise, whereupon a handle is provided in a convenient position with which to carry the outfit. Since the sides of the frame are open, with a brace across the bottom of these sides, the frame also provides a convenient rest for the pipe tools where oil from the stocks will drain off without running down the



The 4½-In. Capacity Stand Set-Up with a Rear Support for Handling Full Lengths of Pipe handles. The equipment of the size and capacity described weighs only 50 lb., is said to take but one-half minute either to assemble or to dismantle and can be set up in a 6-ft. by 8-ft. space.

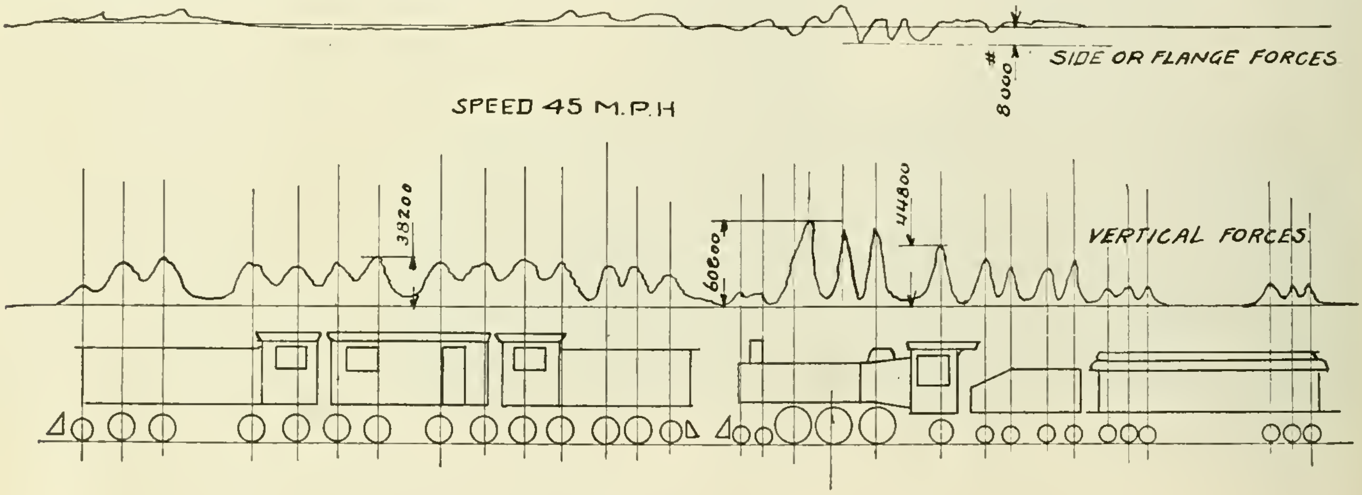
The outfit described is built to handle pipe ranging from ⅛ in. to 2½ in. in diameter. For pipe up to 4½ in. in diameter a heavier stand is provided with which is also furnished a rear support, permitting full length of pipe to be used without tilting the stand. A roller on this rear support, aside from keeping the correct alinement, enables one man to move full lengths of pipe forward or backward at will. With this equipment the bender capacity is increased sufficiently to handle one-inch pipe with ease. The weight of this machine, complete with a four-inch hinge vise, is 172 lb. and with a chain vise, 156 lb.



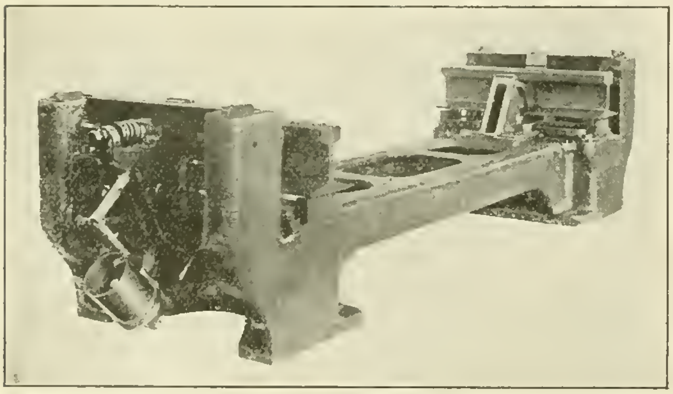
The Large Size Stand Assembled for Transporting

Tie to Determine Wheel Impact on Rail

An interesting device, known as an otheograph, which is in effect a test tie for measuring simultaneously the vertical and transverse thrust or impact of a wheel on a rail, has been recently developed by the General Electric Company, Schenectady, N. Y., and a number of these ties are being installed on the company's test tracks at Erie, Pa. The instrument shows by graphic records the effect of each separate wheel of a locomotive or car on each of the two rails.



Experimental Record Made of a Test on C. M. & St. P. Electric and Pacific Type Steam Locomotive Coupled Together. Figures Show Approximate Stresses in Pounds



A General View of the Otheograph Tie

These otheograph ties may be installed in place of the regular ties, either singly or several grouped together on curves or tangent track. Provision is made for the use of two different springs for recording the vertical load, one having a deflection of about ⅛ in. for each 25,000 lb. of axle loading, and the other spring having the same deflection for each 50,000 lb. of axle loading. The springs are designed for a maximum deflection of ⅜ in. The springs for recording the transverse thrust have a deflection of about ⅛ in. for each 20,000 lb. The deflection of the spring is recorded through a lever having a ratio of 8 to 1, the record being traced on paper wrapped around a revolving cylinder similar to an engine indicator. The operating mechanism provides for moving the recording cylinder on any number of ties simultaneously so that as many records may be taken of each wheel on each side of the locomotives as there are ties that are grouped together.

In the fall of 1922 there were 152 locomotives, 116 tenders, 242 passenger cars, 1,682 closed freight cars, 870 open freight cars and 3 cranes in use on the Greece State Railway system. Nine of these locomotives, however, were left in Asia Minor, and 20 per cent of the remainder and 30 per cent of the passenger cars were in bad order. The locomotives are small and of old design, except a few bought in the United States and some "armistice" engines turned over to Greece out of deliveries from Bulgaria and Germany. The cars are small and badly worn.

The poverty of the Greek state has prohibited any except emergency remedies, and replacements have been almost out of the question. Earnings in pre-war years have been replaced by deficits that have resulted from costly working of inefficient locomotives, from increased wages, from higher repair costs, and from expensive track maintenance.

GENERAL NEWS

A report from Valparaiso states that a project is to be submitted to congress for the expenditure of $80,000,000 on the construction of new railways in Chile.

The International-Great Northern has appealed to the United States Supreme Court in the suit involving its desire to move its shops from Palestine, Tex., to Houston.

The Freight Car Shops of the Texas & Pacific at Marshall, Tex., during the month of August, built 146 new cars and rebuilt 69. On one track, running repairs were made on 1,917 freight cars.

The Missouri Pacific has increased its average miles per car per day from 20.84 in April to 31.98 in August. During August the road also established another record by loading locally and receiving from connections 130,810 cars compared with a previous record of 125,347 cars in October, 1916.

The Pennsylvania Railroad offers $1,000 in prizes in an essay contest, open to all employees, on the subject of "The benefits of employee ownership of stock and securities of the Pennsylvania Railroad through the Employees' Provident and Loan Association." In each of the four operating regions, at Altoona Works, and in the general offices, three prizes are being offered for the best essays written by the employees. The first prize will be two shares of stock (par value $50 per share) in the Pennsylvania Railroad Company, the second prize one share of stock, and the third prize a credit on the books of the Provident and Loan Association amounting to half the cost of one share of stock.

Rumored That P. R. R. Will Buy Equipment

It is reported from several sources that the Pennsylvania is making plans for the purchase of a large number of locomotives and cars and also of a considerable tonnage of rail. This information has not as yet been officially confirmed.

Anthracite Shipments for September

Shipments of anthracite for the month of September, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 2,194,940 gross tons. Operation was resumed on September 19, and during the ten working days to the end of the month, there was a daily average shipment of 219,490 gross tons. This daily average could have been materially increased had the collieries resumed full operation on September 19. Some, because of an insufficient force of men, did not resume operation until a later date. The average daily shipment during the preceding month of August, was 247,105 tons.

Savannah Shops Receive Safety Banner

A banner has been awarded to the employees of the Savannah Shops of the Atlantic Coast Line in recognition of the safety record made in those shops during a period of three months in which there was only one personal injury that caused a loss of time of more than three days. The total number of employees in these shops is 554. Robert Scott, chairman of the General Safety Committee, gives credit for this excellent record to J. W. Reams, master mechanic, and his assistants, and to the members of the local safety committee. On the Atlantic Coast Line as a whole there are 28 safety committees on which serve 350 members.

Fires

The Gadsden Car Works, Gadsden, Ala., owned by Southern Railway interests, sustained a loss of about $300,000 by fire on October 11. The erecting shop, 200 ft. x 600 ft., was destroyed, together with other property, and 66 new freight cars. The main car shop was not damaged.

The car shops of the Pennsylvania Railroad at Camden, N. J., were damaged by fire on the night of October 15 to the extent of about $500,000. One of the four main buildings, 60 ft. x 300 ft., was destroyed and 12 coaches were badly damaged. By heroic efforts, the small force of men on duty saved 15 comparatively new coaches. Of the 1,800 men employed at these shops, about 400 worked in the section destroyed.

Pennsylvania Savings Fund to be Discontinued

Since the formation, in July of this year, of the Pennsylvania Railroad Employees' Provident and Loan Association, which has a saving fund provision, the need for the Pennsylvania Railroad Employees' Saving Fund, established by the company in 1888, has ceased to exist; and the Board of Directors of the road has issued an order stopping the receipt of deposits by the older fund after October 31, and discontinuing payment of interest on deposits on December 31, 1923. Depositors may transfer money to the Saving Fund of the new Employees' Provident and Loan Association.

The Pennsylvania Railroad Employees' Saving Fund has regularly paid an average of 4 per cent interest on deposits and has very successfully provided the facilities for which it was intended.

Wage Statistics for July

The monthly returns of Class 1 carriers to the Interstate Commerce Commission show that since January, 1923, there has been an increase from month to month in the total number of railroad employees. For the month of July, 1923, the summary shows a total of 1,954,687 employees, an increase of 20,758, or 1.1 per cent, as compared with the returns for June, 1923, and exceeds the employment reported for July, 1922, by 486,863, or 33.2 per cent. This abnormal increase resulted partly from the shopmen's strike, which became effective on July 1, 1922, and partly from the larger business of 1923. The total compensation reported for July, 1923, compared with that for June, 1923, shows an increase of $2,677,760, or 1 per cent, and in most cases the average monthly earnings show increases as compared with July, 1922.

Record Established in Locomotive Repairs

The El Paso shops of the Southern Pacific has established, what is claimed to be, a record in repairing locomotives. It turned out in 72 hours a Mikado type locomotive sent into the shops for Class 2 repairs. These repairs consisted of a new firebox, flues and general repairs to the machinery, including turning or renewing all of the tires. This sort of job ordinarily requires 40 days to complete. The locomotive was 11 days in the shop, of which two were Sundays when no work was performed, making a total of 9 eight-hour working days, or 72 working hours. Nearly every man in the shop had a part in establishing this record. In addition to breaking speed records for work of this type, the project put the facilities of the new erecting shop to a test that proved satisfactory.

The Monthly Report on Equipment Inspection

The monthly report to the President on the condition of railroad equipment just sent in by the Interstate Commerce Commission shows that in September 5,262 locomotives were inspected by the Bureau of Locomotive Inspection, of which 47.6 per cent were found defective, and 422 were ordered out of service. The percentage found defective is less than has been shown for any month since the shop strike was begun in July, 1922. During the same month 94,517 freight cars were inspected, of which 4½ per cent were found defective and 1 917 passenger cars, of which 2.3 per cent were found defective. During the month two cases involving 72 violations of the safety appliance act were transmitted to various United States attorneys for prosecution.

New York Central Shopmen Vote to End Piecework

By a vote of 10,000 to 4,000, shopmen employed by the New York Central have decided in favor of the abolition of piecework. There are 19,000 shopmen in the employ of the road and 14,000 voted. The Railroad Labor Board will be called upon to pass on the action of the shopmen. The case is a continuation of the one decided by the Railroad Labor Board last March, at which time the New York Central was ordered to operate its shops on an hourly basis. The ruling was protested by the New York Central authorities Subsequently the Labor Board amended its decision, postponing the date upon which the road was ordered to install work on an hourly basis, and the case was remanded pending new negotiations.

Pennsylvania Shop Craft Elections

A final report of the elections held this year in the four operating regions and the Altoona Works shows that 85.9 per cent of all the shopmen on the entire Pennsylvania system voted, by secret ballot, for representatives on the various shop craft committees. The management believes that the result removes any reasonable doubt that might have existed as to the real desires of the Pennsylvania shopmen to be represented by employes elected by themselves. On the Southwestern Region 92 per cent of the shopmen participated in the balloting.

The complete returns show that 60,845 shop employees were eligible to vote for employee representatives in this branch of the service. The total number of ballots cast for employee representatives was 52,278. Out of the total number of votes cast, only 2,601, or less than 5 per cent, were declared to be invalid by the election tellers, jointly appointed by the men and the management.

Extent of Earthquake Damage to Japanese Railways

The New York office of the Japanese Government Railways received the following information by cable concerning the extent of the damage done by the earthquake to its railway lines.

The head office, the government railway hospital in Tokio, the government uniform manufacturing shops in Tokio, the government lumber creosoting plant in Tokio and the following stations were all destroyed: Shimbashi, Manseibashi, Iidamachi, Ueno, Ryogoku (all in Tokio), and Sakuragichi (in Yokohama, the terminal of the electric line between Tokio and Yokohama).

The Tokaido Line, east of Hakone and around Tokio was seriously damaged. Officials and employees' residences at Shiodome, near Shimbashi, Ueno and Ryogoku were entirely burned down, but no casualties resulted among the chief officials.

The losses also include the burning of 416 passenger cars, 31 electric cars, 893 freight cars, and 33 locomotive engines.

Law as to Handholds on Car Roofs Held Applicable to Tenders

The Georgia Court of Appeals holds that the provision of section 2 of the Federal Safety Appliance Act requiring that "all cars having ladders shall also be equipped with secure handholds or grabirons on their roofs at the tops of such ladders," in view of the rule of the Interstate Commerce Commission, conceded to apply to tenders, that: "A suitable metal end or side ladder shall be applied to all tanks more than 48 in. in height, measured from the top of end sill, and securely fastened with bolts or rivets," and the undisputed evidence that a tender (with its locomotive) is within the class of "cars having ladders," and in view also of the general intent and purpose of the act, was properly held applicable to the tender, notwithstanding that a tender, in a strict and literal sense, may have no roof.—Davis v. Maury (Ga. App.) 117 S. E. 283.

C. N. R. Neebing Terminal in Service

The Canadian National's new terminal at Neebing, near West Fort William, Ont., has been placed in service. The terminal was built to expedite the handling of grain traffic, most of which goes via lake from this point eastward.

The Neebing yard is designed to handle 2,000 cars a day classifying them for distribution to the elevators and vessels. Most of the cars will be put over the hump. There are eight receiving tracks with a capacity of 80 cars each; an eastbound classification yard with 20 tracks of a total capacity of 1,250 cars; a westbound departure yard of 13 tracks, each with a capacity of 80 cars, and repair tracks with a capacity of 108 cars.

The buildings and equipment include a 24-stall roundhouse; an 85-ft. electrically operated turntable; a 300-ton coaling station; a 150,000-gal. steel water tank; a 1,000-gal. oil tank; an automatic electrically driven ash remover and loader, as well as other modern mechanical features in and about the repair yards, engine houses and plant.

Locomotive Shipments in September

The Department of Commerce has given out its September figures on shipments of locomotives from the principal manufacturing plants, based on reports received from the individual establishments, as follows:

	September, 1923	August, 1923	September, 1922	Nine months' total January to September 1923	Nine months' total January to September 1922
Shipments—					
Domestic	313	259	113	2,115	585
Foreign	22	13	6	136	175
Total	335	272	119	2,251	760
Unfilled orders (end of month)—					
Domestic	1,102	1,406	1,347	....	....
Foreign	76	91	116	....	....
Total	1,178	1,497	1,463	....	....

Motor Trains Increasing in France

The use of internal-combustion motors for trains appears to be developing rapidly in France. The state lines, it is announced, have recently placed an order for 10 units on the model of the one tried out successfully between Mortagne and St. Gauberge, the engine being built into an ordinary passenger coach. The Renault firm is also actively engaged in perfecting a new type of motor train called the Scemia-Renault, which was run on trial recently over the lines of a local Rheims company. This car carries 40 passengers and is equipped with double-end controls whereby the necessity of a turntable is avoided. On the 350-mile stretch between Rheims and Asfled, with 2.5 to 2.8 per cent grade, the average gasoline consumption was 108 gallons per 1,000 miles and the average speed 25 miles per hour. With a trailer, the consumption would be 138 gallons. It is stated that orders for six cars have been received and that the Societe des Transports en Commun de la Region Parisienne, which controls all the surface traffic in and around Paris, intends to place one of them in regular service on the Versailles-Les Mureaux line.

Recent Labor Board Decisions

A number of decisions of local character have marked the return to activity of the Railroad Labor Board after the summer vacation. Clerical employees on the Southern Pacific holding positions of minor or supervisory authority below the rank of subordinate officials have been granted all of the privileges accruing to the ordinary workers, including the eight-hour day, benefits of the rule relating to discipline, seniority, overtime and various other provisions. The board denied a petition for rehearing by the Gulf Coast Lines and the Houston Belt & Terminal on a decision handed down June 29, directing that a secret ballot be taken to determine whether the Railway Employees' department of the American Federation of Labor or a "company" organization should represent the shop employees on the two lines.

Shopcrafts employees on the Michigan Central and the Ann Arbor have been granted wage increases of two cents an hour, according to notices recently sent to the Labor Board.

A railway employee's membership or non-membership in a labor organization is not a matter of compulsion, according to a decision of the Labor Board in sustaining the complaint of the Switchmen's Union of North America against a contract of the San Antonio & Aransas Pass and the Brotherhood of Railroad Trainmen guaranteeing that 85 per cent of the road's yard employees should be members of the trainmen's organization. In the board's decision it was noted that the Switchmen's Union of North America "negotiated the first percentage agreement ever executed, but that organization has renounced the practice and become a victim of it." Reinstatement of an employee who had been discharged through operation of the percentage provision was ordered by the board. In another decision, the Labor Board held that it was without jurisdiction to pass upon the question of the removal of the shops of the Missouri-Kansas-Texas from Sedalia, Mo., to New Franklin.

The Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen presented requests for wage increases of 12½ per cent to roads in all parts of the country on October 1. The petitions were filed with the roads whose contracts expired on that date and others will be filed when later contracts expire. The requests are for restoration of the scales in effect before the reduction of July 1, 1921.

National Exposition of Power and Mechanical Engineering

The second exposition of Power and Mechanical Engineering is is to be held in the Grand Central Palace, New York, from Monday to Saturday, December 3 to 8 inclusive. This exposition is being held at the same time that the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers are meeting in New York. In addition, the National Association of Stationary Engineers and affiliated bodies are organizing to interest their memberships in the exposition.

The exhibits will be supplemented by an extensive program of moving picture films to be presented in co-operation with the manufacturers. About 200 exhibitors have signed contracts for space at the exposition. The devices and apparatus to be exhibited are aimed to cover the field of power and mechanical engineering and the many special subjects devoted to this field of engineering work. One section of the exhibits will be devoted entirely to meters and other instruments for power plant control. The managers of the exposition are Fred W. Payne and Charles F. Roth, with offices in the Grand Central Palace.

Gas Manufacturers to Co-operate with Welding Schools

The Gas Products Association, Chicago, recently appointed an educational committee to co-operate with trade and technical schools all over the country in supplying a practical and standard course in welding procedure. The application of the welding processes has been extended to so many new fields that the demand for skilled operators is constantly increasing. It is felt that the welding school instructors are desirous of giving the students such training as will guarantee them the very best earning power. By making a thorough investigation of the needs of the industry and then making recommendations to the instructors, the course of study can be revised and standardized so as to more fully meet the requirements of the employers. The plan has already been submitted to some schools and has met with their co-operation.

The committee will endeavor to build up a list of accredited schools which are known to give standard instruction and whose students can be depended on to qualify as satisfactory welding operators. It is proposed to make this educational movement effective all over the country, as the members of the association have gas and apparatus manufacturing plants in practically all of the important industrial centers of the United States.

MEETINGS AND CONVENTIONS

Annual Meeting American Society of Mechanical Engineers

The forty-fourth annual meeting of the A. S. M. E. will be held in New York, December 3 to 6. The opening day of the meeting will be devoted to the meetings of the council and the administrative committees. The technical sessions will start on Tuesday. The Power Division will have a session on boiler plant economies. The Railroad Division is centering on the subject of modern subway cars and their operation. The Fuels Division and the Materials Handling Division are co-operating in one session on the subject of coal storage. The Machine Shop Practice Division will consider the development of modern metal stamping practice and will hear a progress report of the Research Committee on the present status of the art of cutting metals. The Management Division has a program on the relation of mechanical engineering to management in the metal working and other industries. In addition to the technical sessions, there will be a public hearing on the Power Test Codes for Stationary Steam Generating Units and the Test Code for Locomotives.

New York Railroad Club Will Hold Annual Dinner on December 6

The New York Railroad Club will hold its fifth annual dinner at the Hotel Commodore, New York, at 6:15 p. m. on December 6. Reservations may be made until November 24 by application to H. M. Norris, secretary to the president, Interborough Rapid Transit Company, 165 Broadway, New York; subscription price, $5 a person.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical. V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting November 8. Paper on "Jewels of Industry" will be presented by Francis Bowman, advertising manager Carborundum Company, Niagara Falls, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting November 13, annual dinner and election of officers.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting November 13, Copley-Plaza Hotel, Boston. Paper on "A Railway Contribution to the Development of a Nation" will be presented by D. C. Coleman, president, Canadian Pacific.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Annual dinner December 6, Hotel Commodore, New York, N. Y.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting November 9. A paper on "Europe—Five Years After the Armistice" will be presented by Dean Scarlett.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The American Steel & Wire Company has purchased 130 acres of land at Gary, Ind., on which it will construct a new plant.

The McMyler Interstate Company, Cleveland, Ohio, has removed its New York City office from 50 Church street to the Woolworth building, 233 Broadway.

A. W. Gillespie & Co., 426 South Clinton street, Chicago, has changed its name to the Ar-an-ess Manufacturing Company, and will continue the business at the same location as heretofore.

The property of the Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, has been sold at public auction to R. Huntington, of the Huntington National Bank, Columbus, Ohio.

The Blacker Engineering Company, Inc., New York, manufacturers of blacksmithing hammers, has opened an office in Pittsburgh at 421 Wood street, with George Hesse as district manager.

John Knox Nimock has been appointed assistant purchasing agent of the American Car & Foundry Company, New York. Mr. Nimock was born in Ireland and came to the United States in 1894. He received his education in the Southern Illinois Normal University at Carbondale, Ill., in return for which he taught in the public schools of the state. After taking up a business course he entered the service of the American Car & Foundry Company at St. Louis, Mo., in 1904, and was transferred to New York in 1918. Mr. Nimock started work with the American Car & Foundry Company as a stenographer and has been steadily advanced until he now becomes assistant purchasing agent, with headquarters at New York City.

J. K. Nimock

Milton C. Fidgeon, who has served for a number of years with Joseph T. Ryerson & Son, Inc., Chicago, has been appointed eastern machinery sales manager, with office at 30 Church street, New York City.

The American Brake Shoe & Foundry Company will construct a new plant at North Kansas City, Mo., and is now accepting bids on a foundry, sand and cleaning shop and machine and repair shop, at an estimated cost of $300,000.

H. A. Wilson has been appointed manager of the Detroit branch of the Gibb Instrument Company, Bay City, Mich., succeeding F. M. Luchs, resigned. Mr. Wilson was formerly district manager in New York for A. P. Munning & Co.

Albert S. Boisfontaine, assistant to the manager of the Southern Pine Association, New Orleans, La., since last June, has been appointed assistant secretary. Mr. Boisfontaine has been serving in a number of capacities with the association since 1917.

P. E. Stickler, formerly locomotive engineman on the Southern Pacific and L. H. Rupert, formerly locomotive engineman on the Mexico North Western, have been appointed service engineers of the Franklin Railway Supply Company, Inc., New York.

The Linde Air Products Company, New York, recently started continuous operations in its new oxygen producing plant, Savannah, Ga. S. P. Wilson, Jr., is operating superintendent. An additional warehouse has also been opened at Charlotte, N. C.

Blake D. Hay has been appointed district manager of the Williams Tool Corporation with headquarters at Chicago. Mr. Hay, formerly located at Erie, Pa., will take charge of the Chicago branch office and territory, succeeding H. E. L. Mey, resigned.

B. B. Milner, recently from the Orient, will delay his return on account of the earthquake in Japan, and has arranged for an office in room 1237, Knickerbocker building, New York City. Mr. Milner has been serving the Japanese Government railways and certain railroad supply sources in this country, with his headquarters at Tokio, Japan.

John Baker has been appointed assistant vice-president of the Locomotive Fire Box Company, manufacturers of Nicholson thermic syphons. Mr. Baker entered railway service with the Lake Shore & Michigan Southern which is now a part of the New York Central, as clerk and stenographer for the assistant trainmaster. In May, 1903, he entered the employ of the Chicago, Rock Island & Pacific, since which he has been successively stenographer for the roadmaster and the superintendent, secretary to the general superintendent of motive power, chief clerk to the master mechanic and superintendent of motive power and chief clerk to the general superintendent of motive power. He held the latter position for the last four years, and resigned to become associated with the Locomotive Fire Box Company on October 1.

John Baker

John B. Wright, assistant district manager of the Westinghouse Air Brake Company, Wilmerding, Pa., has been appointed assistant to vice-president with headquarters at the general offices in Wilmerding, Pa. He will also retain the title of assistant district manager in charge of the company's commercial activities in the Pittsburgh district which he has held since January, 1920. Mr. Wright was born on July 27, 1875, at Pleasantville, Pa., and was educated in the public schools of his native town and at Central State Normal School, Lock Haven, Pa., graduating in 1896. He worked for about 18 months with the Cambria Steel Company at Johnstown, Pa. In February, 1899, he entered the service of the Westinghouse Air Brake Company at Wilmerding, as a clerk in the engineering department. After serving for some time as chief clerk in that department he was transferred to the general office in charge of engineering correspondence and subsequently was made assistant to the vice-president. In May, 1919, he was appointed assistant southeastern manager and in January, 1920, was made assistant district manager.

J. B. Wright

The main office in Tokio, Japan, of Roku-Roku Shoten having been destroyed, requests are made to manufacturers in the United States to send to the company's branch office at Osaka, street address Enokojima Nishiku, complete catalogs and prices to replace their files. S. Noda is president of the company.

R. A. Hamaker, manager of the Montreal branch of the Canadian Johns-Manville Company, Ltd., was swept off from his boat and drowned, in Lake St. Louis recently. Mr. Hamaker was born in October, 1882, at Reading, Pa. In 1907 he became identified with the Johns-Manville Company, and in 1909 went to Montreal to take charge of the company's interests in that city.

R. R. Lally, formerly of Baltimore, Md., has been appointed manager of sales of the Globe Steel Tubes Company, Chicago, in charge of eastern territory with headquarters at 110 East Forty-second street, New York City, and A. A. Loeffler has been appointed manager of sales in charge of Michigan territory with headquarters at 5-169 General Motors building, Detroit, Mich.

The Clark Car Company, of Pittsburgh, Pa., has appointed B. K. Mould, eastern manager with headquarters at 2107 Woolworth building, New York City. Mr. Mould formerly spent thirteen years with the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa., and later several years as eastern sales manager, condenser department of the Elliott Company, Jeannette, Pa.

D. S. Murphy has been appointed chief service engineer of the Franklin Railway Supply Company, Inc., New York. Mr. Murphy was born at Visalia, Cal., and attended schools in that state and in Missouri. He began his railroad career in 1903 with the Missouri Pacific in yard and station service. He was connected with the transportation department of that road until 1906, when he joined the operating department of the Missouri, Kansas & Texas at St. Louis. From 1913 to 1917 he was office assistant to president of the M. K. & T. and then to 1918 he served in a similar capacity with the federal manager (United States Railroad Administration) of the group comprising the St. Louis & San Francisco, Missouri, Kansas & Texas and several smaller lines. On March 1, 1918, he was appointed trainmaster of the St. Louis division, Missouri, Kansas & Texas and the following May trainmaster of the Osage division. In September, 1918, he was promoted to superintendent of the Oklahoma district, with headquarters at Oklahoma City, Okla. On March 1, 1920, he was made superintendent of the McAlester district, with office at Muskogee, leaving that position to become chief service engineer of the Franklin Railway Supply Company, Inc., as above noted.

D. S. Murphy

Joseph Wainwright has been appointed sales manager and W. C. Chapman, district manager of the Philadelphia (Pa.) district for Manning, Maxwell & Moore, Inc., New York. Messrs. Wainright and Chapman will have headquarters in the Pennsylvania building, Fifteenth and Chestnut streets. Walter V. Lawton has been appointed district manager of the Boston (Mass.) district, with headquarters in the Textile building, 99 Chauncy street.

The Selflock Nut & Bolt Co., Inc., East Syracuse, N. Y., manufacturers of friction fit nuts and bolts, have entered into a contract with the Bethlehem Steel Company, Bethlehem, Pa., operative at once, for the manufacture and sale of carriage and machine bolts, track bolts and heavy railway nuts and bolts. The Selflock Company will increase its own facilities and specialize on S. A. E. Selflock products, as well as cap screws with Selflock threads.

Loyall A. Osborne, president of the Westinghouse Electric International Company, New York, has started on a trip to Japan to confer with prominent industrialists in Tokio. He sailed from San Francisco on October 10. Mr. Osborne is vice-chairman of the National Industrial Conference Board, and a member of the Imperial Order of the Rising Sun of Japan. Mr. Osborne is accompanied to Japan by Gen. Guy E. Tripp, chairman of the Westinghouse Electric & Manufacturing Company.

The Thornburgh Universal Gasket Manufacturing Corporation, Cicero, Ill., has been organized and has taken over the assets of the Universal Gasket & Manufacturing Company, Cicero, Ill. W. N. Thornburgh, president and treasurer of the W. N. Thornburgh Manufacturing Company, is also president and treasurer of the new company. J. J. Meydrech, vice-president and secretary of the W. N. Thornburgh Manufacturing Company, is also vice-president and secretary of the new company. George E. Barton is vice-president and sales manager.

Frederick V. Green, has been appointed assistant to the president of the Pittsburgh Testing Laboratory with headquarters at 50 Church street, New York. Mr. Green was born in New York City and received his education at Nyack, N. Y. After some experience in the lumber business with his father, he organized in 1895 the Empire Engine & Motor Company and was its treasurer until he joined the Westinghouse Air Brake Company in 1902. He was assistant general sales manager in the New York territory for the Westinghouse Air Brake Company until 1919, when he was appointed manager at Johannesburg, South Africa, for the Baldwin Locomotive Works, returning to this country to enter the service of the Pittsburgh Testing Laboratory.

C. H. Larimer, mechanical expert of the Westinghouse Air Brake Company in the New England territory, has been appointed consulting mechanical expert. He is succeeded as mechanical expert by R. P. Ives, a locomotive engineman from the New York, New Haven & Hartford. H. J. Robinson, for many years mechanical expert of the Westinghouse Air Brake Company at Seattle, Wash., has been appointed superintendent of special training to supervise the special apprenticeship courses for college students at the company's Wilmerding plant. The Westinghouse Company has opened a new branch office at Houston, Tex., in charge of mechanical expert John Hume, assisted by C. A. Breit, who has been transferred from the company's office at St. Louis.

Joseph Hyde Ames, chief engineer, American Car & Foundry Company, died suddenly at Chicago on October 11, and was buried at Lee, Mass. He was born at Brimfield, Mass., on March 22, 1865, and his early education was received at Kings School, Stamford, Conn. He started his professional career with the Northern Pacific at St. Paul, and in 1885, he went to the Peninsular Car Company, Detroit, as draftsman and estimator, later being made assistant superintendent. When the Michigan-Peninsular Company was formed in 1892, he was put in charge of the engineering work, and later was made assistant general manager. Upon the formation of the American Car & Foundry Company in 1899, he was given the title of mechanical superintendent of the two Detroit plants. In 1905, he was promoted to chief engineer, in charge of improvements to plants and machinery, being located at St. Louis for some years and later at Chicago. During the war activities from 1916 to 1919, he was in charge of all engineering work on war contracts at the Detroit plant. Since 1919, his headquarters have been in New York City. Mr. Ames was widely known as an engineer and was considered an authority on car design and manufacturing equipment.

J. H. Ames

Charles M. Brown has been elected president of the Colonial Steel Company, Pittsburgh, Pa., and J. Trautman, assistant sales manager, has been appointed sales manager to succeed Mr. Brown. Mr. Brown was born on October 16, 1870, at Pittsburgh. He graduated from Yale University in 1891, with the degree of A. B., and from the following August served with Howe, Brown & Co., Ltd., Pittsburgh, until that firm was absorbed by the Crucible Steel Company of America. Mr. Brown served for one year in the sales department of the latter company. In 1901, when the Colonial Steel Company was formed he became secretary and general sales manager. About 1917, he was made vice-president in charge of sales and now becomes president of the same company, as above noted.

TRADE PUBLICATIONS

Insulating Materials.—A 160-page handbook entitled, "Everything in Insulation," has been issued by the Mitchell-Rand Company, New York.

Hydraulic Riveters.—A four-page circular illustrating and describing Hanna hydraulic riveters has just been issued by the Hanna Engineering Company, Chicago.

Oil Burners.—The Hauck Manufacturing Company, Brooklyn, N. Y., has just issued Bulletin No. 506 illustrating and describing its Venturi low pressure fuel oil burner, which operates with air pressure from 8 oz. to 2 lb.

Portable Electric Tools.—A 32-page miniature catalogue No. 3027, briefly describing the complete line of Hisey portable electric tools for all purposes, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

Grinding Machines.—A 16-page, illustrated bulletin, No. 1305 superseding No. 1304, fully describing the construction and advantages of Hisey ball bearing grinding machines, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

Coal.—A booklet dedicated to the men in boiler rooms, laboratories and offices, who are untiringly seeking ways of conserving resources through the more efficient burning of coal, has been issued by the Stoker Manufacturers' Association, Philadelphia, Pa.

Power Painting.—Air brushes, air compressors, pneumatic painting machinery, finishing room equipment and other devices for the mechanical application of paint are described in Circular No. 20 recently issued by the Paasche Air Brush Company, Chicago.

Whiting Hoists.—A six-page folder entitled, "Give Your Locomotive Repair Shops This Powerful Lift," has been issued by the Whiting Corporation, Harvey, Ill., featuring some of the uses to which its hoisting equipment can be put in railroad shops and material yards.

The Microgage.—Publication G, supplementing descriptive catalogue D in showing the improved construction of the microgage, which combines the functions of the hand micrometer and the limit snap gage, has recently been issued by the Microgage Company, Boston, Mass.

Core Oven Equipment.—Core ovens, core oven racks, core oven cars and trucks, etc., are described in catalogue No. 170 recently issued by the Whiting Corporation, Harvey, Ill. This catalogue supersedes No. 163 and contains a number of illustrations of typical installations of Whiting core equipment.

Belting Tables.—Tables showing the brands of Schieren belting best suited to the different kinds of mechanical equipment under various operating conditions are given in the fifteenth and sixteenth installments of "Practical Facts About Belting," reprints of which may be obtained from the Chas. A. Schieren Company, New York.

Air Hoists and Elevators.—Valves for cast iron and brass cylinder hoists and trolleys are among the equipment illustrated in Catalogue No. 169 recently issued by the Whiting Corporation, Harvey, Ill., outlining the general design and construction of its several types of air hoists and elevators. This catalogue supersedes No. 149.

Hydraulic Machinery and Power Tools.—"An Album of Engineering Achievement" is the title of a 64-page, illustrated catalogue recently issued by the Southwark Foundry & Machine Company, Philadelphia, Pa., featuring the wide application of Southwark hydraulic valves, accumulators, presses, intensifiers, power punches, etc.

Electric Headlights.—A 12-page booklet entitled "Electric Headlights" has recently been issued by the Sunbeam Electric Manufacturing Company, Evansville, Ind., which illustrates and describes the locomotive headlight, industrial headlight, and floodlights manufactured by that company. The booklet also describes the focusing device used in conjunction with the air-tight, silver-plated, metal reflectors.

Electric Motors.—The Reliance Electric & Engineering Company, Cleveland, Ohio, has issued a 32-page booklet on its Type T heavy duty Reliance direct current motors. The booklet includes a detailed, illustrated description of how the motors are built, tables of ratings, general outline dimensions and a large number of illustrations showing motor applications.

Drilling Machines.—Portable drilling and tapping machines, applicable to practically every branch and phase of engineering, are illustrated and described in catalogue No. 24 recently issued by William Asquith, Ltd., Halifax, England. The catalogue contains 43 neatly arranged pages, also a table showing the range of sizes in which this type of machine is built.

Welding and Cutting Equipment.—Catalogue No. 23, covering its complete line of oxy-acetylene welding and cutting apparatus, lead welding, soldering, brazing and decarbonizing units, gas pressure regulators, automatic machines, generators and supplies, and containing cross-sectional views of equipment with detailed explanation, has recently been issued by the Torchweld Equipment Company, Chicago.

Wrought Iron Pipe.—A catalogue, outlining the differences between genuine wrought iron and steel pipe and summarizing the conditions of vent pipes in installations from 10 to 20 years old and over, has been issued by the A. M. Beyers Company, Pittsburgh, Pa. The catalogue also contains a report by an Investigating Committee of Architects and Engineers on wrought iron pipe as manufactured by the Beyers Company.

Grinding Machines.—A 24-page booklet, Bulletin No. 520, primarily intended for the man or men who are interested in and responsible for dependable, low-cost and unfailing locomotive performance, has been issued by the Heald Machine Company, Worcester, Mass. The booklet, which is entitled, "Saving Minutes on the Road—Hours in the Shop," illustrates and describes typical railroad jobs done on the Heald grinding machine.

Anti-Friction Bearings.—A paper entitled, "Anti-Friction Bearings in the Steel Mill," and the discussion which followed its presentation before the Association of Iron and Steel Electrical Engineers, is being distributed in the form of a 51-page illustrated booklet by the Reliance Electric & Engineering Company, Cleveland, Ohio. While the paper was prepared by A. M. MacCutcheon, chief engineer of the Reliance Company, it is written from such a standpoint that it is of general interest and value to users and designers of machinery and power equipment in other industries.

Pulverized Fuel System.—"Lopulco Pulverized Fuel Systems" is the title of a catalogue issued by the Combustion Engineering Company, New York. This is the first publication the company has issued describing both the theory and mechanical features of its powdered coal system, which has recently been installed in connection with some of the most notable boiler plant projects in the country. The catalogue contains numerous illustrations, including a section through a Lopulco equipped boiler plant, which shows all the different elements of the system as well as interesting test data and information concerning some outstanding installations.

Boiler Feed Pump and Feed Water Heater.—The construction and operation of the Worthington locomotive boiler feed pump and feed water heater are clearly shown in colored diagrams in an attractive 16-page bulletin, B-1607-B, recently issued by the Worthington Pump & Machinery Company, New York. The heat and coal saving characteristics of the feed water heater are shown in curves. A table of the properties of steam is also given and examples illustrating its use in calculating the reduction in the amount of heat required to generate the steam, the amount of steam required for heating and the amount of water saved by the Worthington locomotive feed water heater.

Charcoal Iron Boiler Tubes.—A 52-page brochure, citing a few instances of the high resistance of Parkesburg charcoal iron boiler tubes to corrosion and long service life, has been issued by the Parkesburg Iron Company, Parkesburg, Pa. Following a brief outline of the physical properties of charcoal iron and its corrosion resisting qualities, is an interesting illustrated story of the Parkesburg process of manufacturing boiler tubes from the charging of the forge fire to the final inspection and test of the finished product. Attention is also called to "Recommended

Practice for the Application and Maintenance of Charcoal Iron Boiler Tubes, Arch Tubes and Superheater Flues," by G. H. Woodrooffe and C. E. Lester, which is now available in book form.

Commercial Oxygen.—An attractively prepared bulletin describing the plant and process used in producing oxygen from the air by the Oxeco liquefaction method has recently been issued by M. Keith Dunham, Chicago. This bulletin contains thirty-four 5-in. by 11-in. pages. Numerous illustrations of the equipment are included; also a large scale colored insert giving a sectional view of the entire plant for producing oxygen from the air. The production process is described in detail with emphasis on the function of various parts of the equipment including the caustic solution mixing tank, caustic solution pump, air purifying towers, four-stage air compressor, oil purging plant, drying battery, high pressure filter, thawing coil, liquefaction column, gas meter, gas holder, oxygen gas compressor and cylinder charging ramp.

Lubrication.—A comprehensive, non-technical discussion of lubrication is afforded in a small 52-page booklet recently issued by the Dearborn Chemical Company, Chicago. This booklet will be of considerable assistance to the purchaser of lubricating oils and greases in deciding which grades will be most effective in developing maximum power equipment efficiency. The fact is emphasized that first cost should not be the only consideration in choosing lubricating oils and greases. Good quality is vital in order that the quantities used may be reduced to a minimum and also the losses due to friction. An interesting discussion of wet and dry steam cylinder lubrication is given. There are also chapters on steam turbine—unaflow engine—and air compressor lubrication. The closing chapter contains valuable information regarding laboratory control and methods of testing lubricants.

Pyle-O-Lyte is the name given to the latest bulletin issued by the Pyle National Company, Chicago. The bulletin, as catalogue No. 4, contains 28 pages, illustrating and describing the applications of Pyle National equipment to the various phases of railroad and construction lighting. There are many photographs and diagrams showing the different types of lighting units, together with the specifications for each. Lamps and reflectors are shown giving descriptive and dimensional tables. A portion of the bulletin is devoted to the explanation of floodlighting calculations which is clearly set forth by diagrams and sample calculations fully worked out. The different types of Pyle National turbo generators are illustrated ranging in capacity from 500 watts to 7½ kw. and steam turbines for various purposes ranging in speed from 2,000 to 5,000 r. p. m. and from ½ hp. to 12½ hp. are also shown.

Waterproofing.—The General Fireproofing Company, Youngstown, Ohio, has issued the sixth edition of a handbook on waterproofing. The booklet, which is a 72-page assembly, is illustrated by photographs of recent construction projects upon which the G. F. waterproofings and preservatives are used and, for the convenience of the reader, is divided into four sections as follows: Section 1—Substructural Waterproofing, devoted to the methods and materials for the waterproofing of foundations, basements, pits, tanks, pools, containers, and other structures subjected to hydrostatic pressure or dampness; Section 2—Superstructural Waterproofing, devoted to methods and materials for rendering walls and roofs proof against weathering and dampness, for the stainproofing of cut stone, for the preservation and beautifying of stucco, brick and concrete walls, and for filling expansion joints; Section 3—Cement and Wood Floor preservation, devoted to methods and materials for hardening, dustproofing, decorating and waterproofing cement and wood floors and for accelerating the setting and preventing the freezing of newly laid cement floors; and Section 4—Technical Paints and Coatings, devoted to the methods and materials for rendering walls, floors, and containers proof against acids and oils, for protecting structural steel and galvanized surfaces from rust and timbers from dry rot and decay, for bonding new concrete to walls, for waterproofing and hardening cut stone and cement blocks and for stainproofing limestone. Each section opens with a specification guide which tabulates various methods adapted to each problem and gives an index of the products useful in each case. This specification guide is then followed successively by a description of each method, followed in turn by a description of the various products for use under the particular method involved, and specifications as to their use. In all cases the specifications are illustrated with drawings to show how the work should be carried out.

EQUIPMENT AND SHOPS

Locomotive Orders

The Missouri Pacific contemplates buying about 60 locomotives.

The Louisville & Nashville contemplates buying about 35 locomotives.

The Long Island has ordered five switching locomotives from the American Locomotive Company.

The Argentine State Railways have placed an order for 1 4-8-2 type locomotive with the Baldwin Locomotive Works.

The Aliquippa & Southern has ordered one 0-8-0 type locomotive from the American Locomotive Company.

The Nadawah Lumber Company, Nadawah, Ala., has ordered 1, 2-6-0 type locomotive from the Baldwin Locomotive Works.

The Pennsylvania Power & Light Company, Wilkes-Barre, Pa., has ordered 1, six-wheel switching locomotive from the Baldwin Locomotive Works.

The Long Bell Lumber Company, Longview, Wash., has ordered 2, 2-6-6-2 Mallet type locomotives and 1, 0-6-0 switching locomotive from the Baldwin Locomotive Works.

The Southern Pacific has ordered 17, 2-10-2 type and 8, 4-6-2 type locomotives from the Baldwin Locomotive Works and has placed an order for 18, 4-8-2 type locomotives with the American Locomotive Company.

Passenger Car Orders

The Southern Pacific contemplates buying about 125 new cars for passenger service.

The New York, Westchester & Boston contemplates buying about 10 cars for passenger service.

The Chesapeake & Ohio has ordered 6 combination mail and express cars from the Pullman Company.

The St. Louis Southwestern has ordered 5 steel underframes for baggage cars from the Commonwealth Steel Company.

The Long Island has placed an order for 60 steel motor passenger cars for electric service with the American Car & Foundry Company.

The Philadelphia & Reading has ordered 40 steel suburban coaches and 10 steel suburban combination coach and baggage cars from the Bethlehem Shipbuilding Corporation, Harlan plant.

Freight Car Orders

The South African Railways has ordered 400 steel grain cars from the Leeds Forge Company, England.

The Mexican Petroleum Company has placed an order for 100 tank cars of 10,000 gal. capacity with the American Car & Foundry Company.

The Chicago & Alton has placed an order for 250 gondola cars with the Pullman Company and an order for 350 gondola car bodies with the Ryan Car Company.

E. L. Dougherty & Co. has ordered 100, 40-ton, 8,000 gal. capacity and 100, 50-ton, 10,000 gal. capacity tank cars, from the General American Tank Car Corporation.

The Union Pacific will have 25 caboose cars built at the shops in Albina, Ore. This company's program for new equipment, it is understood, calls for the purchase of several thousand cars.

The New York, Chicago & St. Louis has ordered 200 steel underframes from the American Car & Foundry Company, and has also ordered 10 underframes for caboose cars from the Pennsylvania Tank Car Company.

The Southern Pacific has ordered 16 Kilbourne & Jacobs type automatic dump cars of 20 yd. capacity from the Case Crane

& Engineering Company. The company's program for new equipment, it is understood, calls for the purchase of about 18,000 cars.

Freight Car Repairs

The Minneapolis & St. Louis has ordered repairs to 600 box cars at the shops of the General American Car Company.

Machinery and Tools

The Southern Pacific has placed an order for 2 axle lathes.

The Erie has placed orders for additional flue shop equipment with Joseph T. Ryerson & Son.

The Union Pacific has ordered a five-ton self-supporting jib crane from the Whiting Corporation.

The Missouri Pacific has ordered one 200-ton locomotive hoist from the Whiting Corporation.

The Pennsylvania has placed an order for a 100-in. boring mill, also for two 42-in. boring mills and a heavy 42-in. by 16 ft. planer.

The Chesapeake & Ohio has placed an order with the Industrial Works, Bay City, Mich., for six 150-ton self-propelling steam wrecking cranes.

The Chicago, Burlington & Quincy has ordered one 20-ton overhead electric traveling crane for its shops at West Burlington, Ia., from the Shaw Crane Company.

The Illinois Central is inquiring for one 1½ to 6-in. motor-driven tube cutting machine for use at Vicksburg, Miss., and one 54-in. heavy-duty motor-driven lathe for use at Waterloo, Iowa.

The Philadelphia & Reading has awarded a contract to the Bury Compressor Company for two heavy duty duplex air compressors, with motors, exciters, starting panels, coolers, aftercoolers, and other apparatus for use in connection with the new terminal at Camden.

Shops and Terminals

Galveston, Harrisburg & San Antonio.—This company will construct an addition to its roundhouse at San Antonio, Tex., to cost approximately $60,000.

Chicago, Rock Island & Pacific.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a 13-stall roundhouse at Shawnee, Okla.

St. Louis-San Francisco.—This company has awarded a contract for a one-story coaling station 26 ft. by 28 ft. at St. Louis, Mo., to the Howlett Construction Company, Moline, Ill.

Atchison, Topeka & Santa Fe.—This company has awarded a contract to Robert E. McKee, El Paso, Tex., for the construction of a new pipe and tin working shop at San Bernardino, Cal.

New York, Chicago & St. Louis.—This company plans the construction of additions to its shops at Frankfort, Ind., including a new engine house, repair shop and related structures.

Atlantic Coast Line.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 500-ton three-track automatic electric coaling station at Waycross, Ga.

Union Pacific.—This company has awarded a contract to the Graver Corporation, East Chicago, Ind., for the erection of two 10,000 gal. per hour water softening plants at Fossil, Wyo., and Arden, Nev.

The Missouri Car Company, East St. Louis, Mo., will erect a car equipment shop at Denver, Colo., at an approximate cost of $750,000. The plant will be a duplicate of the company's East St. Louis shop, will manufacture all kinds and types of steam and electric cars and will be known as the Colorado Railway Equipment Company.

Elgin, Joliet & Eastern.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the installation of automatic electric elevating equipment in its coaling station at Rossville, Ill., and will construct a new car repair shop at Joliet, Ill., to replace the building recently destroyed by fire. The new structure will be 300 ft. by 500 ft., and will cost approximately $500,000.

PERSONAL MENTION

General

D. R. McGrath, division master mechanic of the Chicago, Burlington & Quincy, with headquarters at Brookfield, Mo., has been promoted to air brake instructor, with headquarters at Chicago, succeeding P. J. Murrin, retired on pension after 50 years of active service.

A. C. Graham has been appointed foreman in charge of reclamation of the Chicago, Burlington & Quincy at Eola, Ill. Prior to entering the service of the C. B. & Q., Mr. Graham was employed at the reclamation plant of the Atchison, Topeka & Santa Fe at Corwith, Ill.

W. C. Stone, master car builder of the St. Louis-Southwestern with headquarters at Pine Bluff, Ark., has resigned to become mechanical superintendent of the American Refrigerator Transit Company with headquarters at St. Louis, Mo., succeeding T. E. Parker, resigned.

H. C. Manchester, superintendent of motive power and equipment of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has resigned, and C. J. Scudder, superintendent of the Scranton shops, has been appointed acting superintendent of motive power and equipment.

Patrick J. Colligan, master mechanic of the Chicago Terminal division of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to superintendent of motive power of the Second district, with headquarters at El Reno, Okla., succeeding W. J. O'Neill, whose appointment as general superintendent of motive power of the Denver & Rio Grande Western was reported in the October issue of the *Railway Mechanical Engineer*. Mr. Colligan was born on January 24, 1868, at Rock Island, Ill. He entered railway service in January, 1886, as a machinist apprentice on the Chicago, Rock Island & Pacific and served in this capacity until 1891, when he entered the employ of the Chicago, Milwaukee & St. Paul as a machinist at Savanna, Ill., where he remained until 1893, when he again entered the employ of the Rock Island as a machinist at Horton, Kan. From January, 1894, until 1898, he was machinist and gang foreman on the Missouri, Kansas & Texas at Dennison, Tex. In 1898 he returned to the Chicago, Rock Island & Pacific as a machinist at Davenport, Iowa, and in 1899 was promoted to roundhouse foreman at Chicago. In 1901 he was transferred as roundhouse foreman to Trenton, Mo., and later to Natick, Ill. In 1903 he entered the employ of the Illinois Central as general foreman and master mechanic at Clinton, Ill., but in 1904 returned to the Rock Island as a gang foreman at Silvis, Ill. In 1905 he was promoted to general foreman at Chickasha, Okla., and from 1906 to 1910, he was master mechanic, with headquarters at Fort Worth, Tex. From 1910 until 1914 he was master mechanic at Dallas, Tex. He served as master mechanic at Chicago from 1914 until his recent promotion.

Master Mechanics and Road Foremen

H. C. Gugler, general foreman of the Chicago, Burlington & Quincy, at Wymore, Neb., has been promoted to master mechanic of the Wymore division with the same headquarters, succeeding G. O. Huckett, assigned to other duties.

C. B. Dailey, master mechanic of the Cedar Rapids-Minnesota division of the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa, has been transferred to Chicago, succeeding P. J. Colligan. T. W. McCarthy, master mechanic of the Kansas division, with headquarters at Horton, Kan., has been transferred to Cedar Rapids, Iowa, succeeding Mr. Dailey.

Purchasing and Stores

H. A. Humes has been appointed district storekeeper of the Northern Pacific at Tacoma, Wash., succeeding R. W. Hoisington, resigned. W. H. Robinson has been appointed division storekeeper of the Idaho division at Parkwater, Wash., succeeding Mr. Humes, and R. G. Becker has been appointed division storekeeper of the Minnesota Division at Staples, Minn., succeeding Mr. Robinson.

B·S
TRADE MARK

BROWN & SHARPE CUTTERS

Special Cutters for Railroad Work

Two well known Railroads are using these special Brown & Sharpe helical cutters for milling connecting rods and similar work. Shop men come to BROWN & SHARPE for special cutters because they know that our long experience in manufacturing cutters insures satisfaction. For similar cutters or any other special cutters you may require, our complete facilities and sixty years of experience are at your service.

Advantages of Helical Cutters

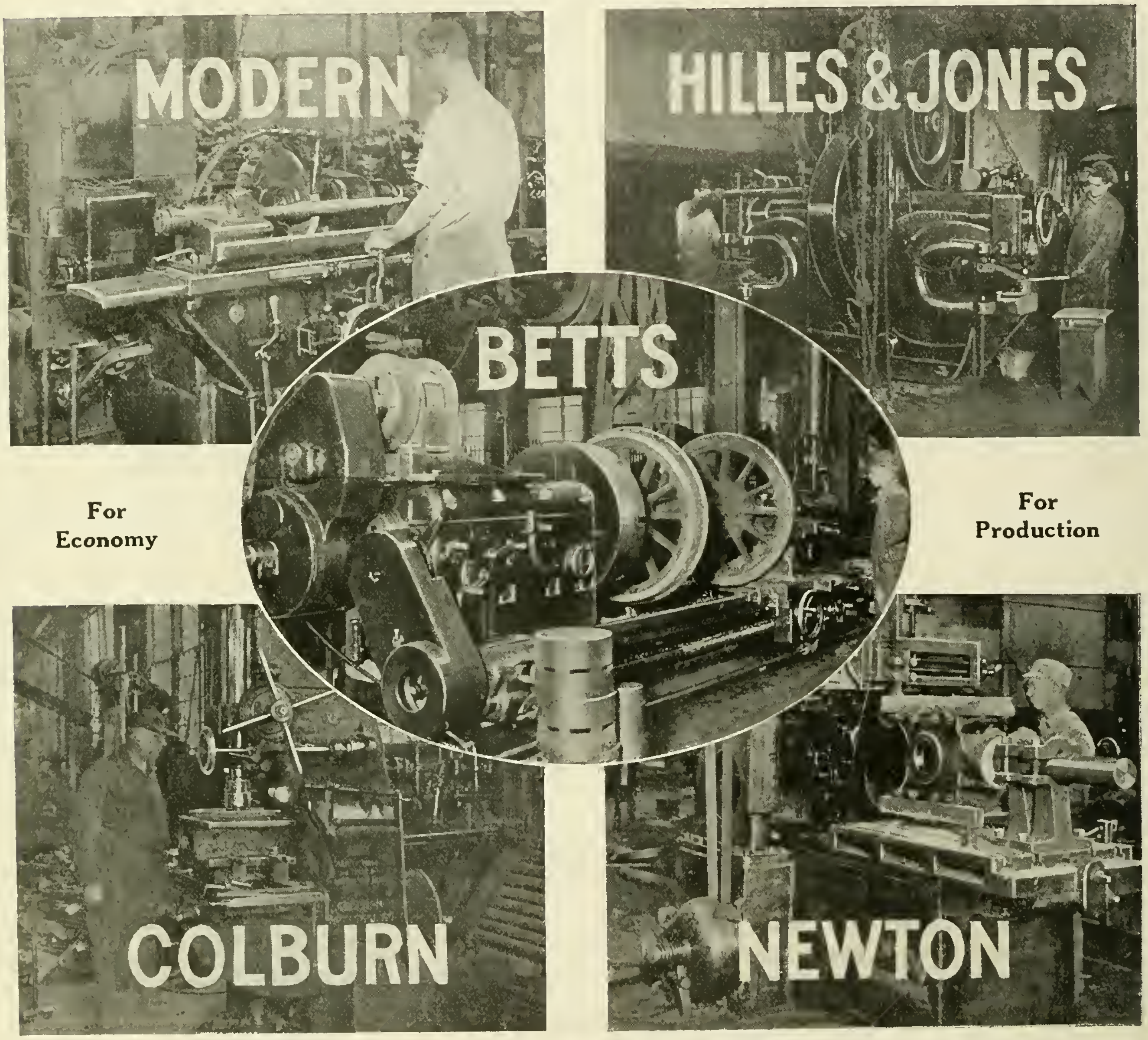
As the cutting thrust of helical cutters is across the work rather than lengthwise or down, they may be used to advantage for heavy cuts on thin material or on work which cannot be clamped at both ends. In milling the open end of side rods, for example, a helical cutter of this type will speed up production and secure smooth, true surfaces without springing the work. Think over the advantages of helical cutters in reference to your own work.

For prompt service and satisfaction on special cutters write to our Cutter Department stating your requirements

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

B·S
TRADE MARK

CONSOLIDATED
MACHINE TOOLS



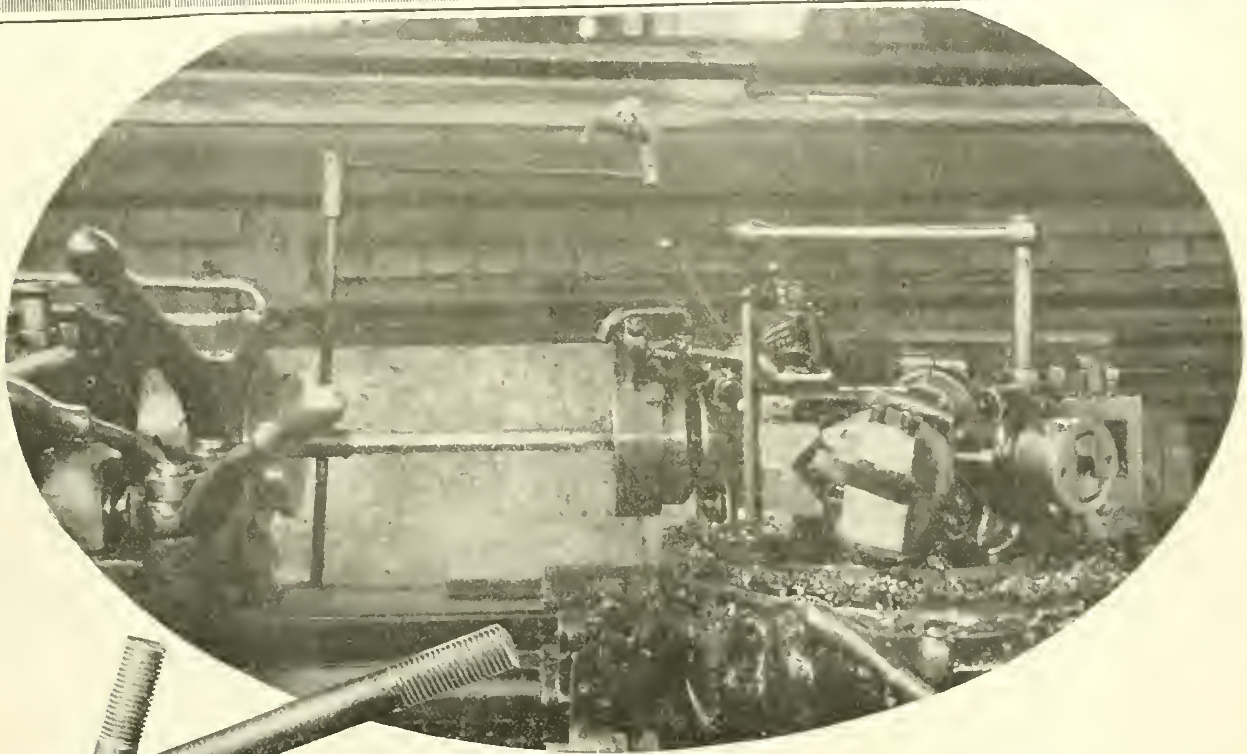
BETTS	COLBURN	HILLES & JONES	MODERN	NEWTON
Engine Lathes	Drill Presses	Punches & Shears	Plain Grinders	Cold Saws
Boring Mills	Special Drills	Bending Rolls	Universal Grinders	Crank Planers
Planers	H. D. Boring Mills	Plate Planers	Magic Chucks	Milling Machines
Slotters	Standard Boring Mills	Flanging Clamps	S. O. Die Heads	Rod Borers
Axle Lathes	Rod Boring Machines	Straightening Rolls	Threading Machines	Cylinder Borers

Sales Offices in:

Chicago, Cleveland, Detroit, New York, Philadelphia, Pittsburgh, Rochester, Richmond, St. Louis

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA
410 Blossom Road—Rochester, N. Y.

Hartness Flat Turret Lathes



For machining steam chest studs

HERE is another one of the well nigh endless list of locomotive parts that can be machined with decisive savings on a Hartness Flat Turret Lathe.

In an eastern shop well known for its up to date equipment and efficient methods of handling repair work Hartness Flat Turret Lathes are used entirely for machining valve chest studs and all studs or bolts of a similar character from bar stock.

In the case of these steam chest studs turned to a 1" diameter at one end and 1¼" at the other, and threaded at both ends,—it is an easy matter to machine 20 of these complete in an hour. These studs are turned complete, threaded at one end and then cut off from bar stock. After the entire bar has been machined in this manner the individual bolts are each chucked in the lathe, and the 1¼" end is threaded.

For high speed, accurate economical turning and threading of car and locomotive parts needed in large quantities, you would not ask for a more efficient method than that provided by the "Hartness" and you could not get it if you did.

Let us assist you in solving your quantity turning and threading problems. Complete information awaits your request.

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

503 Market St., SAN FRANCISCO, CAL. **9-10 Water Lane, Queen Victoria St., London, E. C.**

AGENTS

France, Spain and Belgium: F. Auberty & Company, 182 Rue Lafayette, Paris
Holland: Spliethoff, Beeuwkes & Company, Leuvehaven Wz, 159, Rotterdam; **Japan, Korea, etc.:** Mitsui & Company, Ltd., Tokio; **Australasia:** McPherson's Pty. Ltd., 554 Collins Street, Melbourne; **Sweden:** A. Bol. Oscar Lindbom, Stockholm.

Turning 25 pairs of Car Wheels per day

How Many are You turning?

THE reduction of railway maintenance work to a piecework basis has been much slower than in general manufacturing.

The Interborough Rapid Transit Company of New York has been a pioneer along these lines in the electric railway field. One of their earliest studies with this end in view was made of the operation of turning wheels. The many time and labor saving features of the N-B-P No. 5 Car Wheel Lathe offered a good subject for their consideration.

CENTER DRIVE
CAR WHEEL
LATHE

Having the added incentive of increased remuneration for larger output, each operator has studied the advantages of his machine so well that in the I. R. T. shops, where five of these machines are in use, the time of turning a pair of wheels has been reduced to an average of 22 minutes.

As many as 25 pairs of wheels per day have been turned out recently by the more capable men.

These men are all satisfied workers because they know that they have been provided with a machine that has every convenience for shortening the time of operation—with a minimum of effort on their part—and that will leave them less tired at the end of the day even when working at top speed.

Work on the Niles No. 5 Car Wheel Lathe is speeded up by the following features—

Hinged Drive Gear Segment—that opens and closes automatically as the wheels are rolled in and out of the lathe.

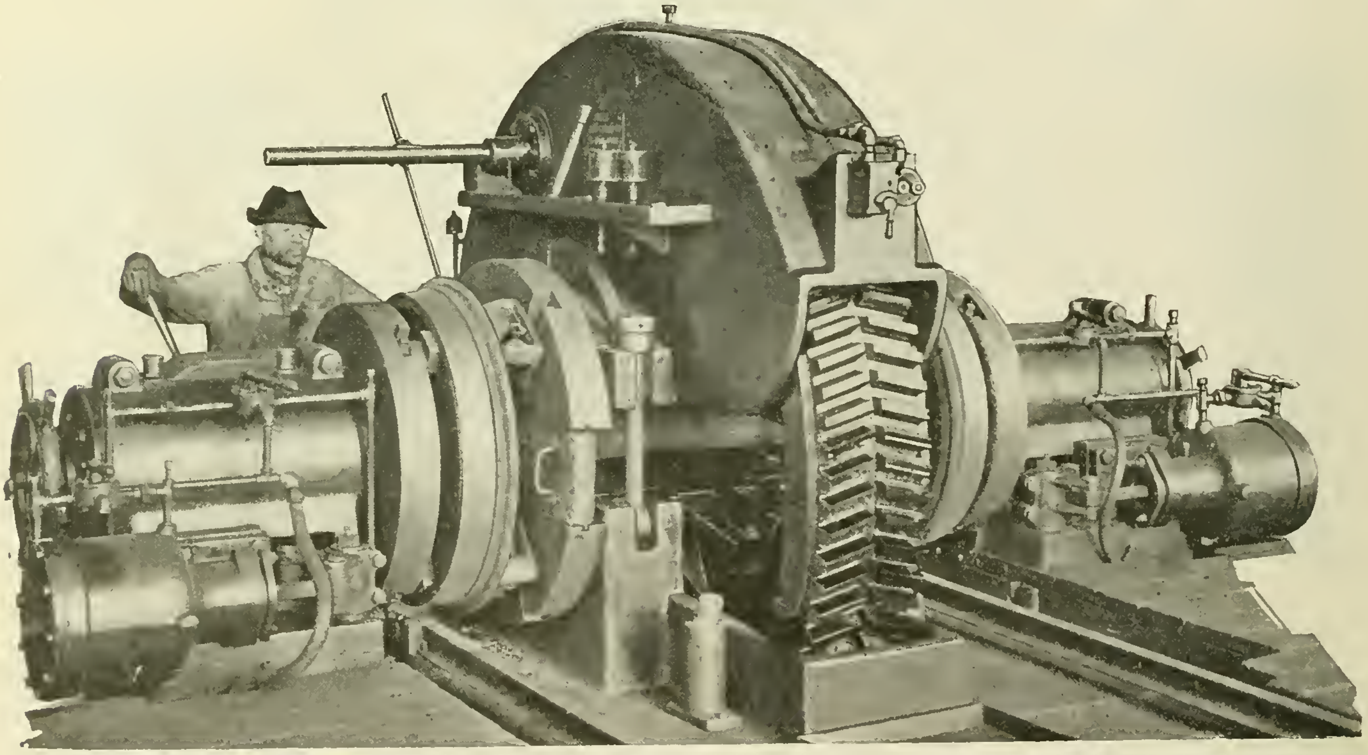
Pneumatically Operated Tailstocks—that grip the work as soon as it is in place.

Pneumatic Tool Clamps—that save the time consumed by older methods in setting up with wrenches.

Push Button Control—that permits the operator to start and stop the lathe or slow down speed without moving a step. Every move becomes a productive operation.

The high production features that make this lathe a work booster wherever installed are typical of the up-to-date improvements that are continually being incorporated in all N-B-P machine equipment. For modern machine tools of any sort, of any size and for any metal cutting requirement—

"Come to Headquarters"



NILES-BEMENT-POND CO. N-B-P NEW YORK U.S.A.

NILES - BEMENT -

General Offices: 111 Broadway, New York City

Boring 15 Car Wheels Per Hour

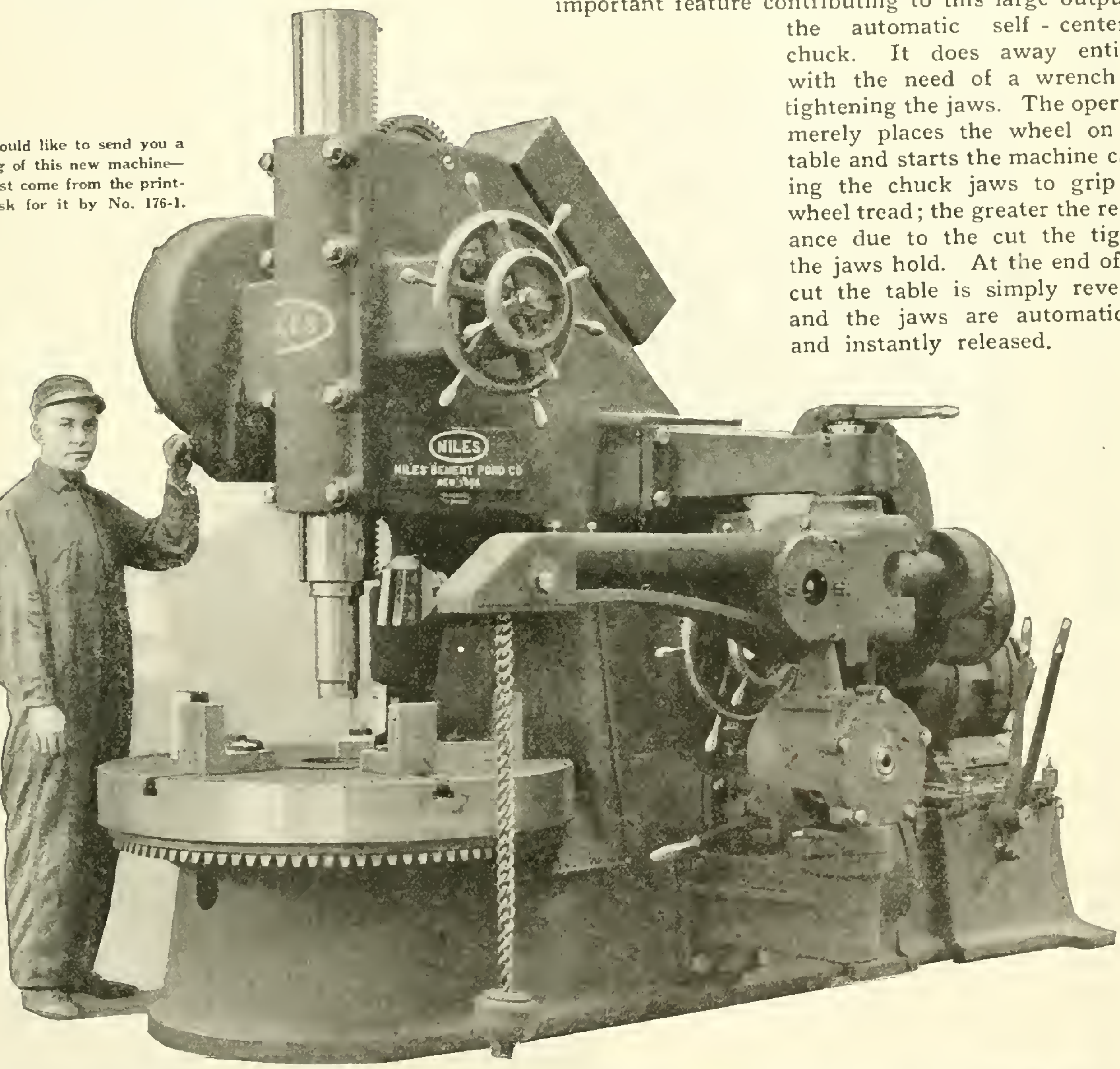
Automatic Self-centering Chuck Speeds Up Work

N-B-P 48-INCH CAR WHEEL BORER

WITH several new production increasing features added to the many advantages of our former machines this newest N-B-P Car Wheel Borer is giving excellent results wherever installed. Due to its power to take heavy cuts and its convenience of operation one master mechanic in a large Eastern shop reports an output of 15 cast iron wheels per hour.

In addition to the quick-operating crane—power driven or pneumatic as desired—perhaps the most important feature contributing to this large output is the automatic self-centering chuck. It does away entirely with the need of a wrench for tightening the jaws. The operator merely places the wheel on the table and starts the machine causing the chuck jaws to grip the wheel tread; the greater the resistance due to the cut the tighter the jaws hold. At the end of the cut the table is simply reversed and the jaws are automatically and instantly released.

We would like to send you a catalog of this new machine—it's just come from the printers—ask for it by No. 176-1.



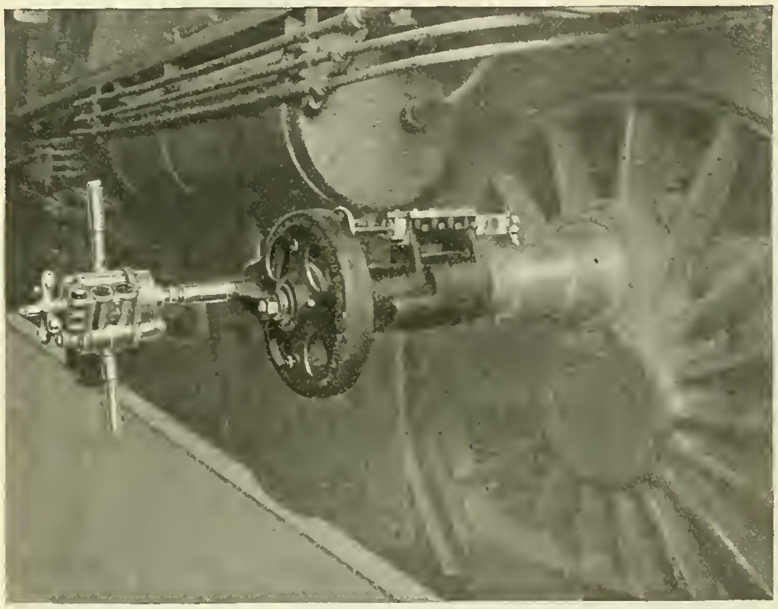
POND COMPANY

NILES-BEMENT-POND CO.
N-B-P
NEW YORK U.S.A.

SALES OFFICES: Rochester Boston Philadelphia Cleveland Pittsburgh Detroit Chicago
St. Louis Cincinnati Birmingham St. Paul San Francisco Los Angeles

UNDERWOOD
FOR LOCOMOTIVE

Underwood Crank Pin Turning Machines



(All Gears Guarded)

OUR new special crank pin machine illustrated at left can be readily bolted to the end of the crank pin as shown.

The stationary spindle is easily fastened to end of crank pin—while a revolving sleeve mounted on spindle, carries the tool slide holding cutting tool.

The tool is fed by star wheel which actuates feed screw—feed is automatic, variable and reversible. Machine cut spur gear drives the revolving sleeve.

Easily and accurately set up it offers a quick and efficient means for restoring crank pins.

When ordering send prints of pins to be turned or give complete retails as to size and dimensions of pins.

Write today for descriptive bulletins.

The standard Underwood Crank Pin Machine is illustrated on the right.

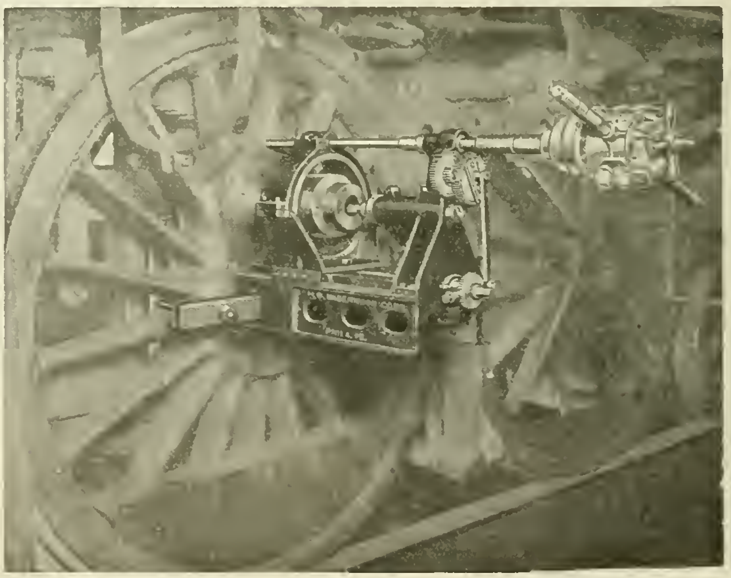
Ruggedly built to insure rigidity and accuracy—easily set up with work always in full view of operator—this tool is a big time and money saver for shops and roundhouse.

Wherever an Underwood operates —efficiency is the watchword.

Write for bulletins giving complete details.

For detailed description — see — LOCOMOTIVE CYCLOPEDIA 1922 Edition

UNDERWOOD Portable Tools



H.B. UNDERWOOD CORP.

PORTABLE TOOLS
REPAIR SHOPS

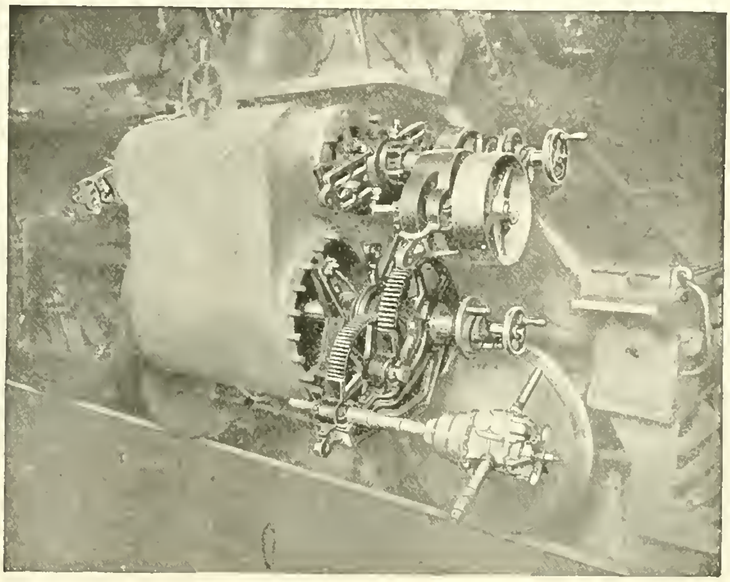
Underwood Portable Boring Bars

NOW is the time to put your shops and roundhouses in shape for cold weather.

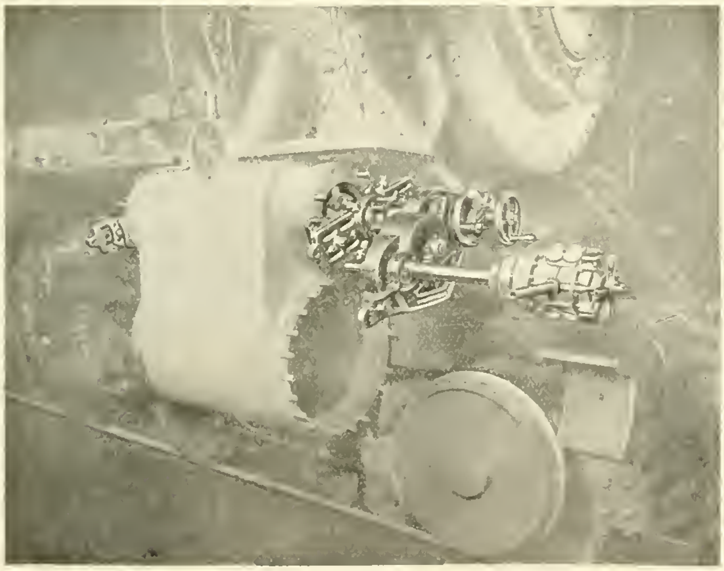
"Underwoods" will prove a big factor in helping to keep your locomotives fit for the increased burdens imposed by cold weather. They will prove a big help in speeding the turning of power at congested terminals during the winter when running repairs must be made in a hurry. They will also aid your shop forces in turning out the larger number of engines per month so urgently needed at this time of year.

Take no chances, make sure that you can handle reboring of cylinders and valve chambers promptly and accurately by installing enough Underwoods now.

Better send in your requisition today.



(All Gears Guarded)



Take particular notice of the various types of the Underwood Boring Equipment shown in these illustrations.

The upper view shows our standard boring bar for cylinder and valve chamber work, built for either air or electric drive—while the lower illustration features our compound boring bar with contracted driving power especially designed to operate in close quarters and in small space.

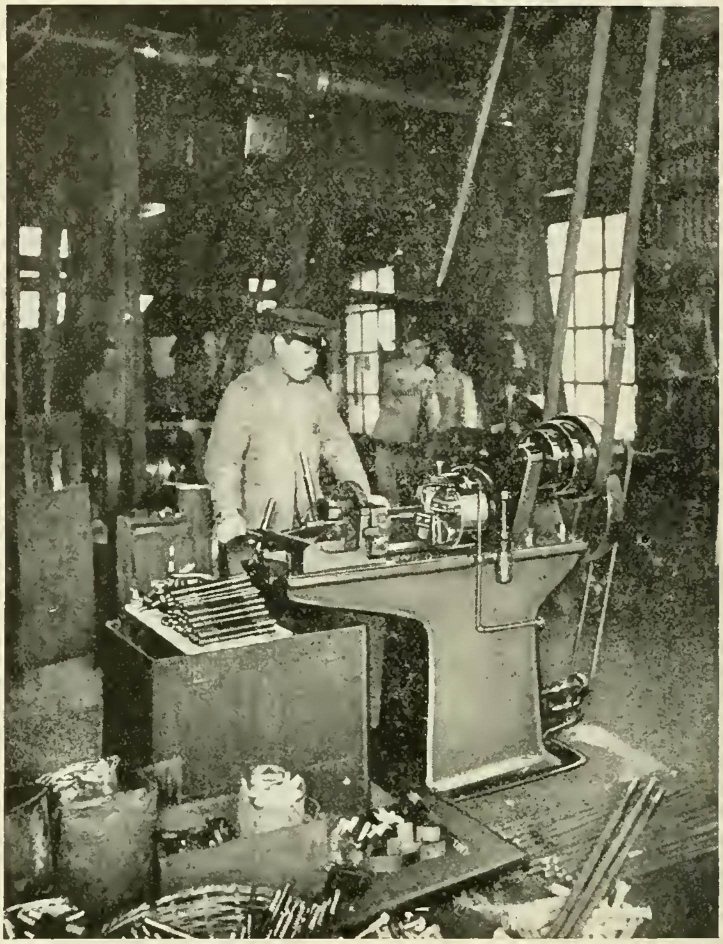
Ask for bulletin explaining many adaptations of this equipment.

For detailed description — see — LOCOMOTIVE CYCLOPEDIA 1922 Edition

Where ever a railway shop UNDERWOOD TOOLS are found

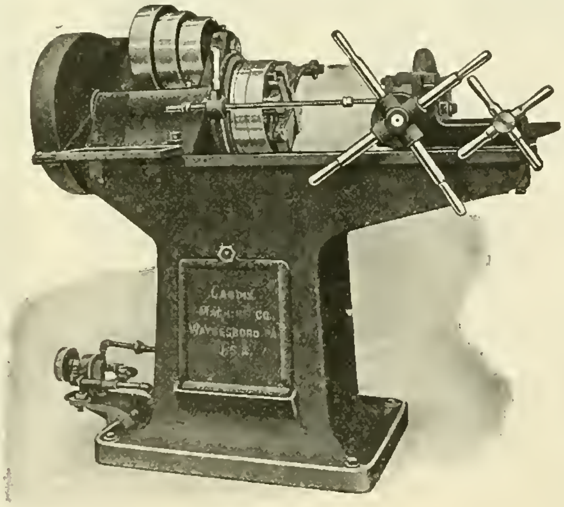
PHILADELPHIA, PENNA.

Around the World with LANDIS



In the Mitsubishi Dockyard Kobe, Japan

Spain, India, England, Belgium, France, Germany, Italy, Japan, wherever he goes the migratory machinist finds **LANDIS Threading Machines**; for whether they build many machine tools or few, local manufacturers produce nothing quite in the "**LANDIS**" class.


LANDIS MACHINE CO. WAYNESBORO, PA. U.S.A.

The accompanying photo of a **LANDIS 1½-in. Single Head Machine** shows it surrounded by a typical assortment of work—bolts, rods, studs, etc.—the best of a day's output in one of Japan's big shipyards.

LANDIS Threading Machines require no skill to operate, are quickly and easily set up; cut right and left hand threads and take rough and finish cuts with the same chasers—clean, accurate threads and as amazingly economical on this side of the Pacific as on the other. The secret lies to a great extent in **LANDIS Chasers.**

Let us tell you about them

Landis Machine Company, Waynesboro, Pa., U. S. A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co., of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; R. B. Whitacre & Co., St. Paul, Minn.; Hamilton Machinery Company, Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wright & Co., New Orleans, La.; Jos. T. Ryerson & Sons, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Herberts Machinery & Supply Co., San Francisco and Los Angeles, Calif.; Harry M. Euler Co., Portland, Ore.; Hallidie Machy. Co., Seattle, Wash.; Hallidie Co., Spokane, Wash.

CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Toronto and Montreal.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Calcutta, India; Yokohama, Japan; Allied Machinery Co., Shanghai, China; Barcelona, Spain; Turin, Italy; Zurich, Switzerland; Stokvis & Zonen, Rotterdam, Holland; Lindeteves Stokvis, Batavia, Java; Dutch East Indies; D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia.

Freedom from adjustment troubles

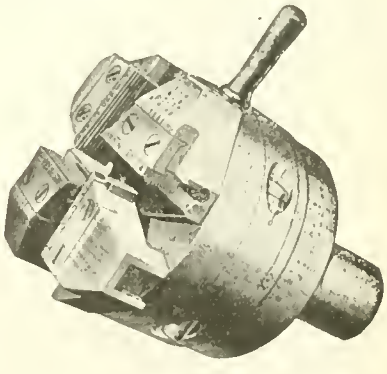
This is a mighty big factor in the production of duplicate parts.

Mr. A. G. Peter, Production Engineer of the Milwaukee Air Power Pump Co. says that the **LANDIS Automatic Die Head** is "accurate at the beginning and always holds to size."

Below, the **LANDIS** is threading the pipe connection on ½ in. cast brass Return Elbows. The limits on this work are .002 in. and the **LANDIS** produces 450 Elbows per day.

Nice work when you take interchangeability into consideration, yet, typically **LANDIS.**

Let us tell you about some of the threading records established by



LANDIS TRADE MARK

Automatic Die Heads

LANDIS MACHINE CO., Waynesboro, Pa., U. S. A.

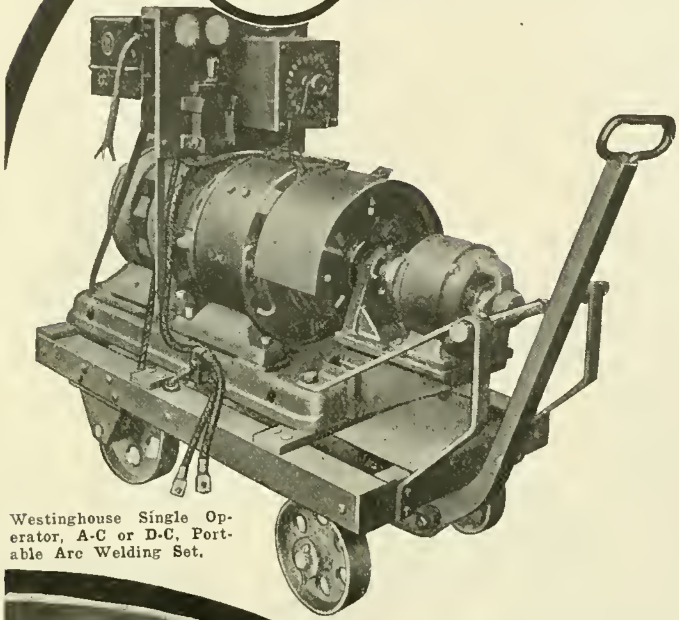
DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; R. B. Whitacre & Co., St. Paul, Minn.; Hamilton Machinery Company, Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wight & Co., New Orleans, La.; Jos. T. Ryerson & Sons, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Herberts Machy. & Supply Co., Los Angeles and San Francisco, Cal.; Harry M. Euler Co., Portland, Ore.; Hallidie Machy. Co., Seattle, Wash.; Hallidie Co., Spokane, Wash.

CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Toronto and Montreal.

FOREIGN AGENTS: Burton Griffiths Co., London, England; Allied Machinery Co., Shanghai, China; Stokvis & Zonen, Rotterdam, Holland; Lindeteves-Stokvis, Batavia, Java, Dutch East Indies; D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia.

WESTINGHOUSE ELECTRIC

A New Lease on Life For Worn and Broken Parts



Westinghouse Single Operator, A-C or D-C, Portable Arc Welding Set.

The electric arc for welding and building-up worn parts will save thousands of dollars worth of material from going to the scrap pile. Westinghouse welding gives a new lease on life to cracked cylinders, frames, wheel centers, worn couplers, mud rings, piston heads and numerous other parts that would ordinarily be discarded. Such material can be made as good as new—quickly and economically.

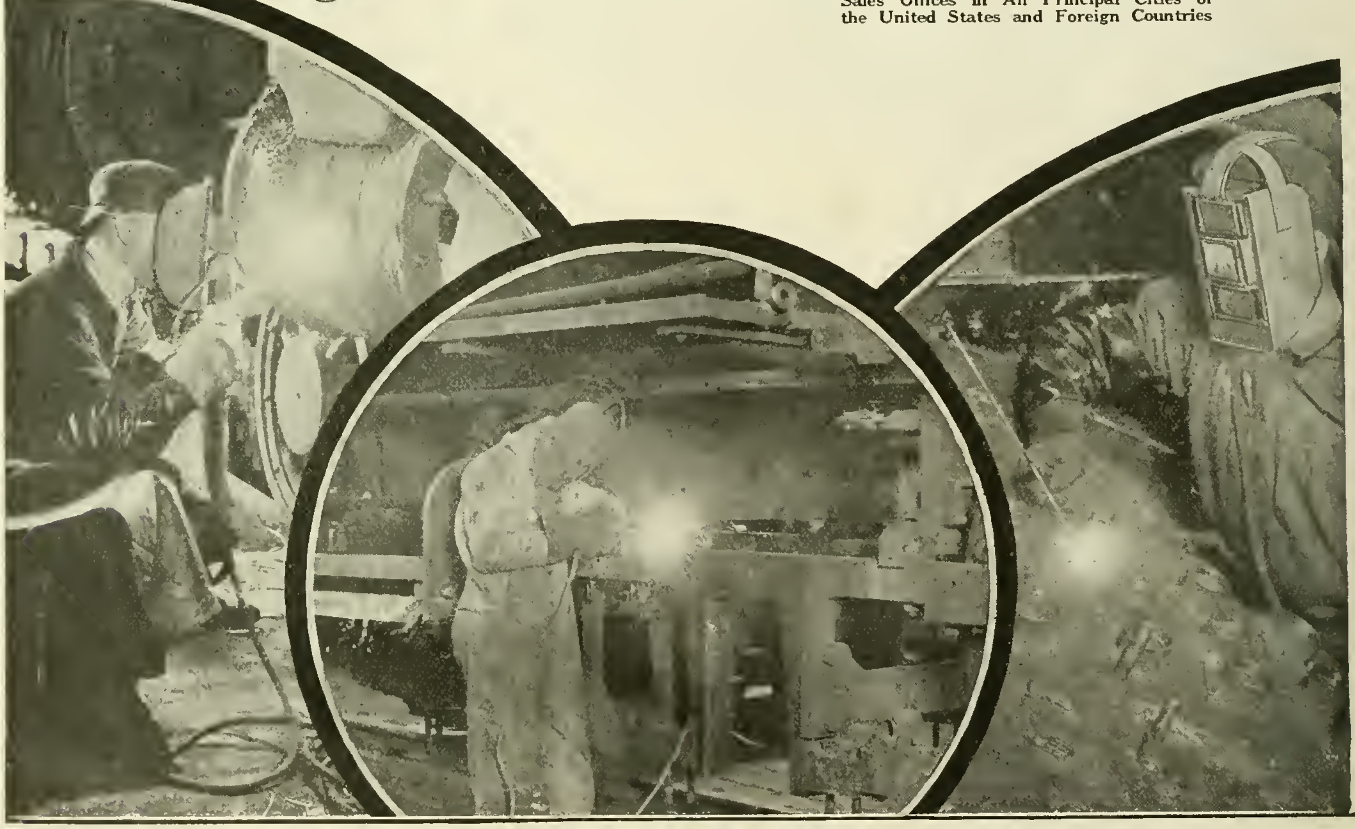
Aside from the dollar-and-cent value of arc welding, it looms large as a time-saver. The time that locomotives are held out of service is greatly reduced because very little dismantling is necessary when arc welding is used.

Westinghouse welding equipment supplies stability to the welding arc. Stability is necessary to produce a weld that will withstand the severe road service.

Make good welding a certainty. Specify Westinghouse Arc Welding Equipment.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries



Westinghouse

New Vigor Supplied by Electric Drive

Realize the greatest benefits from modern machine tool equipment by installing the right motors and controllers when the machines are placed in service.

To keep abreast of the increasing demands made on machine shops for locomotive and car repair parts, direct motor drive is a necessity. Ease of operation and control, economy of electric transmission, reliability, compactness and freedom in locating machines most advantageously for production purposes, are the reasons why modern machine shops are electrically equipped with direct motor drive.

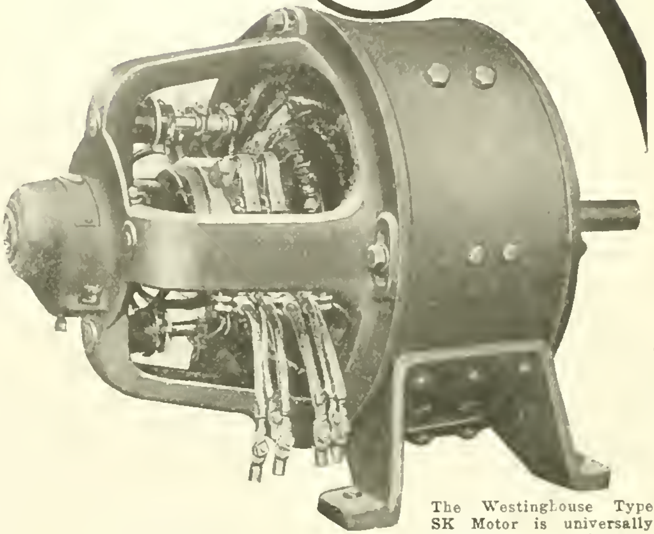
Westinghouse engineers have made a special study of the application of motors and controllers to all types of machines. They are at your service—to inject new vigor in machine shop operation.

Assure yourself of continuity of service. Specify Westinghouse motors and controllers.

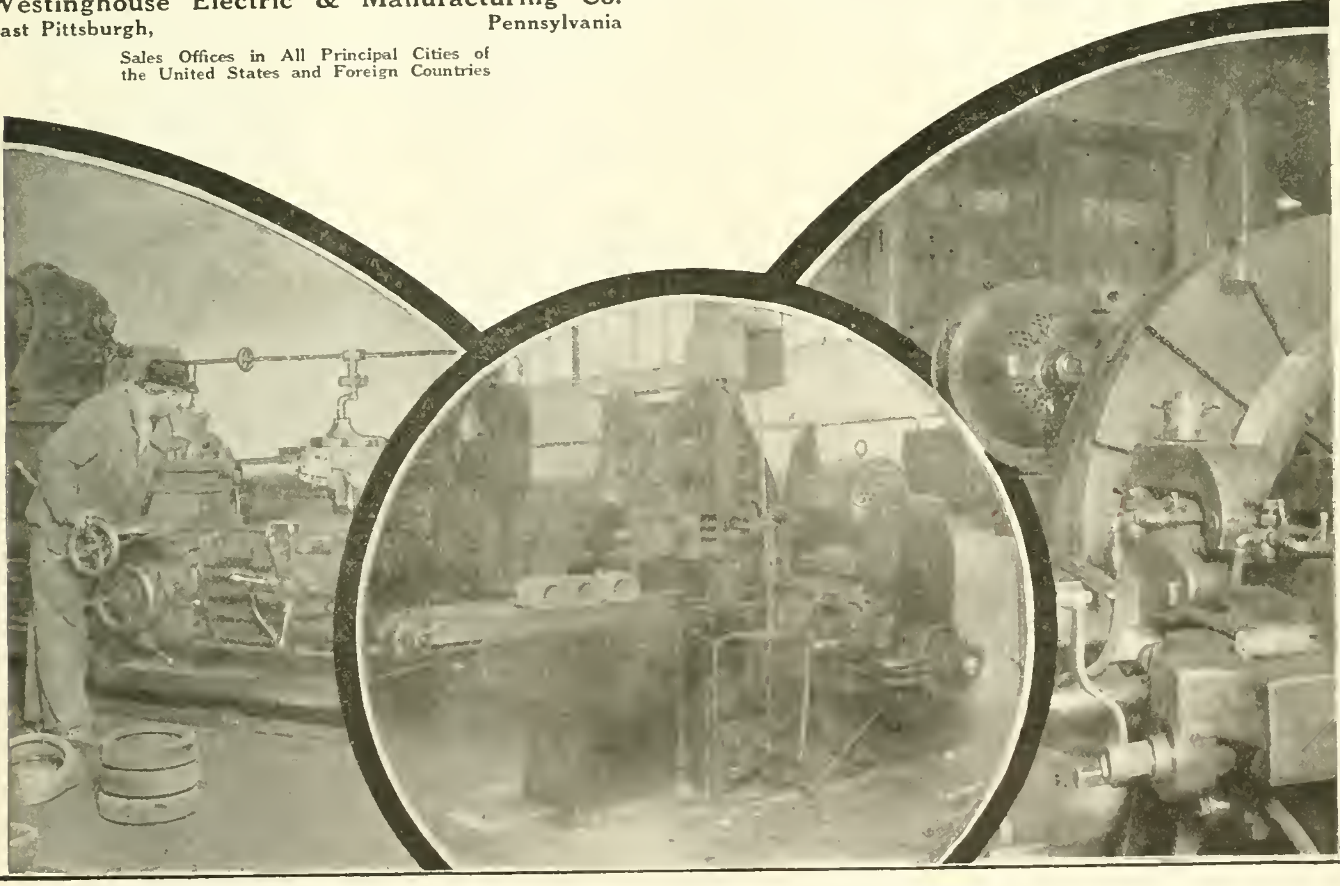
Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pennsylvania

Sales Offices in All Principal Cities of
the United States and Foreign Countries

W
WESTINGHOUSE
ELECTRIC

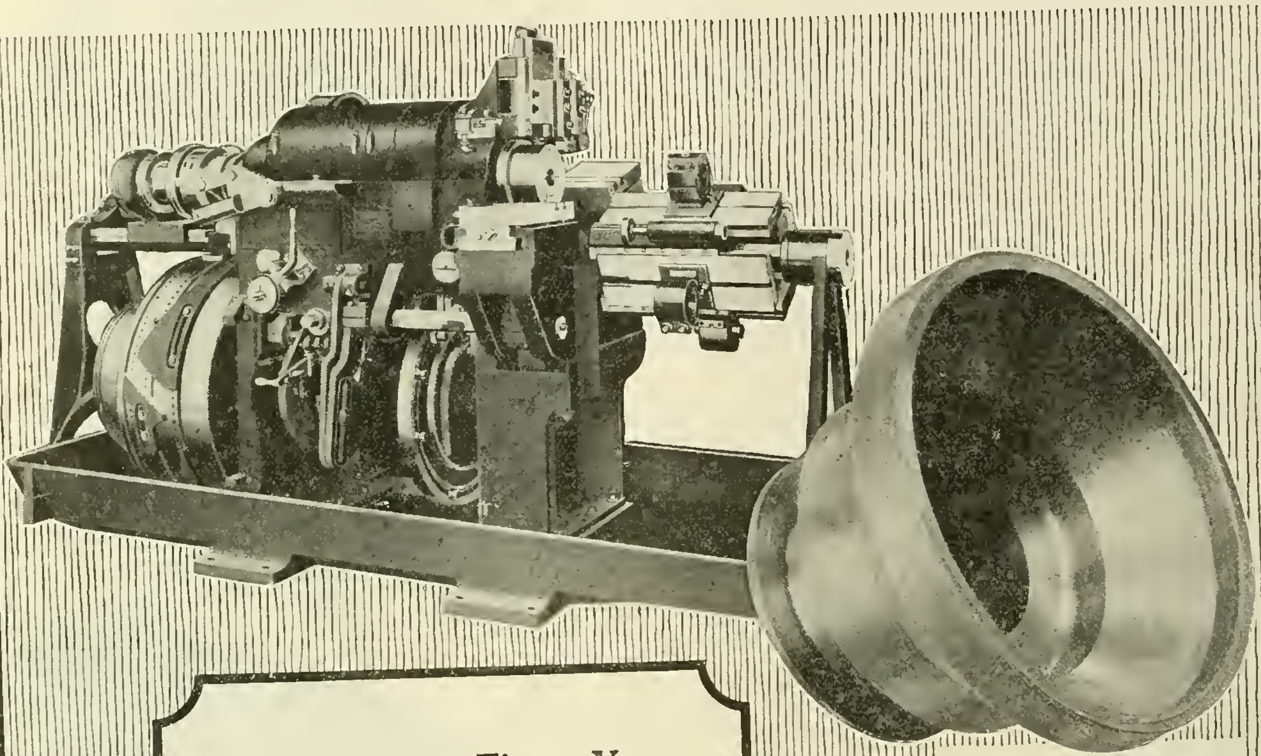


The Westinghouse Type SK Motor is universally used in machine shops.



Westinghouse

MODEL L GRIDLEY S. S.



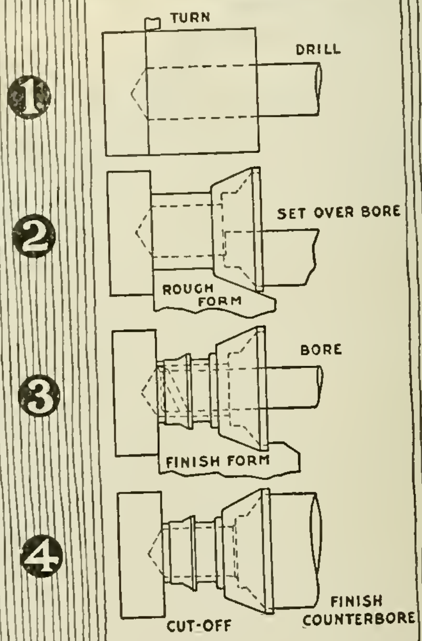
Construction First—Your Costs Depend On It

The kind of tool supports you see in this 5¼" Model L Gridley turret lathe are responsible for the heavy forming, boring and counterboring operations shown on the diagram of this steel job.

And the standardization of tools for both roughing and fine finishing enables you to change from one job to another on the shorter runs without excessive expense of equipment or time.

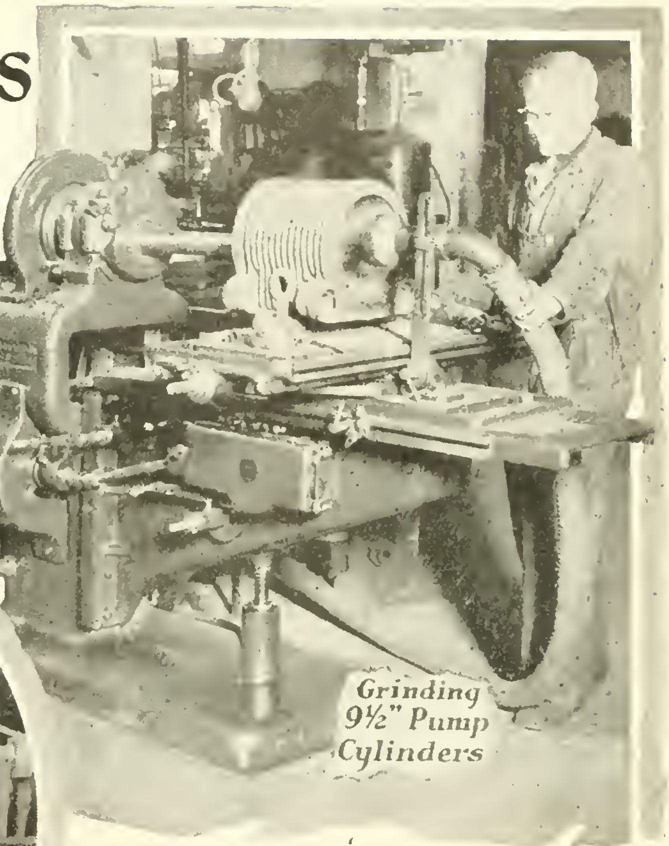
After all, it's the quantity per hour that measures the cost per piece. It costs you nothing to find out how many you can get on Gridley Automatics.

(Capacities 2¼" to 5¼")

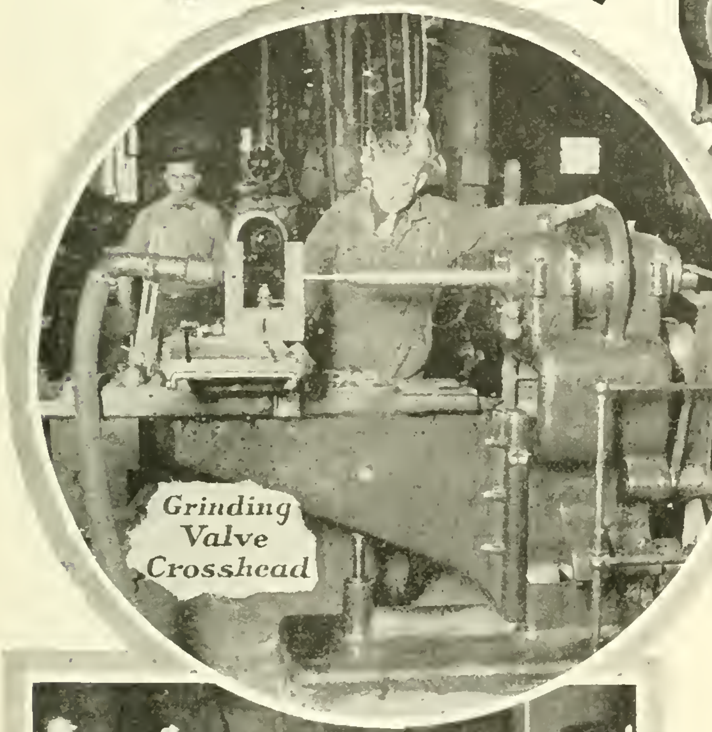


The National Acme Company
Windsor, Vt. Cleveland, O.
New York—Boston—Buffalo Detroit—Chicago—Los Angeles

What some shops are doing with a HEALD



Grinding 9½" Pump Cylinders



Grinding Valve Crosshead

Grinding Pin Hole in Combination Lever

THESE illustrations show some typical examples of the class of work performed on a Heald Hole Grinder installed this year in the main repair shops of an important eastern railroad.

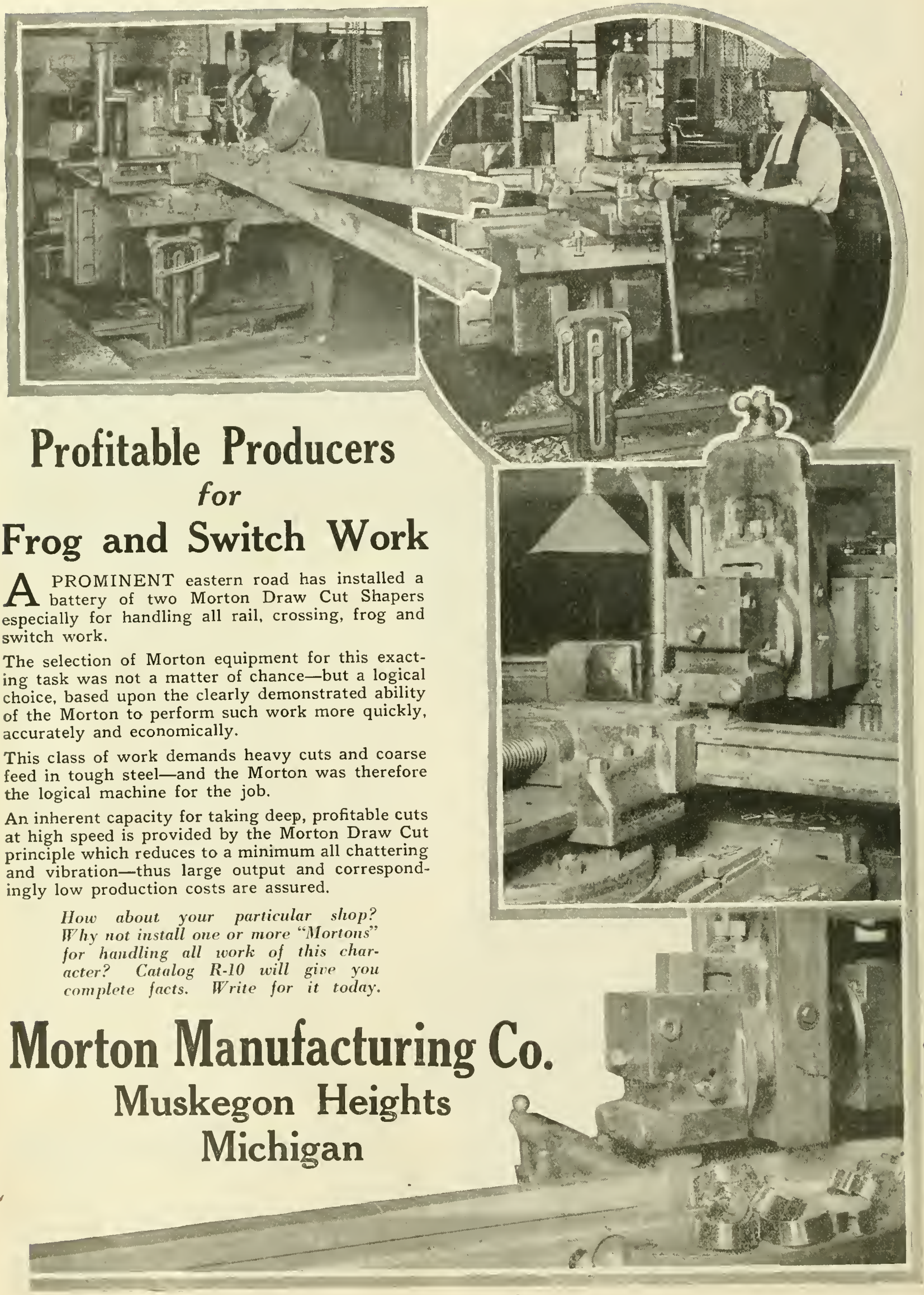
The 9½ inch air pump cylinder shown above is refinished complete on the Heald in 30 minutes, floor to floor.

Valve crosshead pin holes are ground as shown in illustration at left, absolutely straight, true and round, and to exact fit in 8 minutes or less. In the case of the larger holes in combination lever shown in lower view, 2" diameter by 5" long, the fit can be ground to size with just the right tolerances, in ten minutes or less.

These examples serve to show in a limited way what Heald Grinding can do in your own shop on countless similar operations. When you are seeking quicker and better methods for handling your motion work, air brake, power reverse gear, pneumatic fire door and stoker repairs—install a Heald.

Have you received your copy of the new Heald booklet, "Saving Minutes on the Road — Hours in the Shop"? If not, write for one today.

The Heald Machine Co.
Worcester, Mass.



Profitable Producers
for
Frog and Switch Work

A PROMINENT eastern road has installed a battery of two Morton Draw Cut Shapers especially for handling all rail, crossing, frog and switch work.

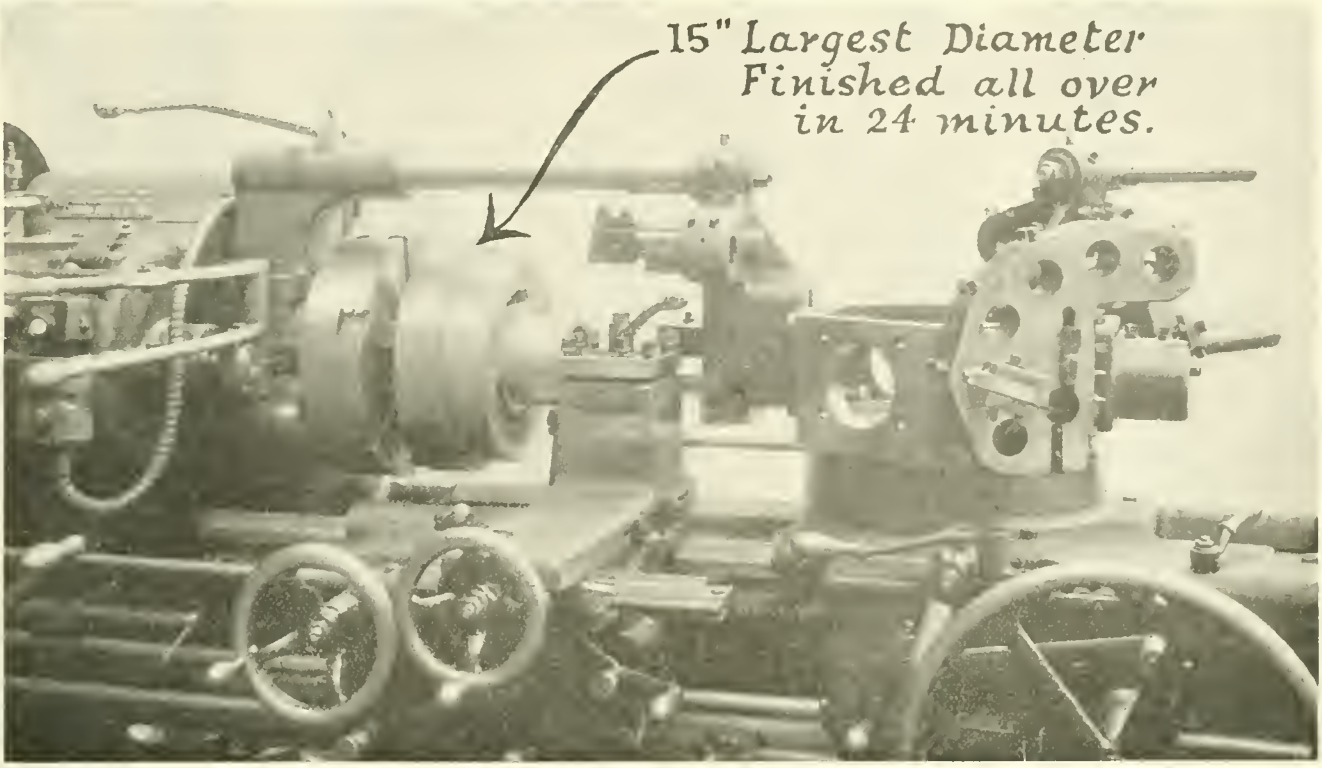
The selection of Morton equipment for this exacting task was not a matter of chance—but a logical choice, based upon the clearly demonstrated ability of the Morton to perform such work more quickly, accurately and economically.

This class of work demands heavy cuts and coarse feed in tough steel—and the Morton was therefore the logical machine for the job.

An inherent capacity for taking deep, profitable cuts at high speed is provided by the Morton Draw Cut principle which reduces to a minimum all chattering and vibration—thus large output and correspondingly low production costs are assured.

How about your particular shop? Why not install one or more "Mortons" for handling all work of this character? Catalog R-10 will give you complete facts. Write for it today.

Morton Manufacturing Co.
Muskegon Heights
Michigan



Keeping Locomotives Repaired

To keep equipment in repair is very important to any railroad system. To do this job well the shop mechanic keeps informed as to the best and easiest methods.

Here is a machine which is becoming more and more appreciated in the railroad repair shop because of the quick service and good workmanship it is possible to obtain from it.

The large gear blank shown on the machine in the picture was finished in 24 minutes as against 48 minutes by former methods.

Information about how Railroad Shops save time and get better results from Warner & Swasey Turret Lathes is yours for the asking. Shop Foremen and lathe operators, tell us your problems. We'll be glad to help you.

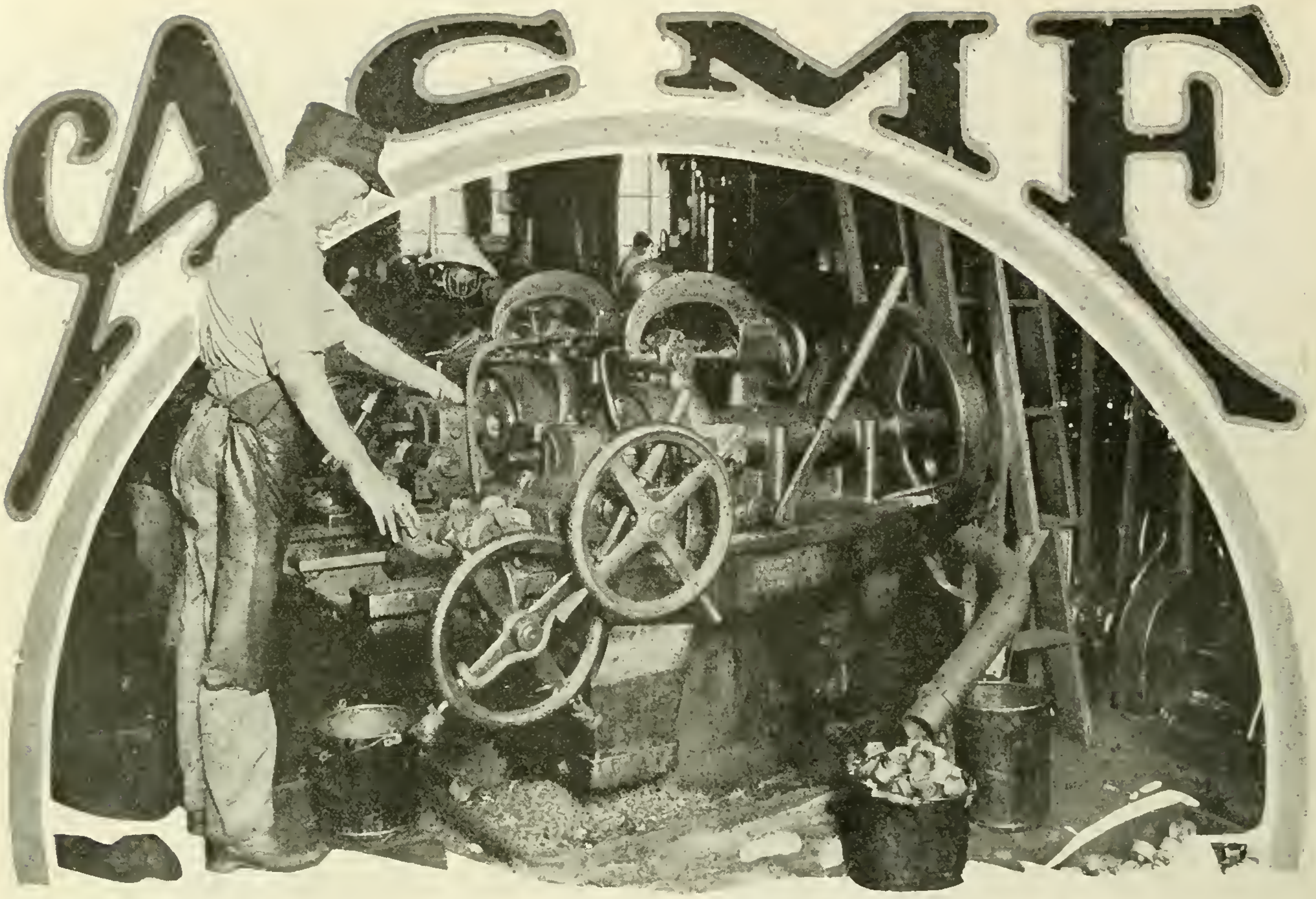
The Warner & Swasey Company

Cleveland, U. S. A.

NEW YORK: Singer Building
CHICAGO: 618-622 Washington Boulevard
MILWAUKEE: 1143 Wells Building

BOSTON: Oliver Building

BUFFALO: Iroquois Building
DETROIT: 5928 Second Boulevard
DAYTON: 518 Mutual Home Building



Cutting Down and Threading Rod Grease Plugs—200 Per Hour

HERE is a typical example of what an Acme Bolt Cutter and Threading Machine can do in any railroad shop.

The demand for countless small parts such as these grease plugs needed in large quantities in every shop as well as for stock and to supply roundhouses or other outlying points, calls for the efficient production made possible by Acme methods.

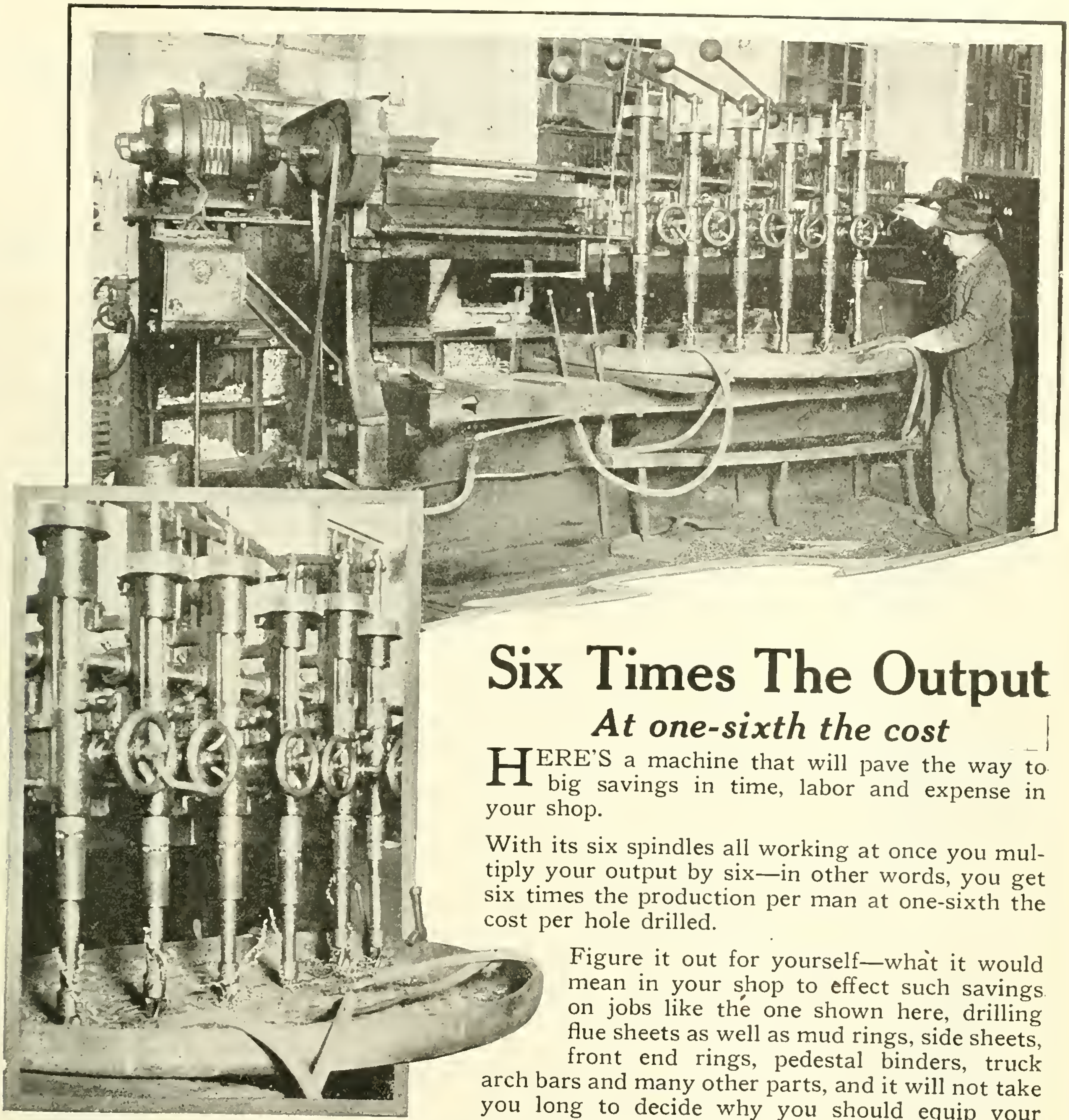
The shop where this view was taken may well be proud of its record of 200 grease plugs turned and threaded per hour—a record made possible by Acme capacity for high speed output.

The same ability to handle the quantity production of a wide variety of threaded parts at minimum cost and in record time is yours also if your shop is equipped with Acme Bolt Cutters and Threading Machines.

If your shop is not already Acme equipped, let us tell you more about the decisive savings effected by Acmes in railroad shops. If you already have an Acme—perhaps you need another to meet the demand for greater output. In either case it will pay you to specify Acme on your next requisition for threading equipment.

Why not write us today for complete facts and figures?

THE ACME MACHINERY CO.,
Cleveland, Ohio.



Six Times The Output

At one-sixth the cost

HERE'S a machine that will pave the way to big savings in time, labor and expense in your shop.

With its six spindles all working at once you multiply your output by six—in other words, you get six times the production per man at one-sixth the cost per hole drilled.

Figure it out for yourself—what it would mean in your shop to effect such savings on jobs like the one shown here, drilling flue sheets as well as mud rings, side sheets, front end rings, pedestal binders, truck arch bars and many other parts, and it will not take you long to decide why you should equip your shops with

FOOTBURT

Multiple Spindle Drills

Let us submit complete facts and figures for your consideration before selecting new drilling equipment for your shops.

Why not put your drilling problems up to us? We have made a specialty of meeting railroad drilling requirements for many years, and can furnish just the drilling equipment for your particular needs.

THE FOOTE-BURT COMPANY, CLEVELAND, OHIO

MILWAUKEE OFFICE
1143 Wells Bldg.

"Drill it on a FOOTBURT"

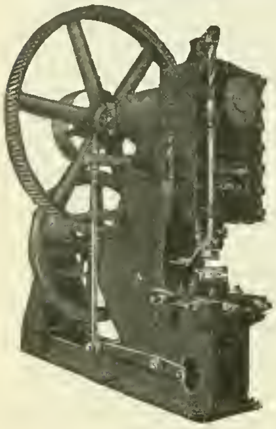
DETROIT OFFICE
5928 Second Boulevard

Tools which give long efficient service under rough hard usage
ESTABLISHED 1836

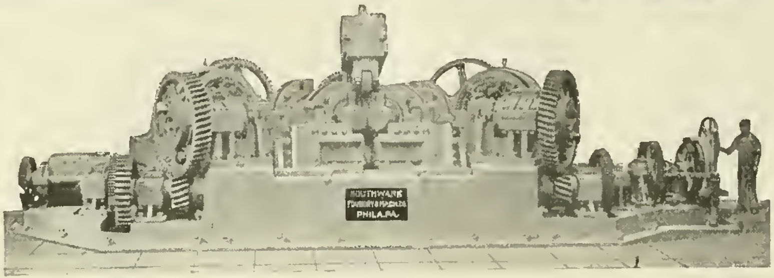
SOUTHWARK

Hydraulic and Power Tool Equipment

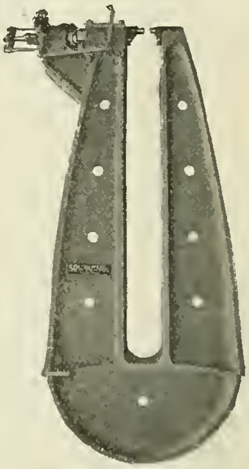
for railroad, locomotive and steel car shops



Washer Press



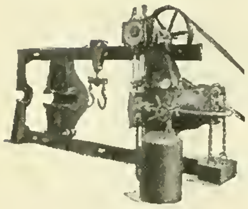
Wheel Mill



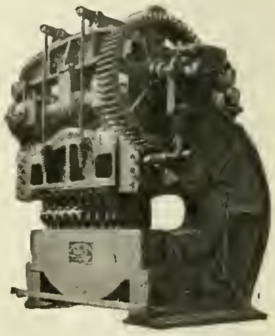
Hydraulic Riveter

A few of the standard Hydraulic and Power Tools designed and built by Southwark are illustrated on this page. In addition to standard equipment we specialize on the design and construction of tools and machinery for unusual operations or special processes.

Our engineering staff is always available for suggestions as to the most efficient machine for your special work.



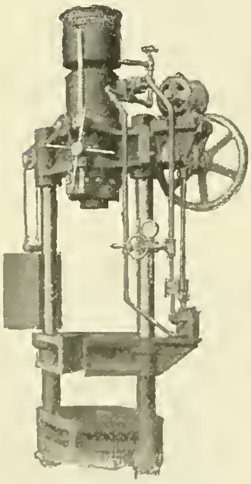
Carwheel Press



Multiple Punch

AMONG OUR STANDARD PRODUCTS

- Flanging Presses
- Sectional Flangers
- Bending Presses
- Bulldozers
- Bushing Presses
- Wheel Presses
- Forging Presses
- Boiler Riveters
- Bending Rolls
- Vertical and Horizontal Punches
- Hydraulic Pumps
- Valves
- Shears
  - Hydraulic Power
- Shears
  - Turret Head Rotary
- Angle Benders
- Upsetting Presses
- Shaft Straighteners
- Manhold Punches
- Portable Riveters
- Jacks
- Accumulators
- Fittings, etc.



Bushing Press

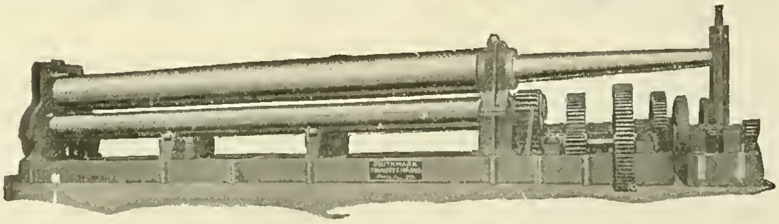
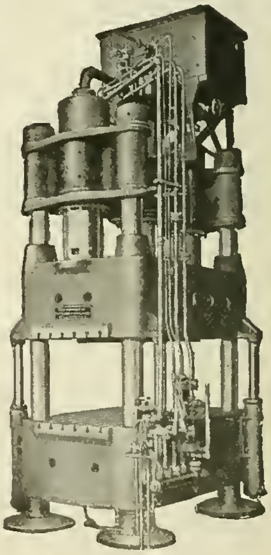


Plate Bending Rolls of Every Size and Description



2000-ton Flanging Press

SOUTHWARK
FOUNDRY AND MACHINE CO.
ESTABLISHED 1836
PHILADELPHIA, PA.

CLEVELAND
SWETLAND BLDG.

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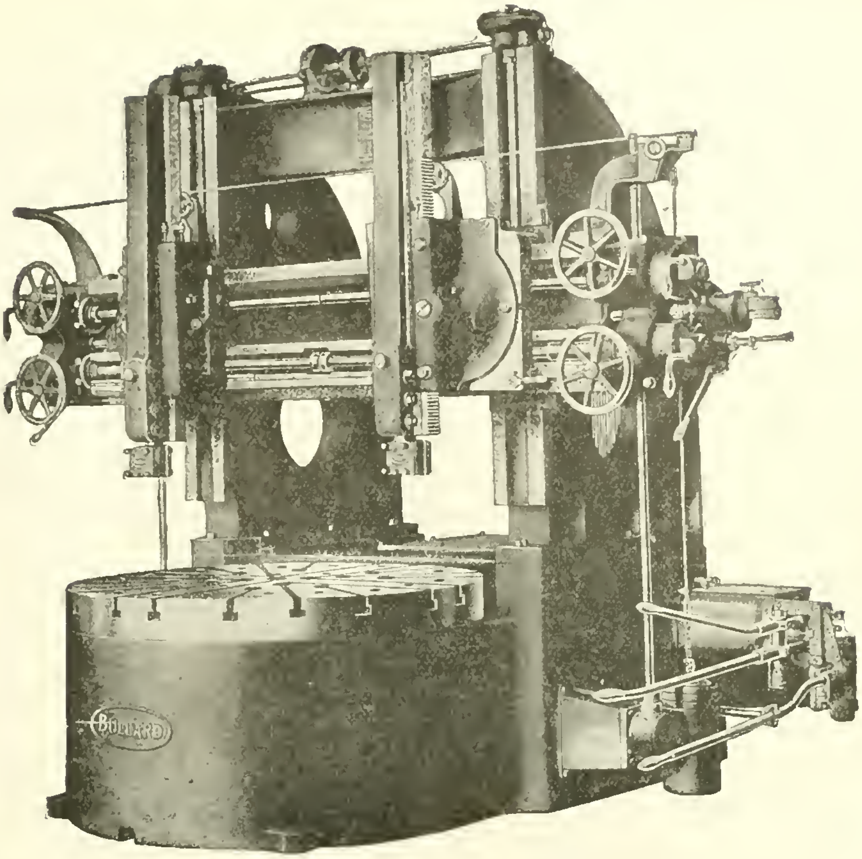


THE BULLARD MAXI-MILL

Built in 44 in., 54 in. and 61 in. sizes

The Bullard Maxi-Mill is, in every sense, a Modern Boring Mill,—built to stand the gaff of heavy cutting or to finish to close tolerances. A constant speed pulley transmits the power through clutch and brake to drive units where a full range of speeds are quickly and easily obtained. All driving gears and shafts are of heat treated chrome-nickel steel.

Positive feeds from .011″ to ½″ per revolution of the table can be obtained vertically or horizontally—independent for each head. The movement of heads between cuts is aided by Power Rapid Traverse.

A constant flow of lubricating oil to all moving parts removes the uncertainty of squirt-can methods.

Operation of the machine is extremely simple. All control levers are within easy reach and operator and machine are protected by safety devices from danger resulting from carelessness.

The Bullard Maxi-Mill is especially suited to Railroad shop boring, and on a wide variety of such work has earned

A Reputation Built on Performance

THE BULLARD MACHINE TOOL CO
BRIDGEPORT, CONNECTICUT

CHAMBERSBURG

WHEEL PRESSES

Single and Double End

Mounting and Demounting

Universal **FLANGING** Machinery

PUMPS

ACCUMULATORS

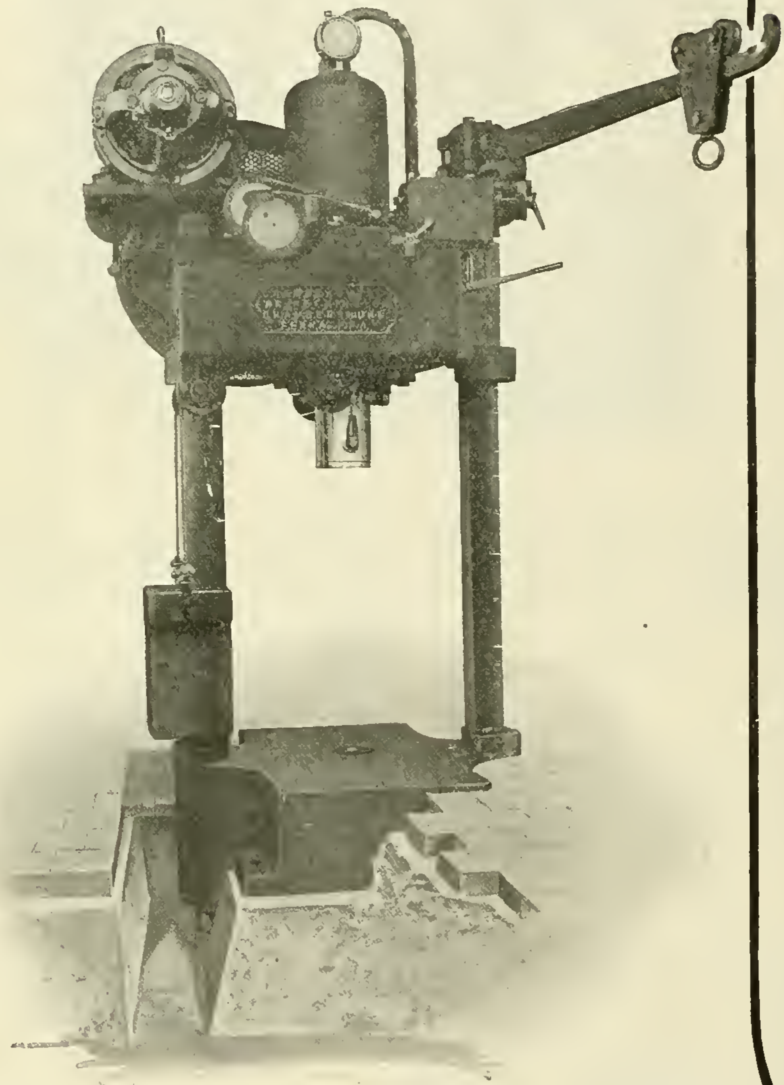
STEAM HAMMERS

Single and Double Frame

All Types

PUNCHES and **SHEARS**

BUSHING PRESSES



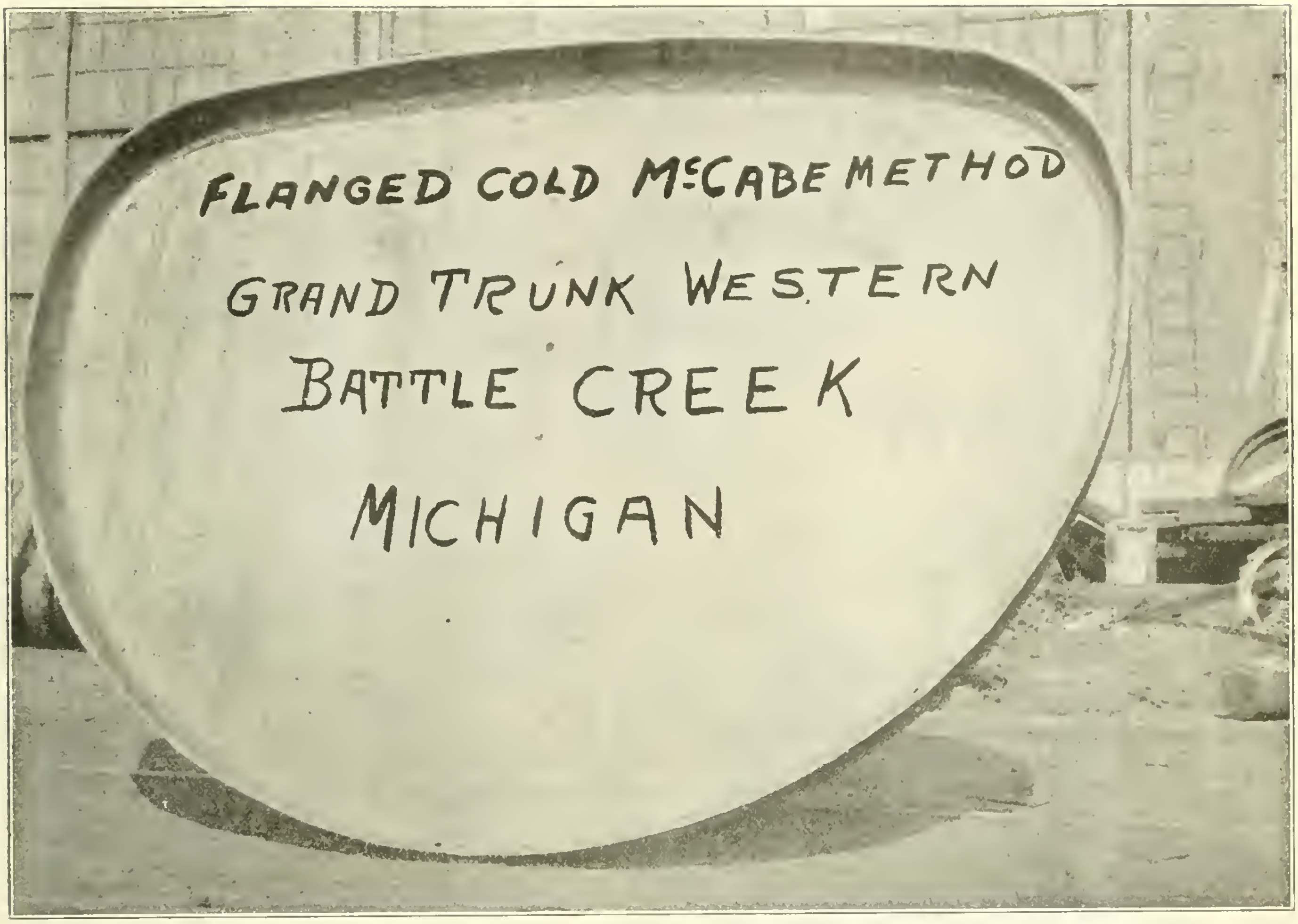
CHAMBERSBURG BUSHING PRESSES TYPE B

Ready for instant use. Completely self-contained. Fitted with Crane as standard equipment. Over-loading and consequent breakage impossible. All sizes and types to meet any individual requirement.

Bulletin No. 206 ready for distribution.

Nationally Represented by Manning, Maxwell & Moore, Inc.

CHAMBERSBURG ENGINEERING COMPANY
CHAMBERSBURG, PENNA., U. S. A.



THE HAND WRITING ON THE WALL!

**The
Picture
Gives
Range of
Capacity
½" and ¾"**

The
"McCABE"
Pneumatic Flanging Machine

Is a Proven Fact—
Not Mere Warning.

**McCABE
MFG. CO.**

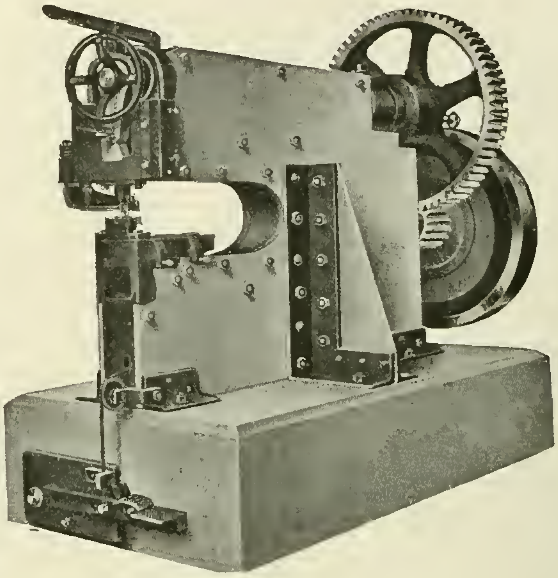
Lawrence
Massachusetts

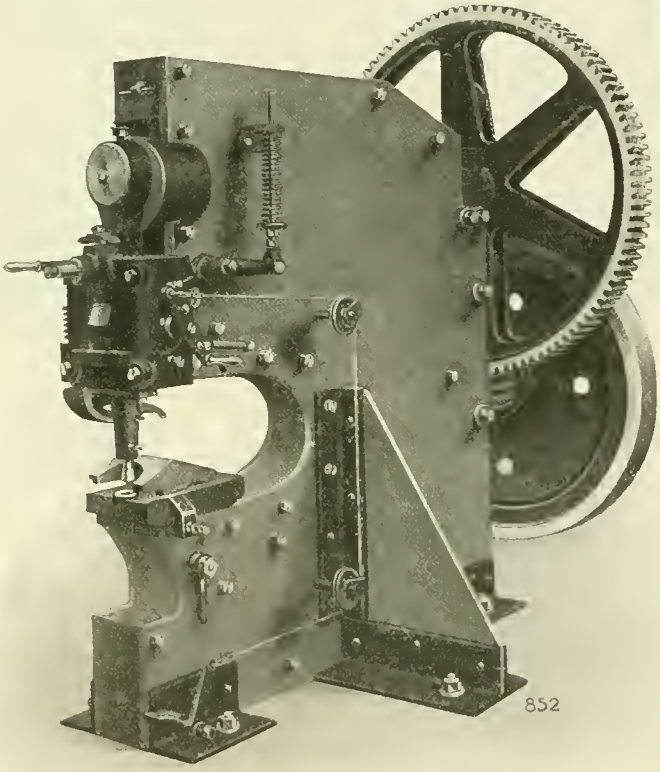
PELS VERTICAL PUNCHES

are made in all sizes from the rapid stroke-a-second small capacity tool to the ponderous boiler makers' 20″ diameter manhole machine. Throats vary from 12″ to 84″.

The machine illustrated at right punches 9/16″ holes through 5/16″ material, operates at sixty strokes per minute and has 30″ throat.

The one below punches 1″ holes through 1″ material and has 24″ throat. Strokes per minute: 25.





PELS punches are made with frames of very heavy O. H. steel plate, unconditionally guaranteed against breakage. All gears are steel with cut teeth; all pinions, shafts, and working parts are forgings; all bushings are phosphor bronze.

This construction provides greater machine strength, with less weight and less floor space. The proper design and construction of the machines permit their use with less horsepower. The patented balanced punch head means more punched holes per hour and consequently low cost production.

The installation of a PELS punch is an insurance against breakdowns. Thouands of PELS installations bear out this fact.

Our large stock assures prompt deliveries

Write for details

Pioneer Builders of steel plate frame, unbreakable punching and shearing machinery.

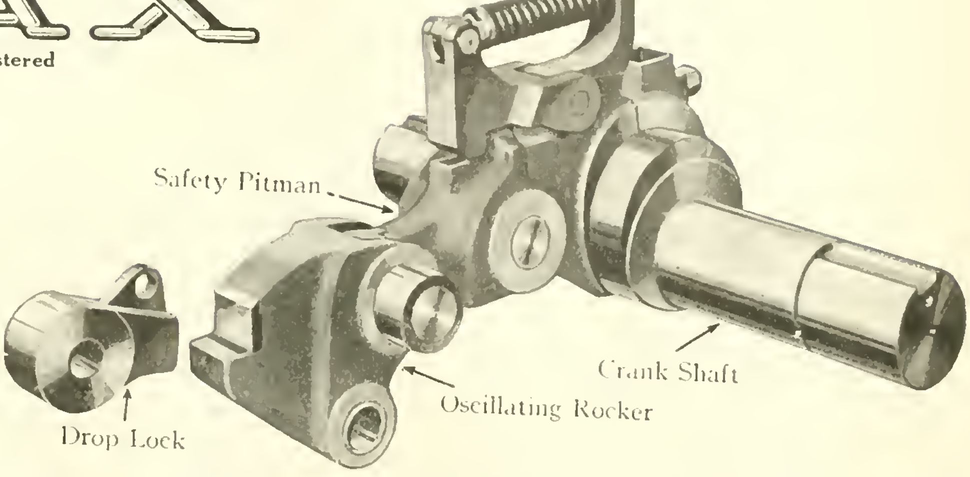
Henry Pels & Co
84 West St New York

AVOID IMITATIONS

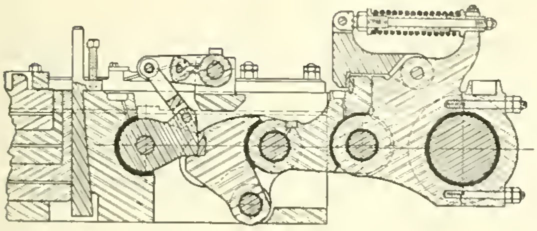
Buy a Genuine PELS Machine and Have No Regrets

Single—and Double—Ended Punches and Shears, Gate Shears, Bars and Billet Cutters, Double-Ended Angle Shears, Beam and Channel Shears, Coping Machines, Bending and Straightening Machines

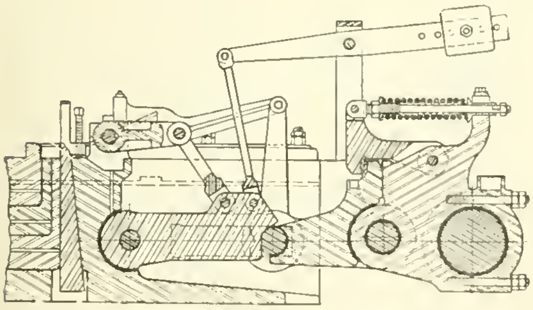
AJAX
Trade Mark Registered



THE NEW ROCKER TYPE DROP LOCK



The New Rocker Type Drop Lock engaged with the Rocker, Pitman and Crankshaft which are in constant motion.



The Original Slide Block Type Drop Lock showing its greater length which necessitated the use of a Counter Weight.

THIS NEW ROCKER TYPE DROP LOCK is the stop motion mechanism of Ajax NEW MODEL Forging Machines by means of which the slides are thrown into action for one or more strokes at the will of the operator.

It is a decided improvement over the old design due to its extreme shortness, increased engaging area, smooth action and light weight, which eliminates the necessity of a counter weight and timing lock.

As with the old type drop lock, the crankshaft and pitman remain in idle rotation when the slides are at rest. The pin end of the pitman is carried by an oscillating rocker instead of by reciprocating slide blocks, as formerly.

The lock engages the rocker at its extreme back travel where its velocity is zero as the crankshaft passes over dead center, and picks up the slides from rest with a smooth action free from shock.

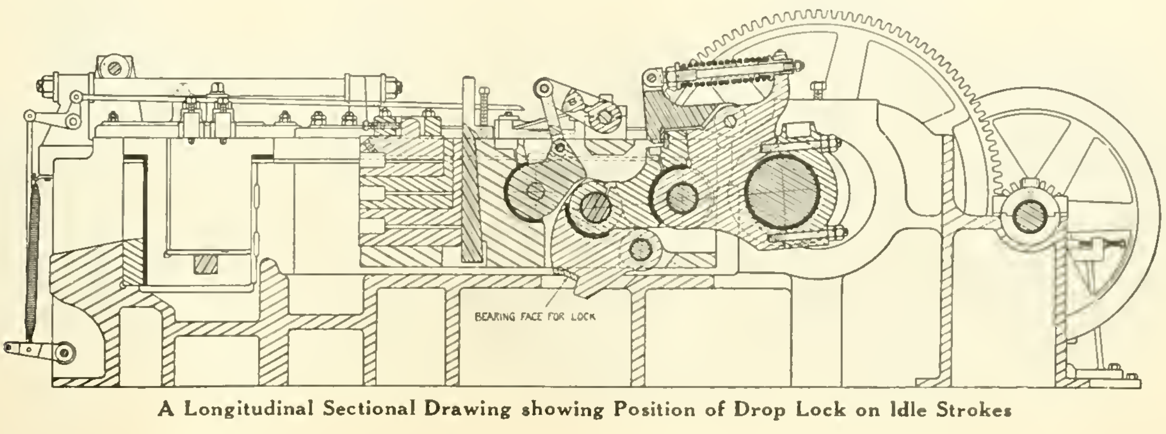
This drop lock never "misfires" and always brings its full surface into engagement. It is an exclusive Ajax feature protected by patent.

THE AJAX MANUFACTURING CO.

621 Marquette Bldg.
Chicago, Ill.

3830 Lakeside Ave.,
CLEVELAND, OHIO

1369 Hudson Terminal
New York City



A Longitudinal Sectional Drawing showing Position of Drop Lock on Idle Strokes

Abundant Power

Big Die Opening

Large Gathering Capacity

are features which enable handling wider range of work, and making many jobs with less heats and fewer operations on

THE NATIONAL

Heavy Pattern Forging Machine

(STEEL BED)

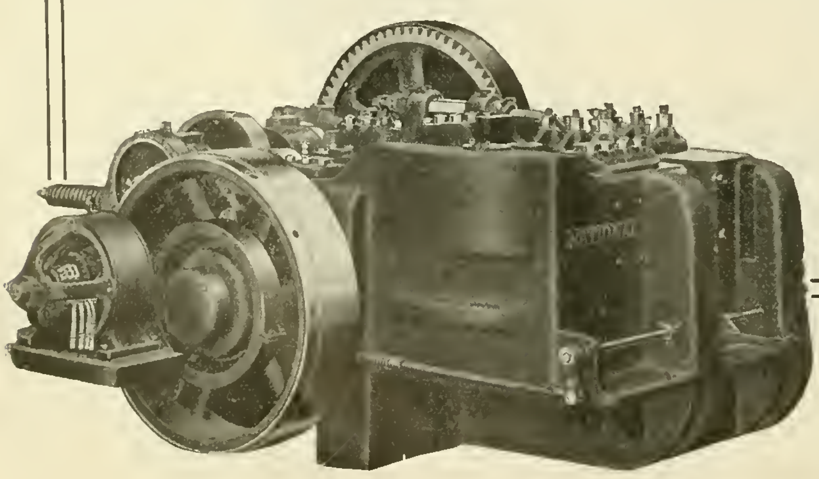
The Suspended Heading and Gripping Slides, the Wedge Adjusting Liner System, the Automatic Grip Relief and the Friction-Slip Flywheel are factors which eliminate shutdowns for petty repairs and adjustments—insuring constant production.

Submit your forging problems to us. We'll be glad to solve them for you.

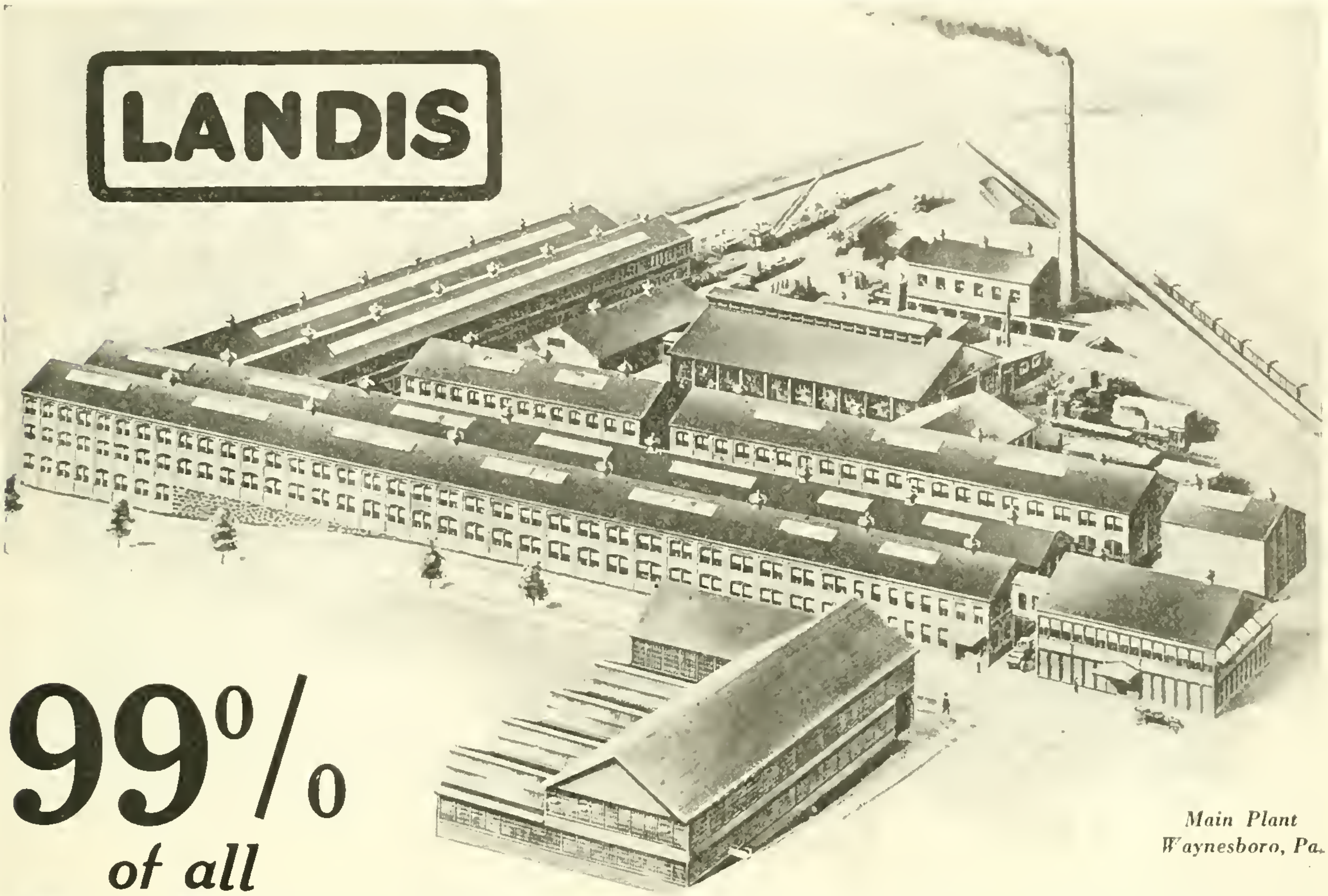
We are issuing an interesting series of Talks on Forging Machine Die Design. If you are not receiving these valuable Talks, we will be glad to add your name to our mailing list.

THE NATIONAL MACHINERY CO., TIFFIN, O.

ORIGINATORS OF MODERN BOLT, NUT AND FORGING MACHINERY



LANDIS



Main Plant
Waynesboro, Pa.

99%
of all

Master Mechanics in Railroad Shops Know the Value of Ground Parts

Yet how few railroads have up-to-date grinding equipment to help in reducing the time and labor costs. Ground parts are always accurate and finished with a smooth glass-like surface in one-half the time required by the usual railroad shop methods. Grinding finishes all parts uniformly, making all operating units function easily and eliminating excessive wear on the packing, glands and bearings.

Landis Grinding Machines are the best tools for doing all classes of railroad shop work. The *Gap Machine* is suitable for work having projections which require a large swing with a small diameter to be ground. *Universal and Plain Machines* are used on such work as link blocks, triple valves, knuckle pins, boring tools, reamers, gages, arbors, dies or any work that can be held by face plate or chuck. Landis machines are flexible in all operating units. All levers, handles and adjustments are within easy reach of the operator at all times from the front of the machine, insuring no lost motion to retard production.

Let our engineers estimate on grinding time. Our catalogue is free. Write for your copy.

LANDIS TOOL COMPANY

WAYNESBORO, PA.
New York Office - - - - - - 30 Church St.

Domestic Agents: Hallidie Machinery Co., Seattle; Smith, Booth, Usher Co., San Francisco and Los Angeles; Peden Iron & Steel Co., Houston; Fulton Supply Co., Atlanta; F. C. Richmond Machinery Co., Salt Lake City. Canadian Agents: F. F. Barber Machinery Co., Toronto; Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Nova Scotia, New Brunswick, Manitoba, and British Columbia.
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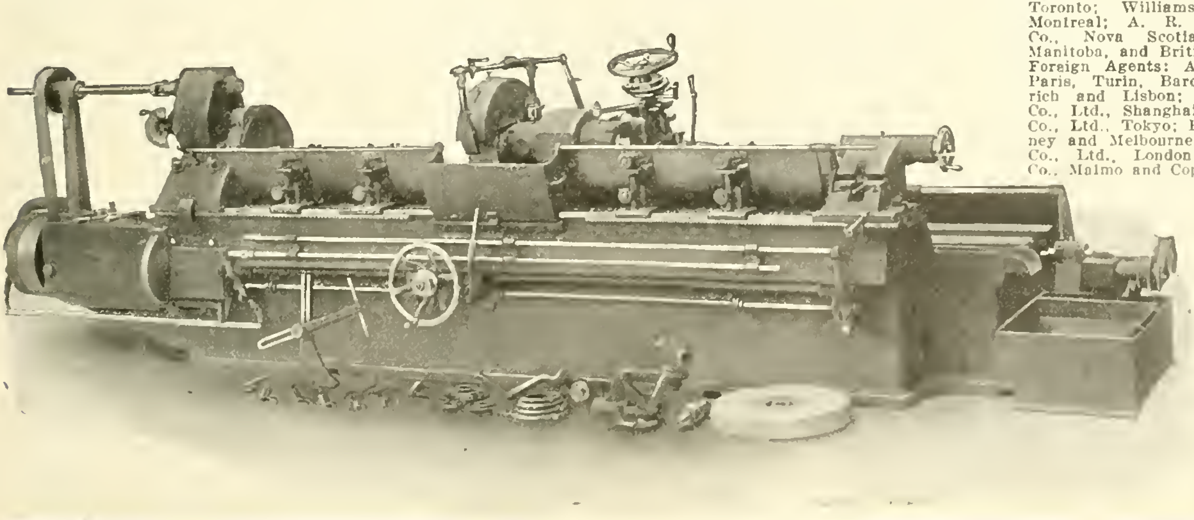
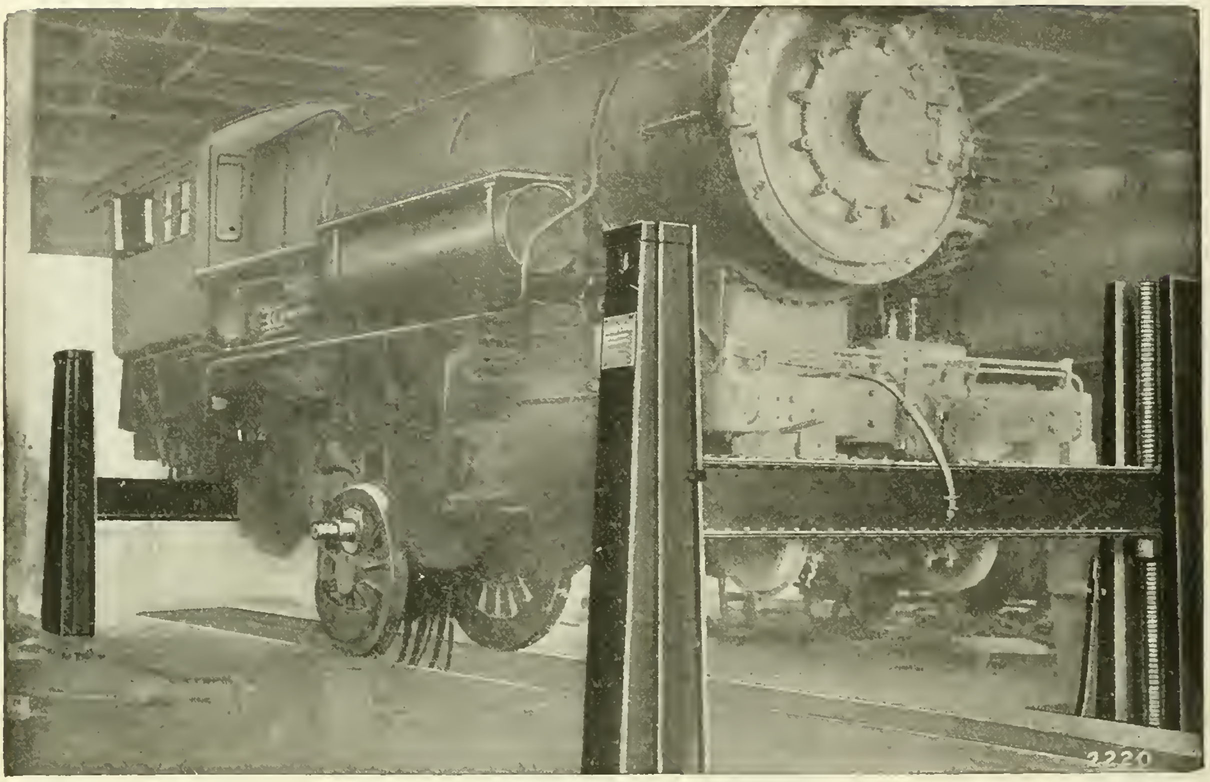




Whiting Four-Jack Locomotive Hoist, Capacity 200 tons. View shows hoist in operation removing a single pair of drivers. In shops of Baltimore & Ohio R. R., Garrett, Ind.

This Hoist Removes all Drivers or only one Pair, as desired

The Whiting Locomotive Hoist is being used with equal advantage to handle one pair of drivers or all of them.

Being absolutely safe, the workmen do not hesitate to work on or under the engine while on the hoist. A Whiting Hoist combines convenience, safety and speed with large savings in time and labor.

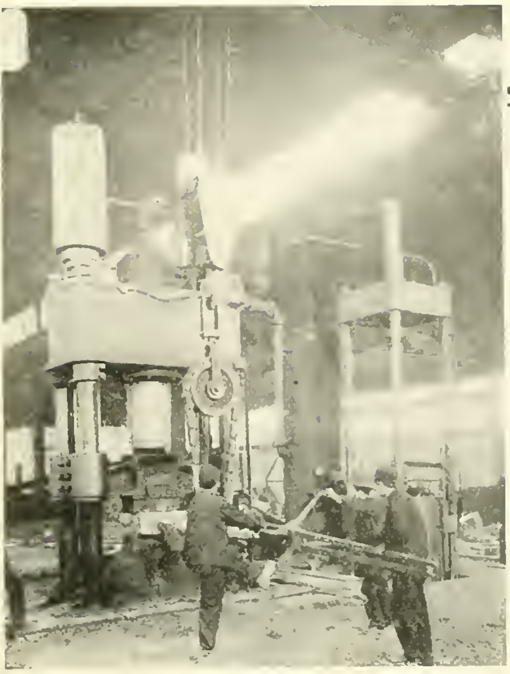
Send for Catalog 160.

WHITING CORPORATION
(Formerly Whiting Foundry Equipment Co.)
15609 Lathrop Ave., HARVEY, ILL. (Chicago Suburb)
Representatives in 25 Principal Cities

COACH HOISTS—TRANSFER TABLES—TURNTABLE TRACTORS

WHITING

CRANES
FOUNDRY EQUIPMENT
RAILWAY SPECIALTIES



1000 Ton Press—Titusville Forge Co.

Are you interested in reducing forging costs and improving your forgings? Then ask for information about UNITED HIGH SPEED STEAM HYDRAULIC FORGING PRESSES.

YOU SHOULD ALSO HAVE THE BEST

We have supplied our presses to practically all the leading forge shops, ship yards, government arsenals and navy yards in the country, also a number for railway use. If they find it necessary to use High Speed Steam Hydraulic Forging Presses in order to produce economically, why should you continue to make forgings by antiquated machinery and methods when there is a better way.

The Press is a very flexible machine and can be used for many other purposes besides straight forging work, such as bending, punching, shearing, straightening, etc., and is a valuable asset to any forge shop.

As it works with a squeeze instead of a blow, it is a much safer machine to operate than a hammer. Massive and expensive foundations and their upkeep are eliminated and no shocks are transmitted to surrounding machines and buildings. The tool and upkeep cost is also very much less than for a steam hammer.

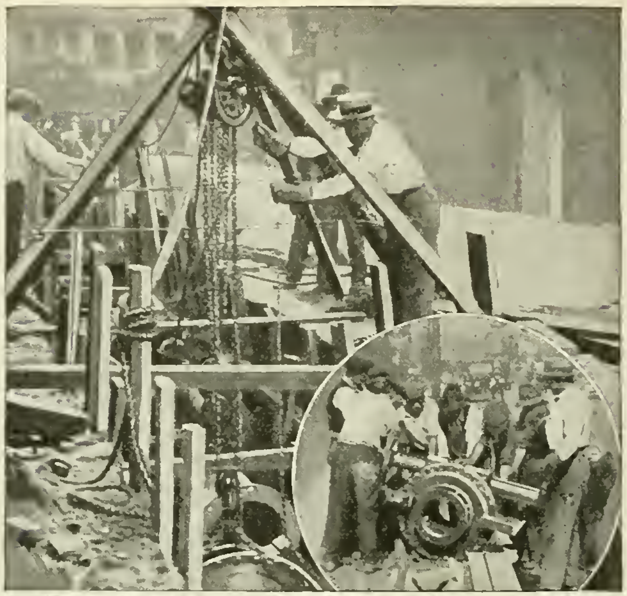
Built in the Following Sizes:

Single Frame, 150 and 300 Ton. Four-Column, 500—750—1000—1500—2000 Tons and Up.

UNITED ENGINEERING & FOUNDRY CO.

PITTSBURGH, PA.

The World's Greatest Manufacturers of Rolls and Rolling Mill Machinery



CYCLONE HIGH SPEED HOISTS

We Saw this Example of Labor Saving From Our Office Window!

IT took nine husky men, with many a "yo" and a heave, to place this ponderous fitting in position for lowering into a trench dug by the Cleveland Electric Illuminating Co. for laying the steam pipes to the new Union Trust Building, Cleveland.

When hooked to the Cyclone Hoist, rigged over the trench, one man alone lowered the same heavy weight into position!

One never need go far to find places where a Cyclone Hoist can save labor and cut costs. Perhaps *you* need only to look out *your* window into your factory yard, your shop or warehouse to see instances where a Cyclone Hoist can profitably replace muscle-methods. Look!

Send for catalog covering 1 to 40 Ton Hoists, Cranes, Trolleys and Overhead Track Systems.

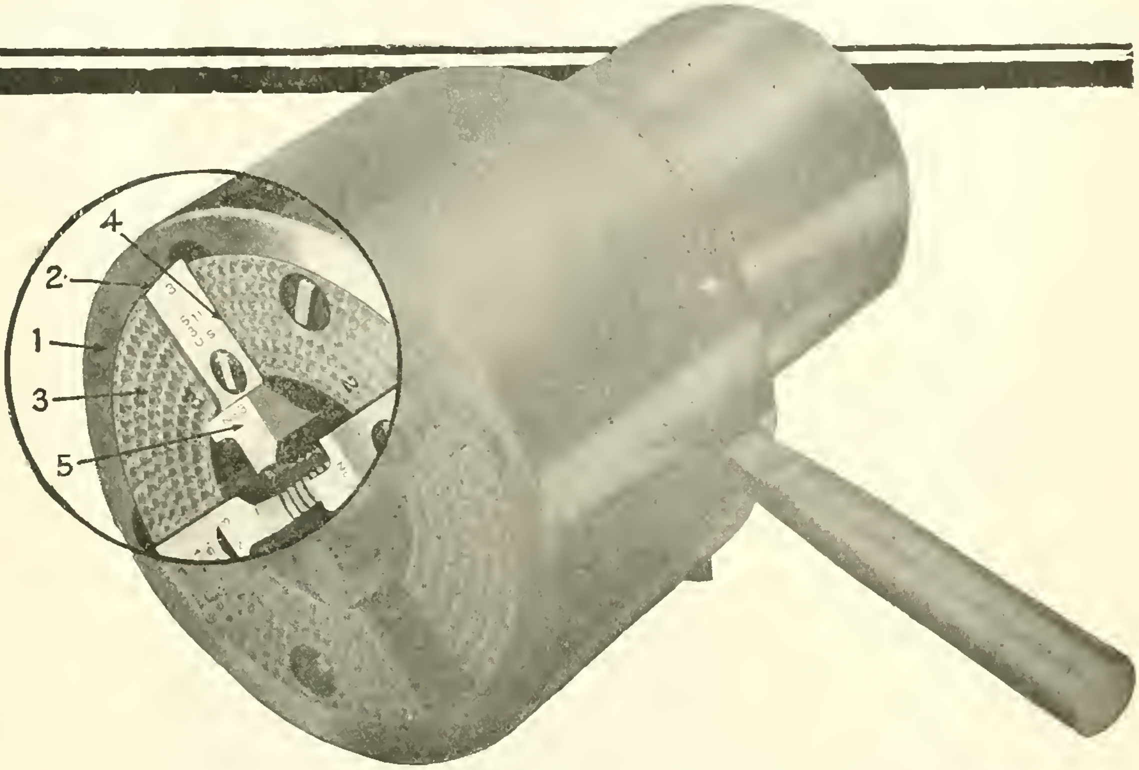
Distributors Everywhere

The Chisholm-Moore Mfg. Co.
Cleveland, O.

Hoists Cranes Trolleys Overhead Track Systems

Branches: **New York, Chicago, Pittsburgh**

Check these Namco Features against your threading experience



NAMCO points that will pay you to consider

Support of chasers directly behind cutting strain against double thick cup wall of fine alloy steel, hardened and ground—1.

A new set of chasers gives new cam, no intermediate parts to wear—2.

Hardened Core—3, holding chasers, is ground outside, also at sides of chaser slots—4.

Chasers—wide and heavy, ground on sides and bottom, hobbed, lapped and every set tested. Overhang chasers for shoulder threading—5.

In thread cutting the simplest is the best in the long run. And it is the long run that counts in a Self-Opening Die Head.

The importance of simple design in NAMCO Die Heads is largely responsible for their success as continuous producers.

The absence of intermediate supports by small parts at points of strain is a common sense factor. Also the generous proportions of Cup and Chasers add strength to the already simple design.

Finally all parts are hardened and ground—no soft spots, no wobble, but a permanent producer that you don't need to fuss with.

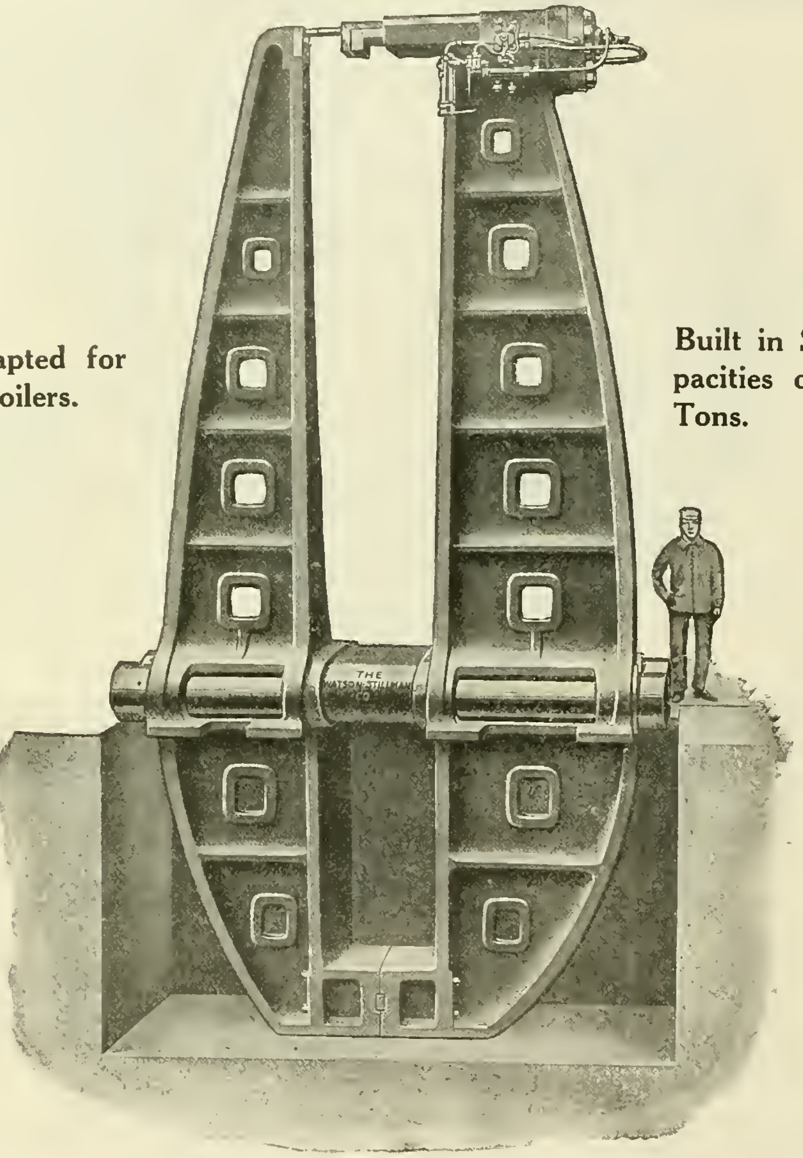
Doesn't your experience warrant a trial of this kind of tools? In capacities up to 2½″ for hand or automatic machines, and Chasers from stock.

The National Acme Company

New York—Boston—Buffalo
Cleveland, O.
Detroit—Chicago—Los Angeles

WATSON - STILLMAN HYDRAULIC RIVETERS

These Riveters are of the Built Up Type, so designed that there is a minimum of spring.



Especially adapted for Locomotive Boilers.

Built in Sizes and Capacities of 50 to 150 Tons.

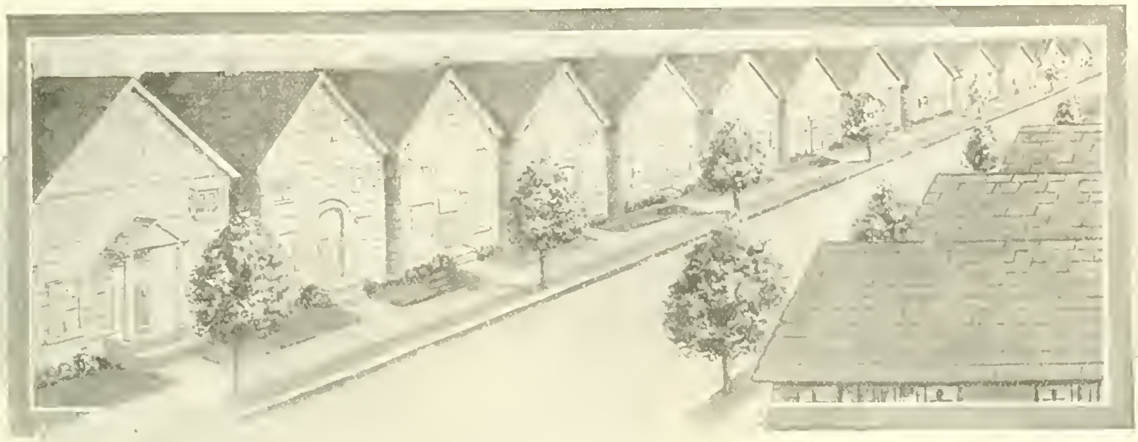
These riveters are of the built up type and have flush top cylinders of our standard type securely bolted and keyed to the stake. The main frames are of cast steel held rigid by means of two massive forged steel bolts. The opening between the stakes is from 24 to 36 inches to suit customers' requirements.

These riveters are made with or without Plate Closing Arrangement as desired.

We are prepared to supply complete Hydraulic equipment including Forging Presses, Wheel Presses, Flanging Presses, Forcing Presses, Rail Benders, as well as the power plant necessary, such as accumulators, pumps, valves, pipe and fittings.

THE WATSON-STILLMAN CO.

188 Fulton St., New York
Chicago: McCormick Bldg.
Philadelphia: Widener Bldg.



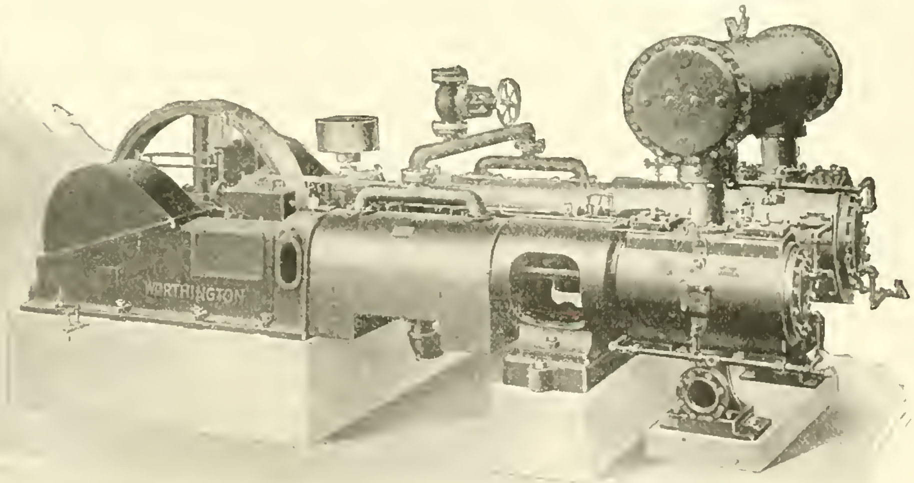
For Engineers Unaflow Simplicity

The steam valves of the Worthington Unaflow Compressor are absolutely steam-tight under any steam conditions, and are operated by a single valve rod from the crank shaft. There are no exhaust valves. No complicated mechanisms; no heavy unbalanced valves to wear and leak; no heavy and complicated reciprocating valve motion to operate and maintain. Owing to these and other unique features, Worthington Unaflow Compressors operate with extreme quietness and a minimum of attention and up-keep.

Saves Enough Coal For Sixteen Homes

A 1,500 cu. ft. Unaflow Compressor will save enough coal in a year to supply heat for sixteen families—135 tons in all. And this as compared with the fuel used in running a Meyer Gear Compressor. In the case of simple slide valve machines the savings are much greater.

Bulletin L-542 tells more about this thrifty Compressor.



WORTHINGTON PUMP AND MACHINERY CORPORATION

Executive Offices: 115 Broadway, New York City, Branch Offices in 24 Large Cities

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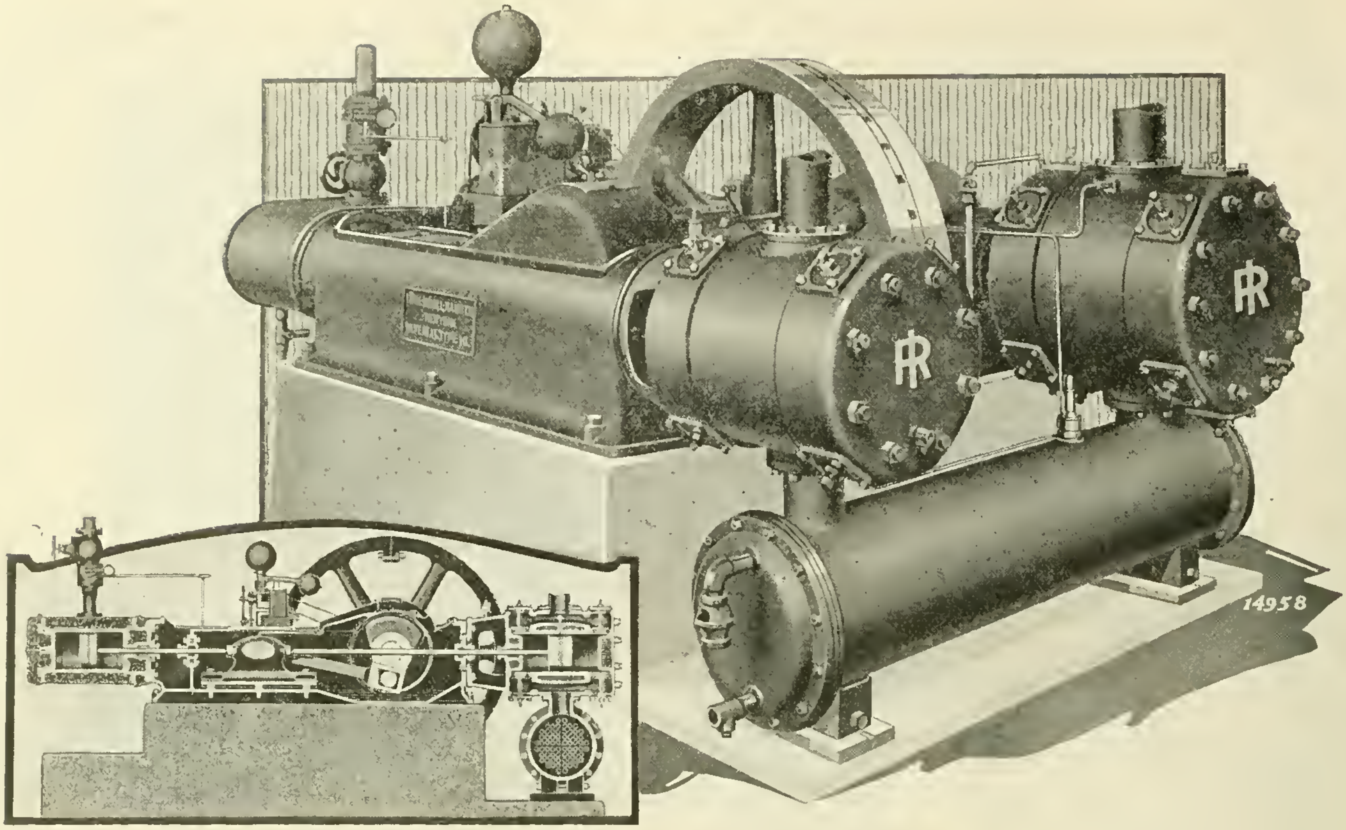

Accessibility

Ingersoll-Rand Type "XPV" Steam Driven Compressors are Compact and Accessible.

DISTINCTIVE FEATURES

Automatic cut-off governor
Piston steam valves
I-R Plate air valves
Enclosed construction
Automatic lubrication

Send for a copy of Bulletin 3044—It's new.

The unique construction, in which air and steam cylinders are located at opposite ends of the main frame, reduces the number of pressure stuffing boxes and eliminates long piston rods. It also permits of quick removal of air and steam pistons and cylinder heads.

Type "XPV" Compressors are easy to erect because of their unit construction which assures correct alignment and requires less floor space.

The accessibility to valves, cylinders, steam valve gear and automatic cut-off governor is characteristic of "XPV" Steam Driven Compressors.

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PITTSBURGH
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SALT LAKE CITY
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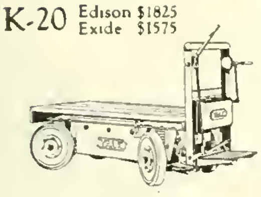
For Canada refer Canadian Ingersoll-Rand Co., Limited, 260 St. James St., Montreal

744-C

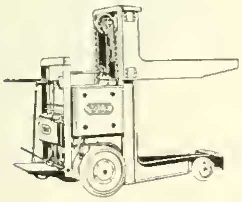
Ingersoll-Rand

YALE—the key to lower handling costs
Chapter 3 on Storage Battery Trucking

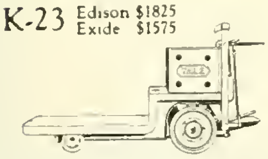
K-20 Edison $1825 Exide $1575



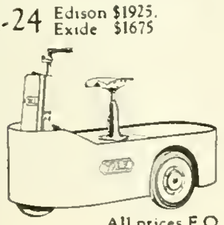
K-22 Edison $2350 Exide $2100.



K-23 Edison $1825 Exide $1575



K-24 Edison $1925. Exide $1675



All prices F.O.B Works with
Edison or Exide Batteries

YALE—
A Synonym for Mechanical Excellence

The "K" models of Yale Industrial Trucks are built with a thorough understanding of industrial needs supplemented by more than twenty years experience in the design and construction of storage battery vehicles.

These trucks have a minimum number of parts, grouped in major units and arranged for maximum accessibility. The majority of parts in the trucks of the K-series are interchangeable between models. Obvious operating economies are thus made possible.

Each part of these trucks—the frames, the control unit, the motor, the wheels, the brakes, the steering mechanism, etc.—has been designed according to the best engineering standards and subjected to the most severe practical tests. The result has been a series of industrial vehicles worthy of the name YALE.

Our engineers are at your disposal to analyze your material handling problem, give you definite recommendations for its solution and prove by actual demonstration, in your own plant, the practical results to be obtained by handling your product the Yale Way.

The Yale & Towne Manufacturing Co.
Makers of Yale Products: Locks, Door Closers and Material Handling Equipment
Stamford, Conn., U. S. A.
Yale Made is Yale Marked

MATERIAL HANDLING EQUIPMENT

for Vertical Travel
Yale Chain Blocks
Yale Electric Hoists

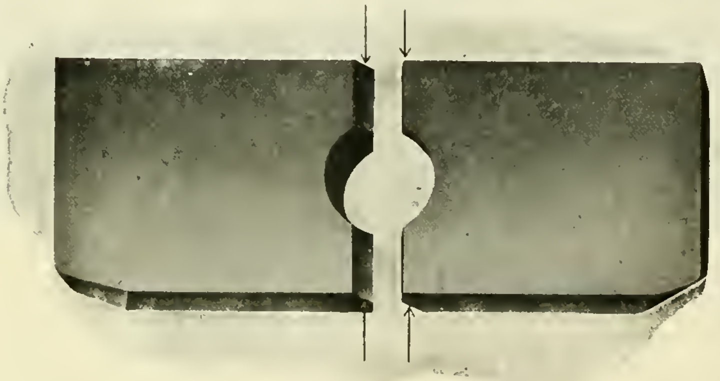
TRADE **YALE** MARK

for Horizontal Transfer
Yale Trucks & Tractors
Yale I-Beam Trolleys

Davis

Cutters

"A PRODUCT BACKED BY TWENTY YEARS OF EXPERIENCE"



The Advantages of Using Davis Cutters Exclusively in Connection With Davis Expansion Boring Tools

1st.	**EFFICIENCY—**	Best results are assured with cutters which are correctly formed, tempered and ground for the class of metal to be bored.
2nd.	**ECONOMY—**	Special production facilities enable us to produce better cutters at a lower cost than could be made in your own shop.
3rd.	**UNIFORMITY—**	Cutters are interchangeable being made to definite standards, which must be met in order to pass rigid inspection.
4th.	**UTILITY—**	The liberal allowance provided for expansion and regrindings insures maximum utility for each cutter.
5th.	**SURETY—**	Our reputation in the railroad field extending over a period of twenty years is your guarantee of the merit of Davis Cutters.
6th.	**SERVICE—**	Real service, with a personal touch, is the policy fostered by this company—quick shipments, direct from stock, without any delay. Take advantage of our large stock of standard size cutters and send us your orders.

Cutter cards Nos. 125 and 169 will be sent on request.

Davis Boring Tool Company
Incorporated
FOREST PARK BOULEVARD—SPRING AVENUE
ST. LOUIS, MISSOURI
ESTABLISHED 1903

LARGEST EXCLUSIVE MANUFACTURERS OF EXPANSION BORING TOOLS AND REAMERS

BRUBAKER

Special Tempered Relieved

SPIRAL
FLUTED
STAYBOLT
TAPS

Patented—Patent No. 1,434,870

Latest BRUBAKER
Catalog sent on request

Mr. Purchasing Agent

EVERY factor lengthening the life and usefulness of a staybolt tap has been incorporated in this new Brubaker design.

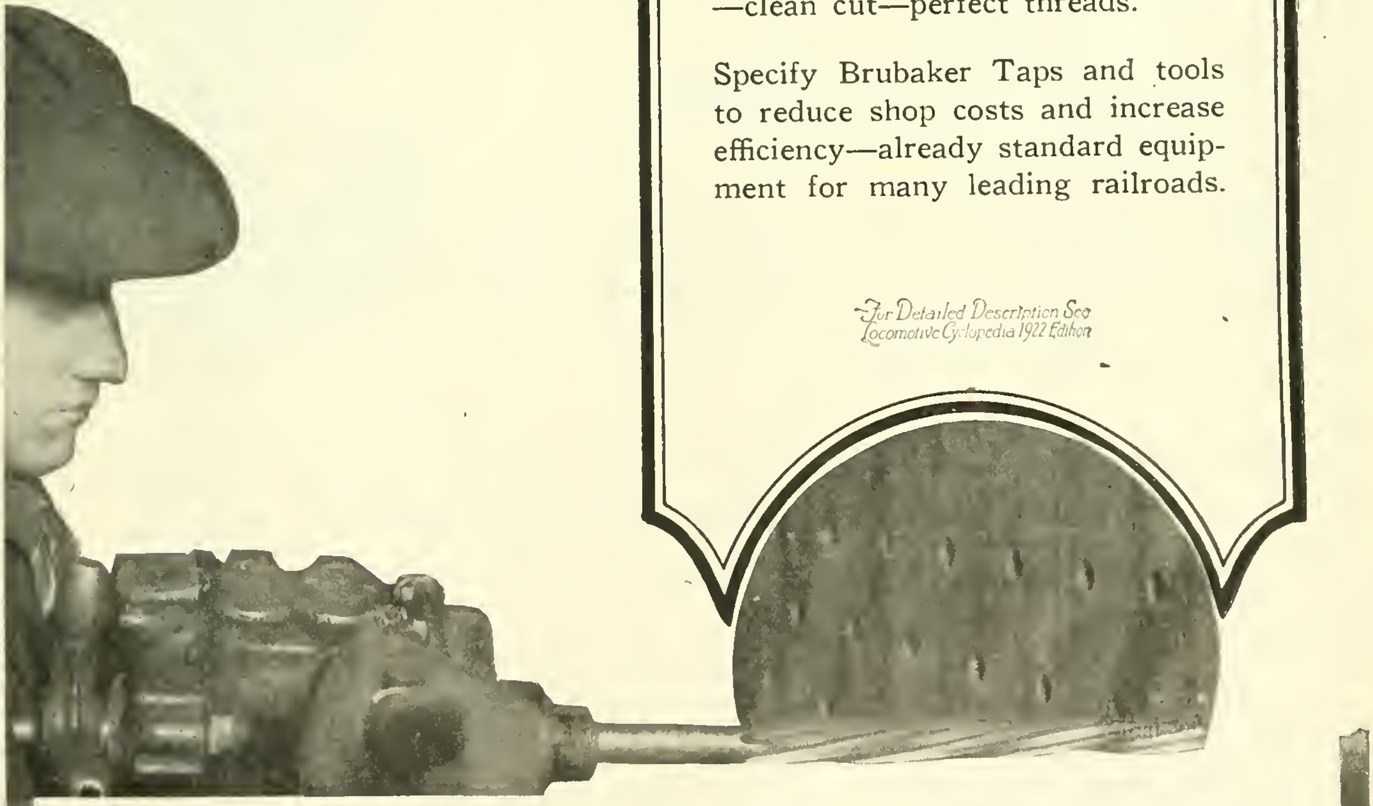
Continuous engagement of the spiral cutting edge reduces vibration and breakage to a minimum.

Tapping speed is increased by reducing friction and chattering through the relief feature.

Practical tests have proven 20% more holes per tap with less power—clean cut—perfect threads.

Specify Brubaker Taps and tools to reduce shop costs and increase efficiency—already standard equipment for many leading railroads.

For Detailed Description See
Locomotive Cyclopedia 1922 Edition



W. L. BRUBAKER & BROS. CO.

Sales Office
50 Church St., New York

Factory
MILLERSBURG, PA.

As installed at Cadillac Motor Co., Detroit

Don't let him slow up your production or impair product—but let our customers do the talking:

"With better light and air due to Buffalo Equipment the workmen can naturally turn out more work and better work," writes the Superintendent of the Hay Foundry & Machine Works.

"The Buffalo Forge Fan System of ventilating and heating by indirect radiation makes our new foundry the best ventilated and heated in the world."—Fairbanks Morse Company.

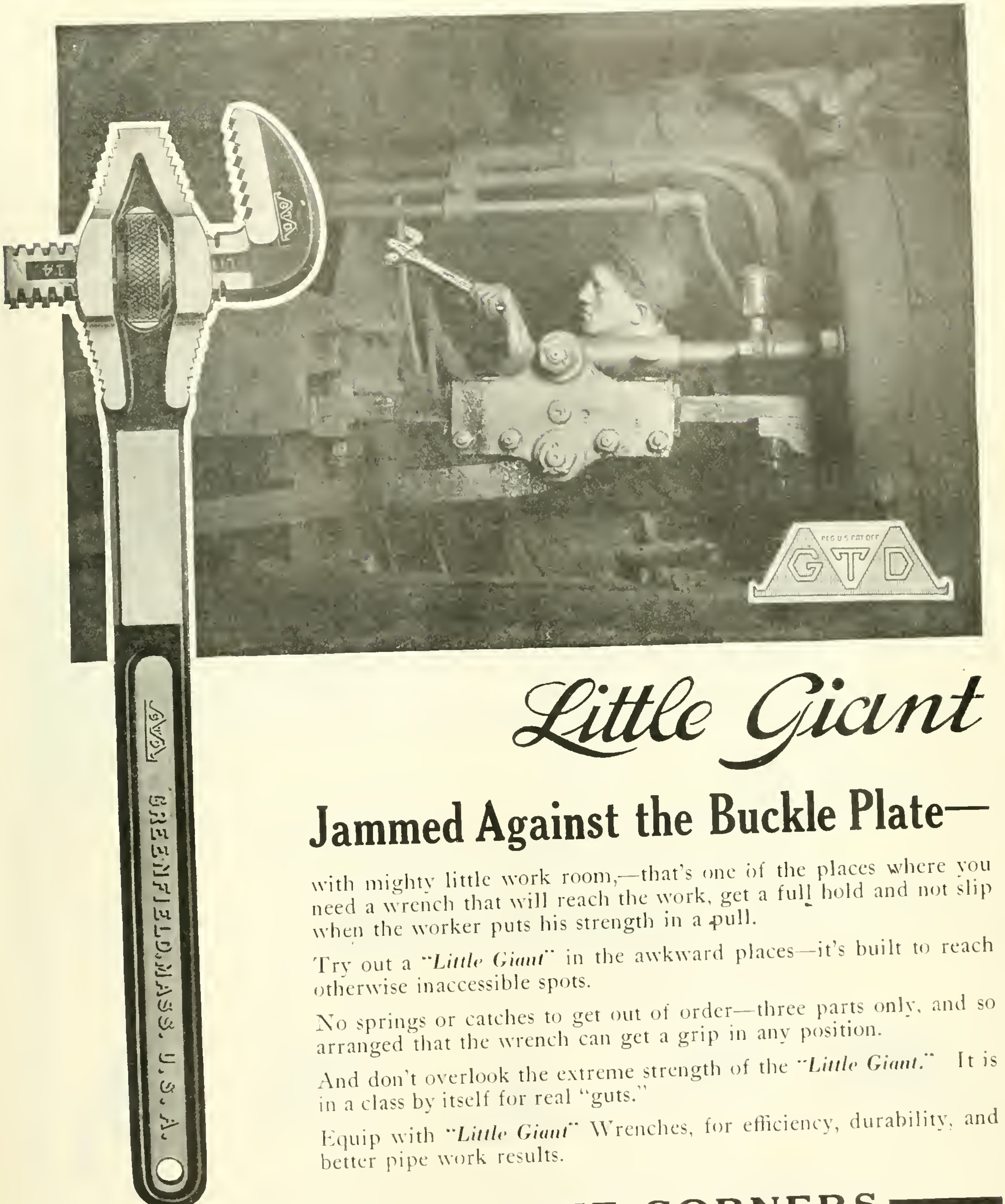
They add, "We easily get 65 degs. inside at 16 below zero, effect a great saving in coal and have clear air even though pouring goes on all day."

The records of such companies as Ford Motor Company, Cadillac Motor Car Co., and many others are partly due to the use of large numbers of Buffalo Fans and Carrier Air Washers to supply bracing, clean air to workers.

Remember you always pay when depressing air makes slow or poor work and causes sickness.

Buffalo Forge Company

184 MORTIMER ST. BUFFALO, N. Y.



Little Giant

Jammed Against the Buckle Plate—

with mighty little work room,—that's one of the places where you need a wrench that will reach the work, get a full hold and not slip when the worker puts his strength in a pull.

Try out a "*Little Giant*" in the awkward places—it's built to reach otherwise inaccessible spots.

No springs or catches to get out of order—three parts only, and so arranged that the wrench can get a grip in any position.

And don't overlook the extreme strength of the "*Little Giant*." It is in a class by itself for real "guts."

Equip with "*Little Giant*" Wrenches, for efficiency, durability, and better pipe work results.

IT GETS INTO THE CORNERS

G T D
GREENFIELD TAP AND DIE
CORPORATION
GREENFIELD, MASS., U.S.A.

Canadian Plant: Greenfield Tap & Die Corporation of Canada, Ltd., Galt, Ont.

Cleveland Air Tools

For Railroad Shops, Car Repair Shops, etc.

Adapted for Riveting, Drilling, Tapping, Flue-rolling, setting Flexible stay-bolts, Grinding or for any general Pneumatic Tool service.

All users of Cleveland Tools like them for their steadiness in operation, low cost of up-keep and dependability.

Corner Drill

The Cleveland "Speed King"
A One Man Air Grinder

Calking Hammer

Your Safest Choice

THEY are always on the job and not in the tool room for repairs—in other words they are "Steady goers."

THEY operate without "recoil," a feature greatly appreciated by the men who hold them day in and day out.

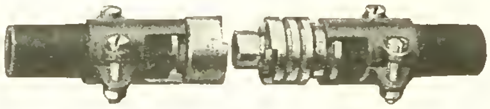
JUST give them a bath in coal oil each night—a "blow out" with air—and a "squirt" of oil in the morning, then watch 'em go.

AN increase in production and a decrease in "Upkeep" will be very noticeable after you install Cleveland Air Tools.

BOWES AIR HOSE COUPLINGS

Standard Equipment Everywhere

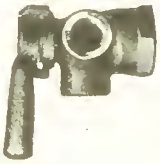
Instantly Connected or Disconnected



Absolutely Air-Tight under all pressures

CLECO PRESSURE-SEATED AIR VALVES

They Improve With Use—They Require No Attention in Service—The Air-Pressure Makes Them Tight—No Packing, Discs or Springs Used.



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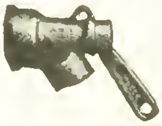

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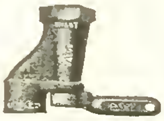

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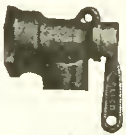

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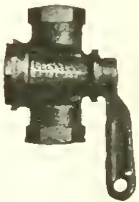

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OFFICES IN ALL LARGE CITIES IN U. S. AND CANADA

The Cleveland

Pneumatic Tool Co., Cleveland, O., U. S. A.

"Van Dorn" ELECTRIC TOOLS

THERE'S a "Van Dorn" Portable Electric Reamer for every reaming operation on steel freight or passenger car construction or repair. "Van Dorn" Electric Drills will handle every boring job on wooden cars. Ask for specific recommendations on Electric Reamers for underframes, cover plates, bolsters and superstructures on freight cars, and vestibule and all other reaming on passenger cars.

Factory Representatives

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Los Angeles Milwaukee Montreal New York City Philadelphia Pittsburgh
Richmond St. Louis St. Paul San Francisco Seattle Toronto

The Van Dorn Electric Tool Co.
Makers of Portable Electric Drilling, Reaming and Grinding Machines, etc.
Cleveland, Ohio

Standing the Gaff

It's that last heave—that final, brawny, whole-body effort which brings out the stamina of MORCO Stillsons. It's muscle against MORCO and MORCO always wins. Strongest where most are weakest. A strength of parts. A surety of grip. In shop, roundhouse or cab, MORCO Stillson Wrenches bear the brunt of all human effort to make or break the toughest joint.

MORCO
STILLSON WRENCH
THE ORIGINAL STILLSON PATTERN PIPE WRENCH

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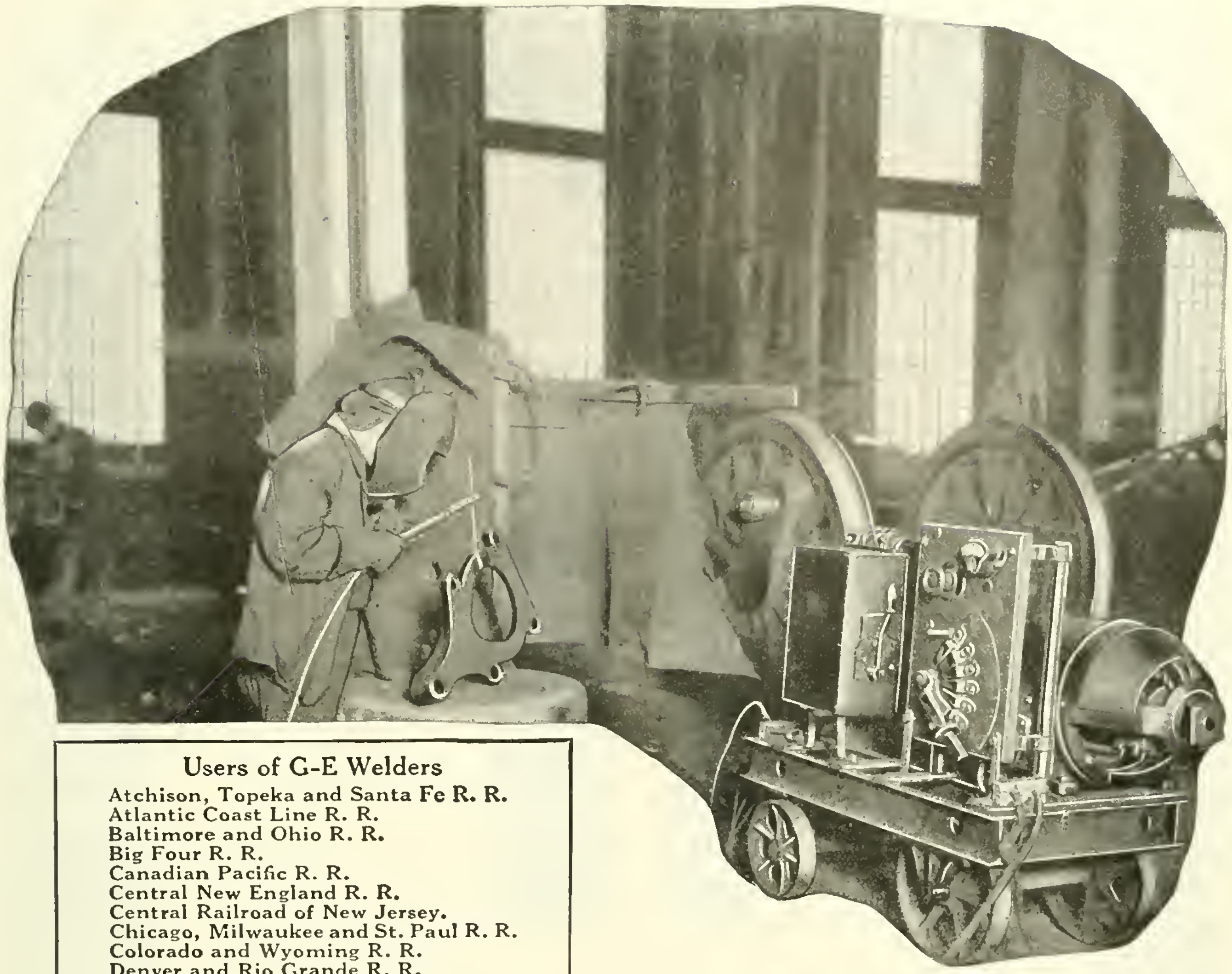

Users of G-E Welders

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Atlantic Coast Line R. R.
Baltimore and Ohio R. R.
Big Four R. R.
Canadian Pacific R. R.
Central New England R. R.
Central Railroad of New Jersey.
Chicago, Milwaukee and St. Paul R. R.
Colorado and Wyoming R. R.
Denver and Rio Grande R. R.
Detroit and Mackinac R. R.
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Grand Trunk R. R.
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Lehigh Valley R. R.
Los Angeles and Salt Lake R. R.
McCloud River R. R.
Michigan Central R. R.
Missouri and Texas Rwy. of Texas.
Missouri, Kansas and Texas R. R.
New York Central R. R.
New York, Chicago and St Louis R. R.
New York, New Haven and Hartford R. R.
New York, Ontario and Western R. R.
Northern Pacific R. R.
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Pennsylvania R. R.
Seaboard Air Line R. R.
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Union Pacific R. R.
Virginian Ry. Co.
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Western Pacific R. R.

A Recommendation

Worth-while savings are being effected by leading railroads thru the successful use of G-E Welders. The Santa Fe finds G-E Electric Welding Equipment so much to its liking that this railroad is using over 80 G-E Welding Sets.

G-E engineers have thoroughly studied the application of electric welding to the various needs of railroad shops, roundhouses, etc.—and have developed several types of welding equipment to accomplish the work required.

For complete welding service the General Electric Company offers single-operator and multi-operator units, portable and stationary, also semi-automatic and full automatic welders. Ask the nearest G-E Sales Office for complete information.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

GENERAL ELECTRIC

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AIRCO

DAVIS APPARATUS
DAVIS-BOURNONVILLE CO.

ANTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING

SERVICE

ECONOMY

Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

Write for Airco booklet:
"Anything and Everything for Oxyacetylene Welding and Cutting"

AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen — Airco Acetylene — Airco-Davis-Bournonville
Welding and Cutting Apparatus and Supplies, Acetylene Generators, and
Specially Designed Machines for Automatic Welding and Cutting—
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Controls the manufacture and sale of National Carbide

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Air Reduction Sales Company maintains its own Apparatus Repair Shops in Airco District Office cities.

"Airco Oxygen and Acetylene Service is Good Service."

WALWORTH

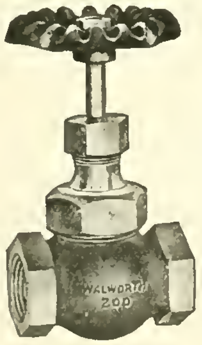
A line of valves complete in every type for every purpose

IN the Walworth list of 23,000 different items are valves of all types, sizes and pressure ratings. The materials of which they are made are chemically tested in the Walworth laboratories. And finally, before shipment, every Walworth valve must prove its margin of safety by a pressure test exceeding its specified rating.

The following is a partial list:

Gate Valves

Designed to meet every requirement in steam and water installations in brass, cast iron, steel and hard bronze. For all pressures from 25 to 350 pounds (steam) and up to a temperature of 800 deg. F. With solid wedge gates or double disc parallel seats.



Walworth Regrinding Globe Valve

Designed and built for long, hard service. Seat and disc are made extra thick to allow for repeated regrinding. (Also made in Angle type.)

200 *Pounds Steam working pressure*

Globe and Angle Valves

Brass, cast iron, hard bronze and steel. For all pressures from 100 to 250 pounds (steam). Globe, angle, horizontal and swing check types.

Our Kewanee Regrinding Valves are especially recommended for severe continuous service and can be reground without disconnection from the line. Convex seat and disc insure perfect contact.

Also *Safety, Relief, Hose Gate, Blow-Off, Radiator, Vacuum,* and *Watts Reducing Valves.*

Our nearest sales unit will be glad to furnish you with full information in regard to any valve listed here.

WALWORTH MANUFACTURING COMPANY, Boston, Mass.
Chicago - Cleveland - Glasgow - Kewanee, Ill. - London - New York - Philadelphia
Portland, Ore. - San Francisco - Seattle - Youngstown. Plants in Boston and Kewanee, Ill.
Walworth International Co., New York, Foreign Representative

23,000 different items

Valves, Fittings, Tools for Steam, Water, Gas, Oil and Air

Christmas 1923

With the approach of Christmas and its spirit of peace and good fellowship it is with the utmost pleasure and sincerity that we join the many friends of

WYANDOTTE METAL CLEANER

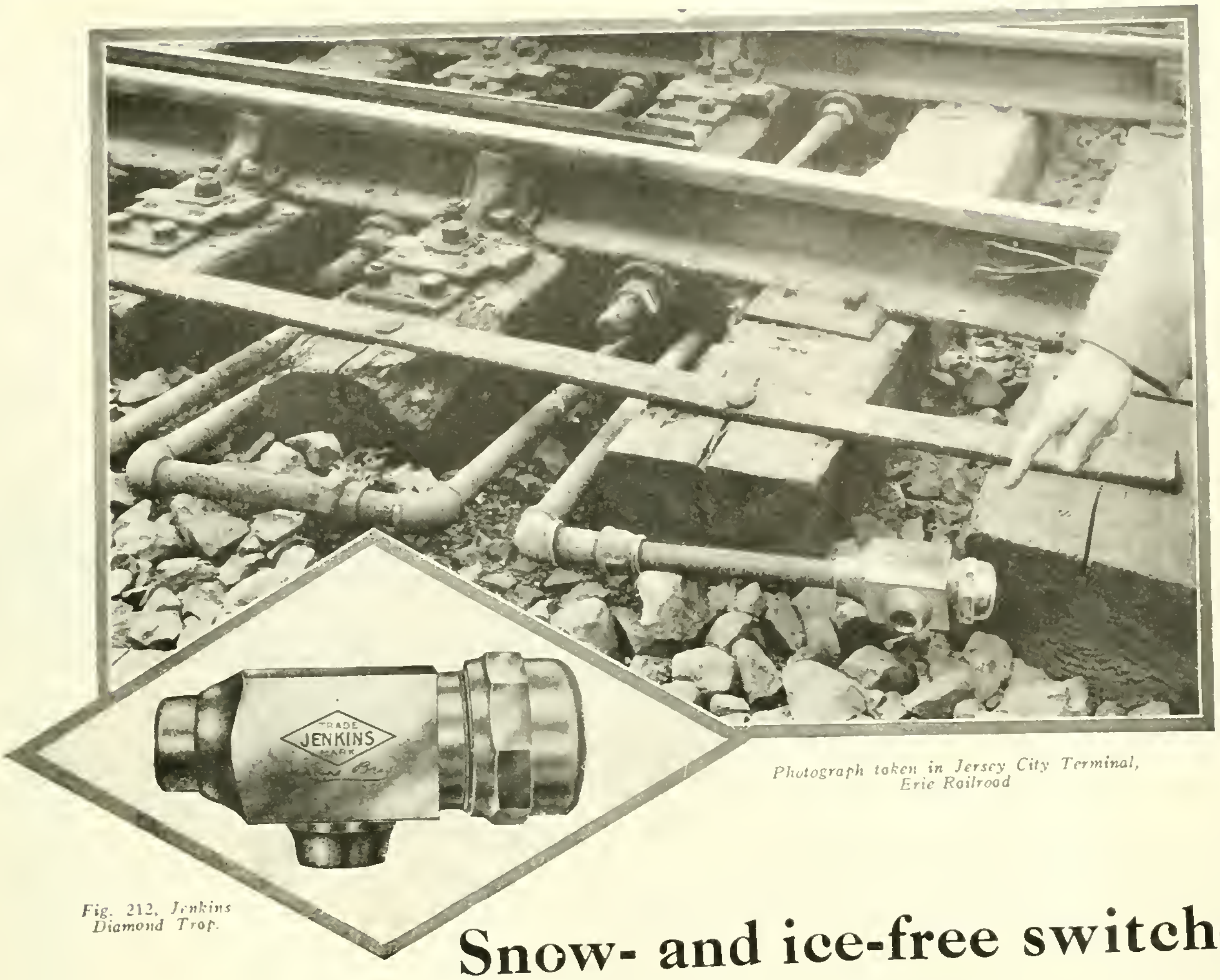
in wishes for success, prosperity and hearty good will.

This year has been exceptional in its opportunities for "honest to goodness" service to humanity.

The realization of this fact not only brings the highest reward, but is also a definite incentive to greater effort and larger success.

To one and all we wish this realization and in the year so soon to come, we hope that your prosperity will eclipse all previous experiences.

THE J. B. FORD CO. · WYANDOTTE, MICH.



Photograph taken in Jersey City Terminal, Erie Railroad

Fig. 212, Jenkins Diamond Trap.

Snow- and ice-free switches for 17 Years

SEVERAL hundred Jenkins Diamond Traps are dependable aids in thawing and keeping switches, on the Erie, in good working order during severe winter weather.

Since 1906 they have been assigned to this important job.

The Jenkins Diamond Trap relieves condensation in steam-heating coils without waste of steam.

It is automatic and will remain open as long as water escapes, closing instantly when steam strikes the adjustable Jenkins Composition plug.

This trap is made of bronze in ½ in. and ¾ in. sizes. Parts are interchangeable and new plugs or caps can be supplied promptly.

Write to our nearest office for information. You'll find this trap a big help in solving the winter-time problem of keeping switches free.

JENKINS BROS.

80 White Street.................New York, N. Y.
524 Atlantic Avenue ....Boston, Mass.
133 No. Seventh Street............Philadelphia, Pa.
646 Washington Boulevard ....Chicago, Ill.

Always marked with the "Diamond"

Jenkins Valves

SINCE 1864

Electric heat has many uses. A few of these applications are suggested by the small sketches. Electric heat can be used in your business.

Strips of Electric Heat

Right now is the time to install them; when Jack Frost is beginning to reach out with his cold fingers to nip some of those exposed pipes—when the watchman begins to visit the boiler room frequently because his shanty is so cold—when you begin to realize it is almost cruelty to ask a man to work all day in a cold crane cab.

Westinghouse electric space heaters save all this inconvenience. They are inexpensive, easy to install, and do not cost much to operate. Let your electrician wire up a couple of space heaters in some of those hard-to-heat places, and see how nicely they take the chill off on a cold morning. No fumes, no dirt, no flames to start a fire. Just turn on the heat when you need it, and turn it off when you are through.

A postal to the nearest Westinghouse office will bring sizes and prices. Better hurry, before cold weather sets in.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries.
See Your Telephone Directory

Send for your copy today

An occasional publication containing accounts of heating installations of interest to every executive. We shall be glad to put you on the mailing list. Write for a copy today.

Westinghouse

120 POUNDS OF AIR PRESSURE

BEHIND RIVET SNAPS HELPED ESTABLISH
THE REPUTATION OF

Firth-Sterling Special
TOOL AND DIE STEEL

BEFORE the late war Firth-Sterling Special Steel for rivet snaps was favorably known and used in many parts of the country because of its wearing qualities and the freedom from breakage which was always a shop problem, even though the air pressure used in the riveting was only about eighty pounds per square inch. During the war the enormously increased requirements called for more rapid riveting and in many shops the air pressure was increased to one hundred and twenty pounds per square inch, with the result that rivet snaps of the weaker steels failed through rapid wear or breakage soon after being put to work.

Snaps made from Firth-Sterling Special Steel stood the test

FIRTH-STERLING
STEEL COMPANY

McKeesport, Pa.

NEW YORK BOSTON HARTFORD
PHILADELPHIA CHICAGO CLEVELAND
DETROIT SAN FRANCISCO LOS ANGELES

No Leaky Mallet Expansion Sleeves on This Road

HEALD

Grinding keeps them steam tight

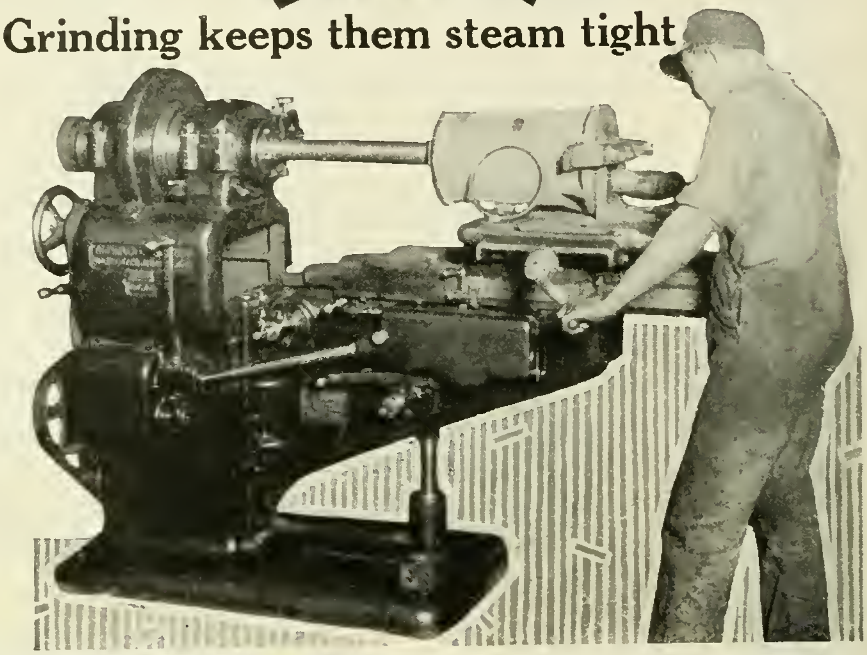
ONE prominent railroad experienced much trouble keeping the expansion sleeves on their heavy Mallet locomotives steam tight.

But when they installed a Heald Hole Grinder in their shops several years ago, they discovered the solution to this annoying problem.

All their Mallet expansion sleeves are now ground accurately to fit, in 45 minutes or even less time on a Heald, and all difficulty with steam leaks has thus been entirely eliminated.

Perhaps you have similar problems that could be solved by grinding. Why not put the proposition up to us?

The Heald Machine Co.
Worcester, Mass.



Thor

PNEUMATIC MOTOR HOIST FOR HEAVY LIFTING

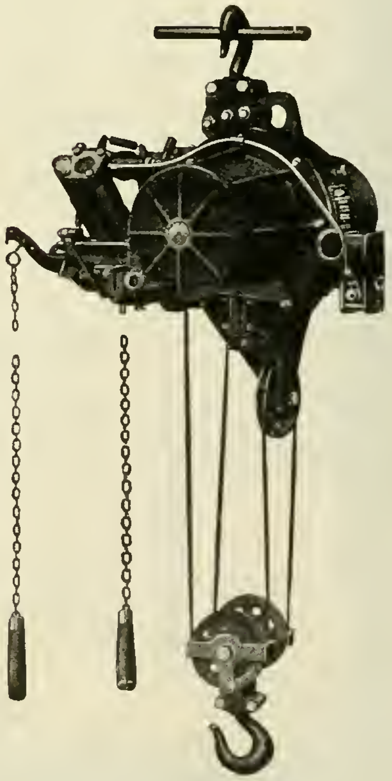
Lifting and assembling heavy parts by hand is costly, and hard on men. It takes six to ten men where one can do the work with a THOR Hoist. Lifts or lowers away the load quickly or slowly as the operator controls the throttle.

Like a locomotive air brake, the THOR Automatic Safety Device holds the heaviest load securely at any point, even if the air line breaks. On heavy lifting, a THOR three-ton Hoist can replace, at a saving of manpower and money, the load ten or more men can lift.

We manufacture a complete line of THOR Pneumatic Tools, Electric Drills and Electric Screw Drivers for R. R. work.

Write for full specifications and prices

INDEPENDENT PNEUMATIC TOOL CO.
600 West Jackson Boulevard, Chicago
Birmingham, Boston, Cleveland, Detroit, Montreal, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Toronto



Reach all the HARD places — Quickly!

Speed Painting with a "SPRACO" Portable Doubles the output of your repair shop

Put a "SPRACO" Pneumatic Portable Painting Equipment at work refinishing your rolling stock. Use it for under-rigging, structural equipment, bridges, buildings, etc. Save time; save 65% to 85% labor cost. Let "SPRACO" Paint Guns smooth out your upkeep and repair problems. Write today for Bulletin P.G.-78.

SPRAY ENGINEERING COMPANY

60 High St., BOSTON, MASS.

Manufacturers of:

Air Washing Equipment, Spray Cooling Equipment, Flow Meters, Park Sprinklers, Self Cleaning Strainers.

Engineers for:

Spray Cooling Systems, Irrigation Systems, Aerating Reservoirs, Air Conditioning, Gas Washing.

TRADE MARK

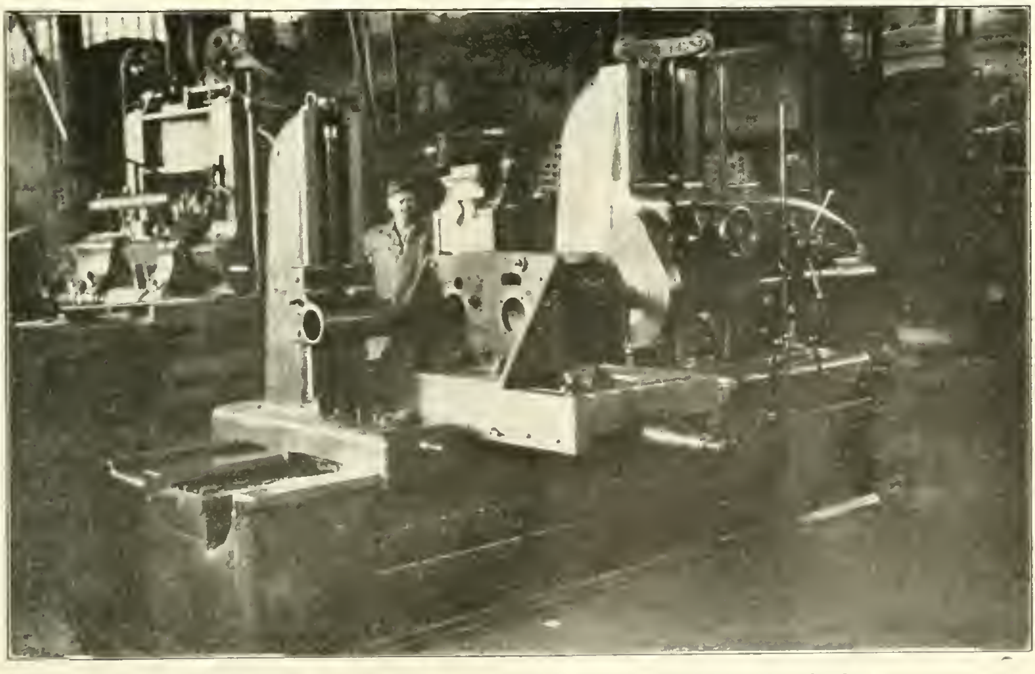
Speed Painting Pays
—if you do it the "SPRACO" Way

Write for Bulletin P.G.-78.

SPRACO
BOSTON

Universal (Horizontal) Boring Machines

"Where Accuracy Counts, We Win"



The Original Tri-Way Boring Cross-Compound Air Pump Cylinders

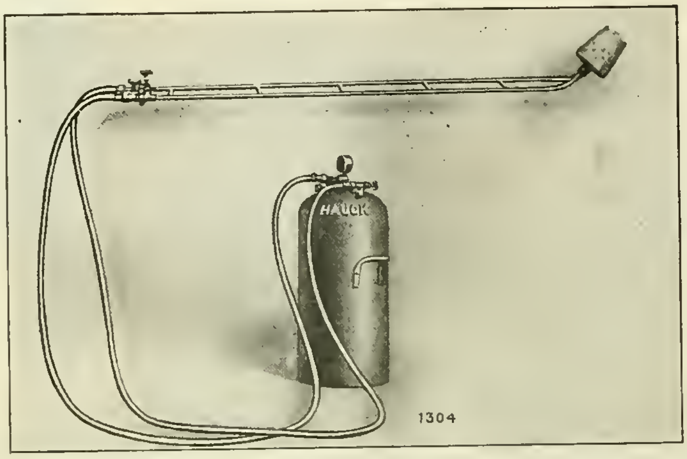
UNIVERSAL BORING MACHINE CO. HUDSON, MASS.

HAUCK

LOCOMOTIVE FIRE KINDLER

BURNS FUEL OIL

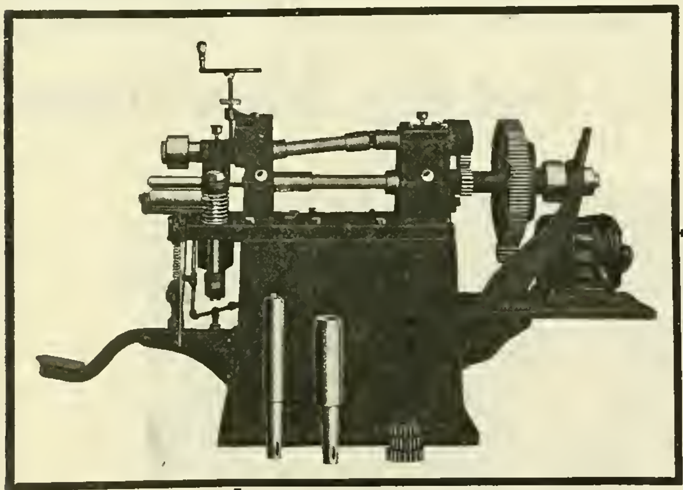
KINDLES A
LOCOMOTIVE IN
FIVE MINUTES



COST—
1 GALLON OF
FUEL OIL

ELIMINATES SMOKE NUISANCE AND THE HANDLING, STORING AND TRANSPORTING OF WOOD.

HAUCK MANUFACTURING COMPANY
116 Tenth Street, Brooklyn, N. Y.



THE MARSHALLTOWN LINE

This Is It—the New Flue-welder

Complete details promptly. Ask for bulletin.

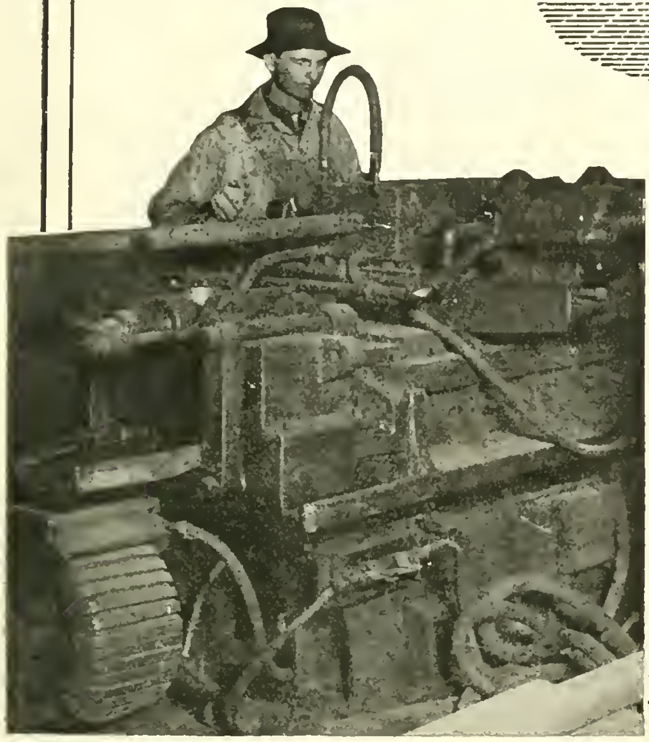
If you could reduce tube welding to a simple operation requiring but a few seconds, and produce at the same time welds so smooth both inside and out as to practically defy detection—if you could do this to any tubing from 2 in. to 5¾ in. with simple adjustment—weld pieces 9 in. in length to the flue and be sure of a perfect weld every time—wouldn't you investigate this means?

The Marshalltown-Schaefer Flue welder is furnished with a heavy anvil for belling long flues, a ball and roller-bearing flue-rest, and mandrels and gears to give the same peripheral speed to outside and inside rolls for all sizes of flues.

The rolls are brought together by air pressure operated by a foot lever—this single movement being all that is required to make the weld.

MARSHALLTOWN MANUFACTURING CO.
900 East Nevada Street, Marshalltown, Iowa, U. S. A.

Thomson Process Electric Welding



Start Now

to simplify your safe ending of Boiler Tubes. The Electric Process has been fully endorsed by the Master Boiler Makers' Association.

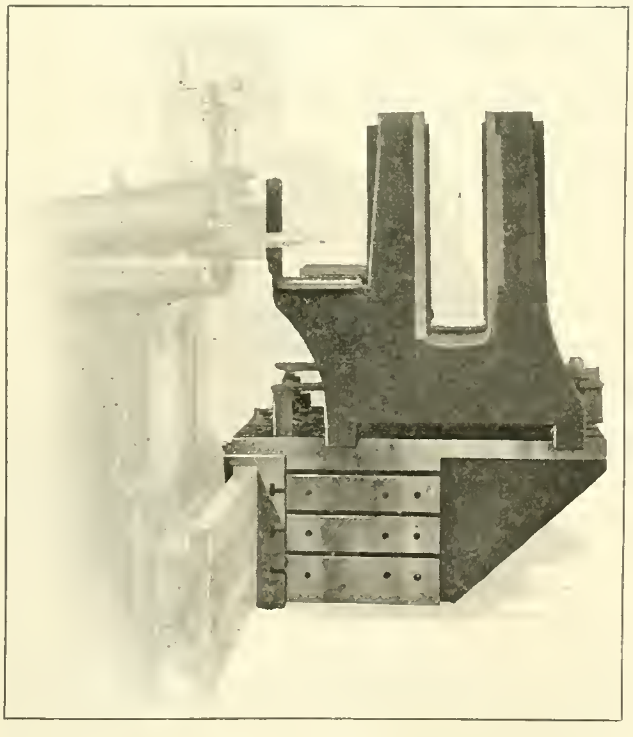
One of the oldest users of the Electric Process when asked to compare this process with other methods remarked that there was "no comparison."

The Electric Process is far superior because the method is very simple—good welds can be made quickly with little human effort or skill. Performance records prove that a greater output of good welds at a lower cost per weld can be obtained. The efficiency of the welds proved to be almost 100% and the percentage of poor welds so very small that it has been found practicable to eliminate preliminary testing.

Thomson Electric Welding Co.

161 Pleasant St.
Lynn, Mass.

Knowlton & Langland Sts.
Cincinnati, Ohio



HENDEY

THESE shapers possess accurate alignment of table with tool slide. If table extension is furnished as shown in cut, it has to align perfectly with main table. Hence, Hendey shapers can be relied upon to do the unusual job well.

THE HENDEY MACHINE COMPANY

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The
Red Devil Rivet Cutter
is Saving Its Users
Money

The Red Devil Rivet Cutter will save you money, too. Why not order one today? The Red Devil Rivet Cutter will increase your production. "All together," "Let's Go."

Rice Manufacturing Company
1011 Fletcher Trust Building, Indianapolis, Ind.

THERMIT WELDING

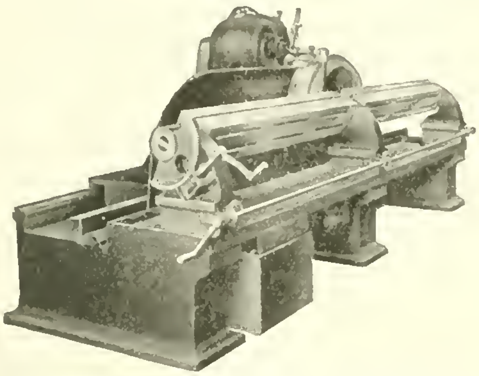
Best Method of Repairing Locomotive Frames and other Sections

1 Used in approximately 80% of all U. S. railroad shops.
2 Most reliable and strongest weld.
3 Costs no more, usually less, than other welding methods.
4 Locomotives with broken frames can be returned to service over night.
5 Average tensile strength 70,000 lbs. per sq. in. with 23 to 25% elongation.
6 Improved practice insures sound welds in every case. Let our demonstrator show you.

Send for Pamphlet 2151

METAL & THERMIT CORPORATION
120 Broadway, New York
PITTSBURGH CHICAGO BOSTON S. SAN FRANCISCO TORONTO

Double the Accuracy and Half the Floor Space



AUTOMATIC GUIDE BAR GRINDER

**With Traveling Grinding Wheel
For Rolling Mills, Tin Plate Mills, Locomotive Plants, Paper Mills, Passenger and Freight Car Shops, etc.**

The most massive, compact, accurate grinder manufactured. For Guide Bar grinding and all classes of straight, flat or bevel, grinding. Full automatic, furnished with or without water, completely enclosed or open, with swivel bar or flat platen, for all classes of work. Cup, Ring or Sectional Grinding Wheel. Compact, long-lived, accurate.

State your requirements and get our recommendations

MACHINERY COMPANY OF AMERICA

Specialists in Saw and Knife Fitting and Accurate Grinding Requirements.

BIG RAPIDS, MICH., U. S. A.

Will you Make six leakproof screw-thread joints at our expense?

SMOOTH-ON No. 3 is the perfect joint filler because the metallic iron body is pressure, heat and time-proof—free from drying, shriveling and shrinkage—and differs from all other filling materials in these respects.

Smooth-On No. 3 is so thoroughly and so permanently effective in making and *keeping* all screw-thread joints tight, that you can't help but realize its superiority.

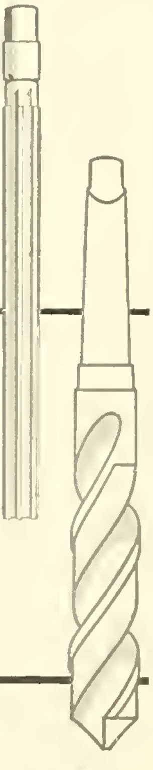
Fair trial will more than repay your time for investigation, and your future business will justify *our* expense in sending the free sample which we will mail on request.

Buy in 1-lb., 5-lb. or 10-lb. gray labeled tins from your dealer, or send us his name so that we can help you get your supply.

SMOOTH-ON MFG. CO.
Dept. 32,
570 Communipaw Ave.
Jersey City, N. J.

Do it with SMOOTH-ON

An organization whose product is recognized as the standard in its field



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REAMERS, HOBS
MILLING CUTTERS
SPECIAL TOOLS**

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DETROIT, U. S. A.

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STEEL AND WIRE PAGE QUALITY PRODUCTS

PAGE-ARMCO
GAS WELDING
RODS

are 99.84% pure iron

The impurities taken in the aggregate do not exceed 16/100 of 1% when considering silicon, sulphur, phosphorus, carbon, manganese, copper, oxygen, hydrogen, and nitrogen.

Page-Armco Gas Welding Rods conform to the American Welding Society Specifications for Gas Welding Rods, Grade G-No. 1-A.

Yellow tag—ends of rods colored yellow.

For Welding High Carbon Steel parts use PAGE HIGH CARBON GAS WELDING RODS. They conform in all respects to A. W. S. Specifications E-No. 1-C.

Red tag—ends of rods colored red.

Page Steel and Wire Co.
An Associate Company of the American Chain Co., Inc.
Bridgeport, Conn.
Chicago New York Pittsburgh
San Francisco

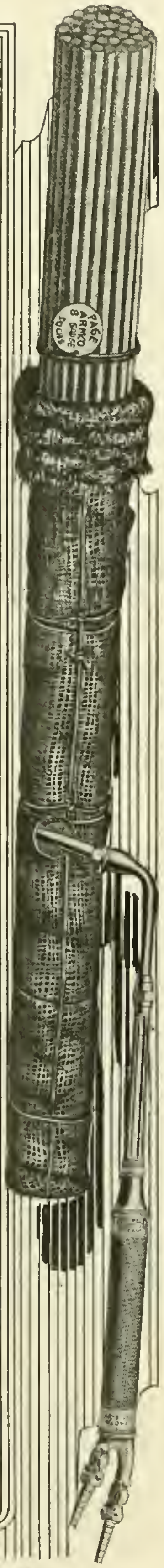
MANUFACTURERS OF:

Rods—Armco Ingot Iron and Special Analysis Steels.

Wire—Plain and Galvanized, Telephone, Telegraph, Bond, Strand, Oxy-Acetylene and Electric Welding Wire.

Fence—Woven Wire for Farm and Railway Right of Way, Wire Link Protection for Industrial Plants, Lawns, Schools and Estates, and Factory Partitions.

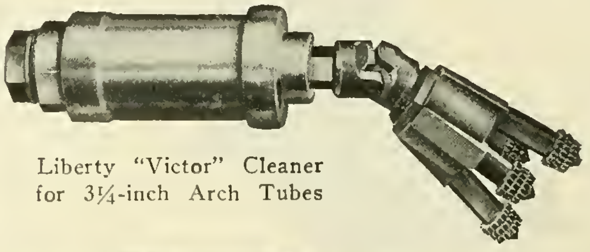
ARMCO
INGOT IRON



PAGE-ARMCO
GAS WELDING RODS

CLEANERS

For Arch Tubes

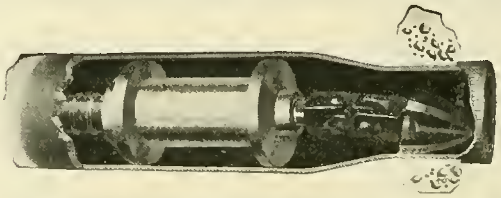


Liberty "Victor" Cleaner
for 3¼-inch Arch Tubes

Liberty "Cyclone" Cleaner
for 2½-inch and 3-inch
Arch Tubes.

Liberty Cleaners are made to exactly fit the various sizes and shapes of Arch Tubes used by different railroads. We can furnish air driven motors in two different types, also water driven machines. Liberty No-Rivet Cutting Heads, with which all Cleaners are equipped, thoroughly remove the scale and are quickly and easily taken apart for renewing cutters.

For Superheater Flues

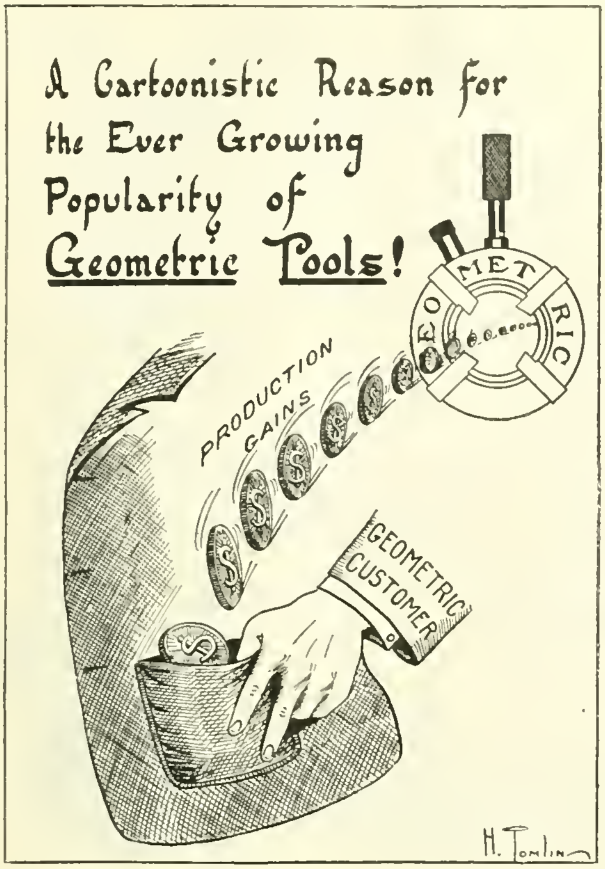


The Cleaner illustrated above is very effectively used for the cleaning of scale from the outside of superheater flues. This Cleaner makes it unnecessary to remove these flues for cleaning. It not only cleans the parts of the tubes which are full diameter, but also is able to remove scale from the tapered end.

Liberty Manufacturing
Company
450 GRANT STREET
Pittsburgh, Pa.

Z-972

LIBERTY


A Cartoonistic Reason for the Ever Growing Popularity of Geometric Tools!
GEOMETRIC
PRODUCTION GAINS
GEOMETRIC CUSTOMER
H. Tomlin

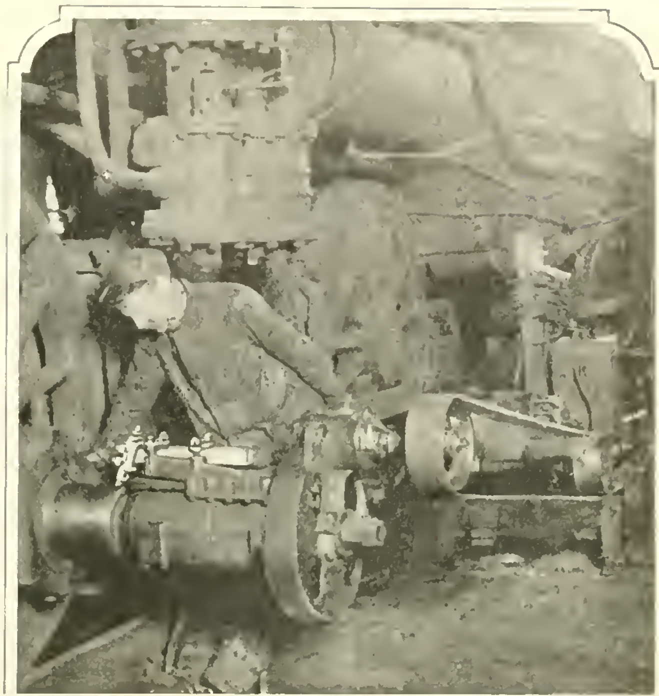
A Graphic Testimonial from an Enthusiastic User of Geometric Tools

Geometric Threading Tools put dollars in the pockets of users.

Send for the Catalogue of Geometric Die Heads and Collapsing Taps, and read the story of Screw Cutting Efficiency.

The Geometric Tool Co.

NEW HAVEN. CONN.



The Rooksby Prevents a Bad Terminal Delay

AFTER circling for the fourth time a 29 stall roundhouse, a much worried and tired looking engine dispatcher spied the roundhouse foreman emerging from underneath a heavy Mallet receiving classified repairs in 17 stall.

"Hey there, Jim! The 6107 just came in with the left main pin scored pretty bad, what's ready to take her place on 2-78 tonight?"

"Nothing," snaps back the roundhouse foreman, "She will have to go back herself."

"You crazy?" asks the engine dispatcher—"I said the main pin was scored, and she don't take no manifest out of this terminal tonight."

"She won't, eh? Well, you just go back and chalk her up on the board, I'll take care of that main pin."

Calling to a machinist and his helper going by, the roundhouse foreman gave the few sharp commands—"Take your tools over to the 6107, Mike, send your helper over to tool room to get that Rooksby Crank Pin Turning Machine—Drop the back end of the left main rod and turn down the pin."

Three hours later the hostler was running the 6107 up and down the coaling track to break in the new main rod brass—

Rooksby Portable Tools will prevent many bad terminal delays with decisive savings in time and labor.

E. J. Rooksby & Company

Manufacturers of Portable Machine Tools for Locomotive Repairs.

1072 Hamilton St. Philadelphia, Pa.

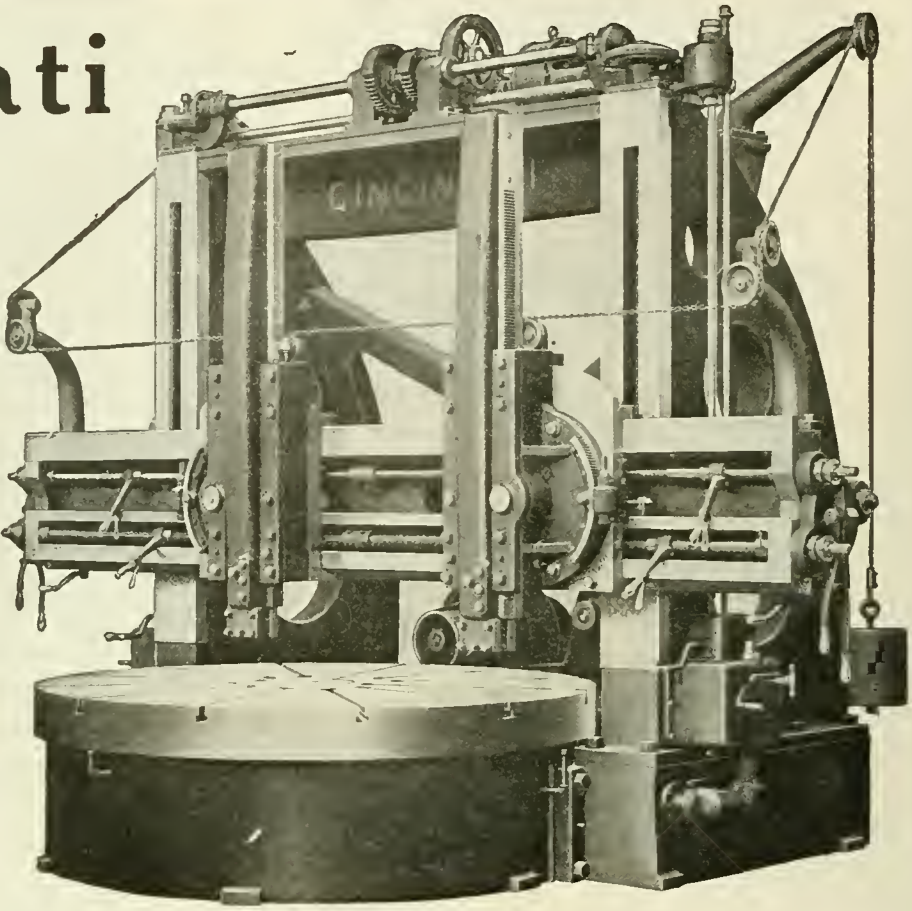
Cincinnati Boring Mills

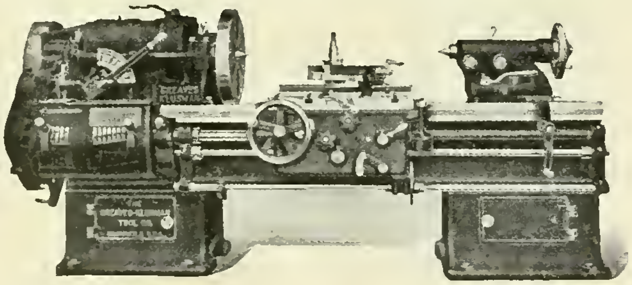
"Original Thruout"

The performance is constant, day in and day out. Repairs and breakdowns are no part of the schedule of "Cincinnati Boring Mills."

"The hard work is done mechanically instead of physically."

The Cincinnati Planer Co.
Cincinnati, Ohio, U. S. A.
Manufacturers of Planers and Boring Mills





Do You Know—

That in many of the largest railroad shops, G-K Lathes have convincingly demonstrated their ability to boost shop output and cut production costs.

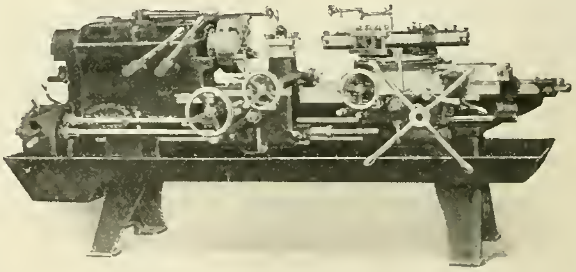
Greaves-Klusman Lathes

have been designed to fully meet the most exacting requirements of railroad service. Convenient single lever control and quick change gear box, unusually sturdy construction, and abundant power are features which make G-K lathes profitable producers wherever installed.

G-K Betterments describe these and other features in detail. Write for your copy today.

THE GREAVES-KLUSMAN TOOL CO.
Cincinnati Ohio

Cincinnati-Acme



No. 3 Cincinnati-Acme Universal Flat Turret Lathe

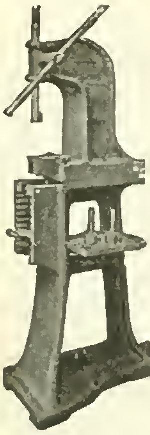
Cincinnati Acme Flat Turret Lathes are especially adapted to bolt finishing work, either straight or taper and threaded. Ruggedness of design throughout, simplicity of control, with power in abundance, enable you to

Lower Bolt Costs.
Reduce Erecting Shop Delays.
Get More Service from Locomotives.

Send for a copy of our bulletin on

Railroad Work and Turret Machinery

The Acme Machine Tool Company
CINCINNATI OHIO, U. S. A.



The Time You Save by Having a

NICHOLSON ARBOR PRESS

in your shop for use in removing various bushings, shaftings and arbors, will pay for the installation in a very short period of service.

Sturdy construction consisting of high grade semi-steel frames and heat treated chrome nickel steel racks, pinions and levers, insures long life under the most exacting demands.

NICHOLSON

Expanding Mandrels

are also designed to eliminate wasted time in the busy railroad shop.

Many idle machine hours can be traced to the lack of a mandrel just the right size to chuck the work, necessitating the operator to look for, or improvise one to suit the needs.

Made in nine sizes to fit any internal diameter from ½" to 7", Nicholson Expanding Mandrels quickly center the work, reducing the time used for chucking, to a minimum.

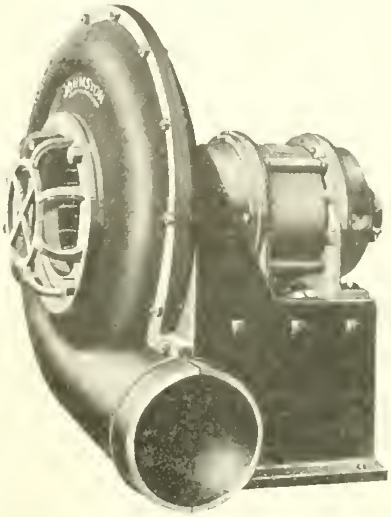
Get details of 30-day trial offer

W. H. Nicholson & Co.

118 Oregon Street, Wilkes-Barre, Pa.

PRESSURE BLOWERS

For Oil Furnaces and Large Coal Forges



Designed for constant pressure of 10 oz. per sq. in. from no load to full load.

Blowers especially designed for standard high speed 60-cycle alternating current motors or direct current motors of same speed—hence, high efficiency.

High speed admits of compactness.

No moving parts except blower wheel and rotor. Motor bearings lightly loaded. No bearings in blower.

Power input 20 per cent of full load at no discharge increasing uniformly to full load.

Also—

Oil Burning Rivet Forges — Torches — Furnaces—Automatic Oil Shut-off Valves.

JOHNSTON MANUFACTURING CO.

Minneapolis Minn.

Nye Dies and Nye Ideas

Nye, the Die Man
Pipe Die Maker to Those Who Know

Every important improvement in pipe dies was made first on the Nye Die.

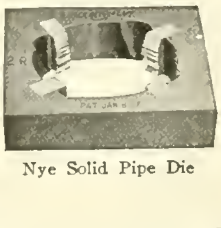
Nye dies and Nye ideas have revolutionized the job of pipe-threading.

Now it is as easy for a plumber to thread a pipe as for a carpenter to cut a board.

The skip-tooth made the Nye Die the fastest cutting pipe-die in the world.

And now the rounded "skip" has made the Nye Die the most durable die on earth.

That's the Nye idea of what a die ought to be.



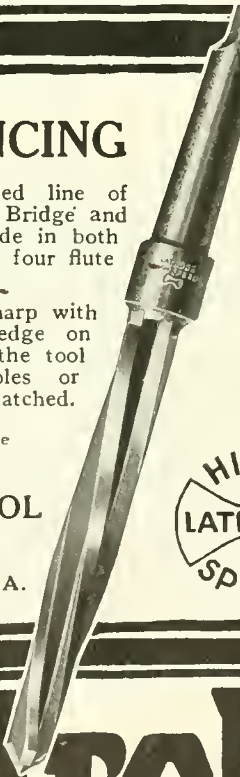
Nye Solid Pipe Die

THE NYE TOOL & MACHINE WORKS

108-128 NORTH JEFFERSON ST. CHICAGO, ILLINOIS

P. S.—Nye Thin Blade Cutter Wheels Guaranteed Against Breakage In Use.

ANNOUNCING



A new and improved line of Latrobe High Speed Bridge and Boiler Reamers. Made in both five flute straight and four flute spiral types.

Points are ground sharp with a chamfer cutting edge on each flute, enabling the tool to enter burned holes or holes that are not matched.

Write for descriptive folder

LATROBE TOOL COMPANY

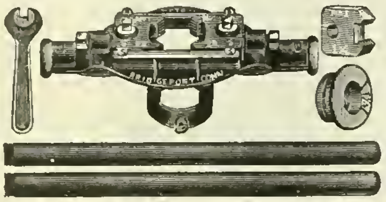
LATROBE, PENNA.

HIGH LATROBE SPEED

Latrobe Bridge Reamers

When you have a thread
to cut on
Pipe or Rod
Always demand the

Genuine Armstrong


BRIDGEPORT, CONN.

Stocks and Dies

to do the job.

Made by
THE ARMSTRONG MFG. CO.

Factory and Main Office
Bridgeport, Conn.

New York Office
248 Canal St.

What Makes a Drill Superior?

You shrewd buyers who judge drills on a technical as well as performance basis—we have data that will interest you. It describes the steel structure made possible by the Hot Rolling and Twisting process used in the manufacture of "Double D" Drills.

Send for it. It will enable you to understand why these super-drills are breaking production records and why they will save you real money in *your plant.*

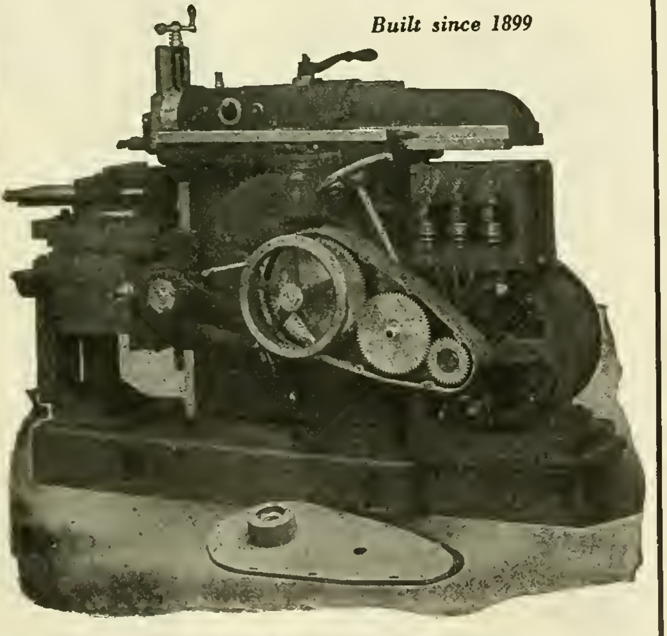
DETROIT TWIST DRILL COMPANY
2108 W. Fort Street
DETROIT, MICHIGAN

DETROIT
DOUBLE D ROLLED
DRILLS

58

STOCKBRIDGE

Built since 1899

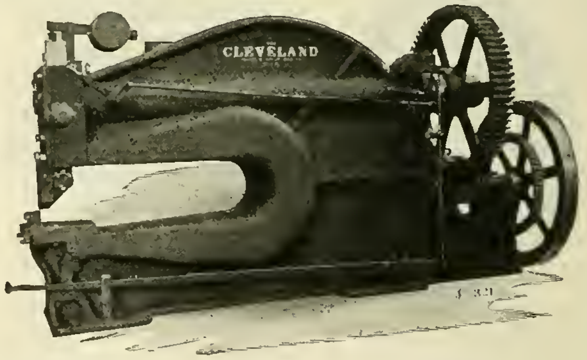


Stockbridge Motor Drives Compact

The motor and column are mounted on a one piece base, controller mounted on bracket bolted to base,—one unit. Provided with a start, stop and brake clutch, operated from the front of machine. Built in all sizes. New 32" Shaper. Ask for circular.

AGENTS NILES-BEMENT-POND COMPANY
STOCKBRIDGE MACHINE COMPANY
WORCESTER, MASS., U. S. A.

CLEVELAND
SOLID SEMI STEEL



EXTRA STRENGTH — EXTRA LIFE

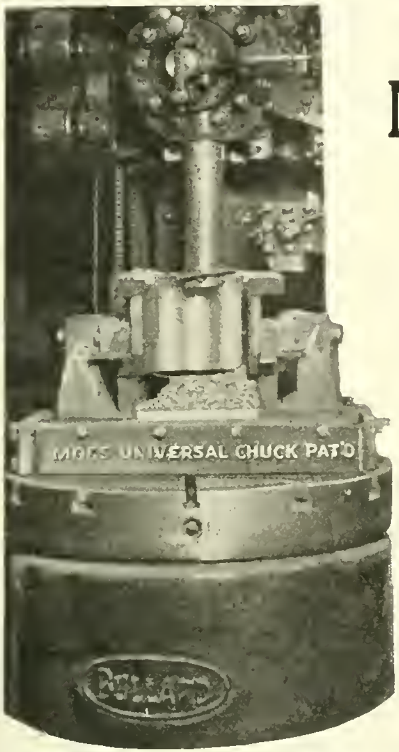
Extra strength in a Punch and Shear is real insurance. You may not need it for years, but some day, you'll thank your lucky stars for your wisdom in choosing the machine that had it.

The extra strength in Cleveland Punches and Shears means longer life, smoother operation and better production.

A Bulletin?

THE CLEVELAND PUNCH & SHEAR WORKS CO.
Main Office & Works CLEVELAND, OHIO
PITTSBURGH - CHICAGO - PHILADELPHIA - NEW YORK

GREATER Efficiency Production possible through MOSS Universal Chucks



Equipping your boring mills and lathes with Moss Chucks, speeds up their production, placing them in the class of modern, efficient machine tools.

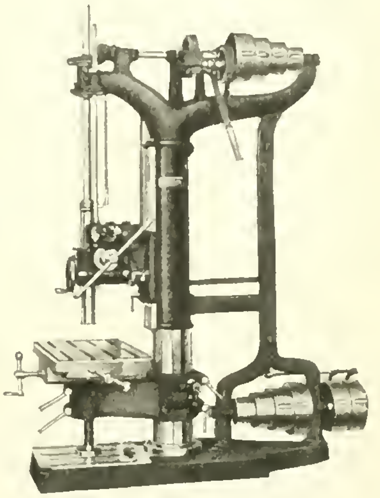
Operating centrally both ways they eliminate the laying out of the work, saving from 60% to 90% on boring and facing jobs.

Our Bulletin explains why. Write for one today.

Commonwealth Supply Co., Inc.
15 North 11th Street Richmond, Va.

Vertical Drilling Machine Equipped with Compound Table

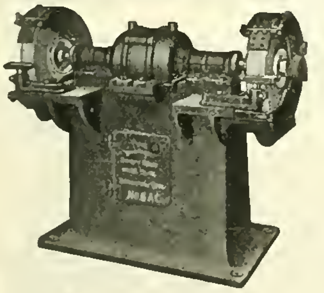
An Excellent Tool for All Purposes Where Accuracy, Rigidity and Longevity Are the Principal Requirements



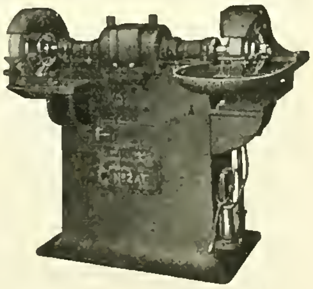
This Style Furnished in
21-25-28-32-36 in. Sizes

SUPERIOR
Upright Drilling Machines
Not Only Superior in Name But Superior in Quality—
Low in Price High in Efficiency
Let Us Send You Detailed Descriptive Matter

SUPERIOR MACHINE TOOL CO.
KOKOMO, IND. U. S. A.



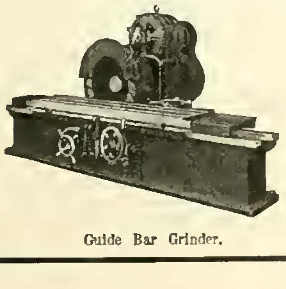
Motor Drive Floor Grinder.



Combination Wet and Dry Grinder.

Railroad Shops Demand—
strong, powerful Grinders. Secure our catalog showing such equipment and the
Bridgeport Safety Sectional Wheel
for
Guide Bar and Surface Grinding, the Peer of Grinding Wheels.

The Bridgeport Safety Emery Wheel Co. Inc.
92 Knowlton St., Bridgeport, Conn.

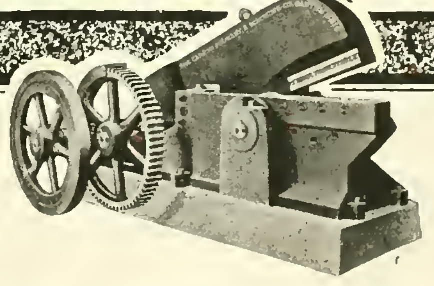


Guide Bar Grinder.

Bridgeport Safety Sectional Wheel.

Furnished for any make of Grinder.

CANTON SHEARS



YOUR reclaiming program will pay better by using Canton Shears—the cheapest method of cutting scrap iron or soft steel up to 6". Scrap cut to marketable size is always quickly disposed of and invariably commands a much higher price.
Canton Shears are built for heavy work in two types, stationary and portable. They operate on 60% less power than required by others of equal capacity.
Write for complete description.
CANTON FOUNDRY & MACHINE CO.
CANTON, OHIO
Also manufacturers of Canton Universal Industrial Turntable and Cranes.

CANTON ALLIGATOR SHEARS

CANTON FOUNDRY & MACHINE CO.
Canton ~ Ohio.

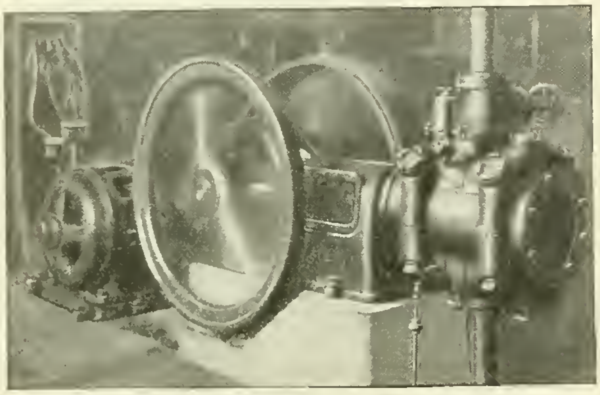
Air Power All the Time

A little air—all the time is the guarantee that goes with Sullivan "WG-6" small belt driven compressors.

Sullivan air power engineers have made the "WG-6" compressors sturdy, dependable, almost automatic, so simple that they are seldom "out of order" but with the same quality built into them in design, in materials, and in painstaking workmanship, that distinguishes the largest and most costly Sullivan compressors.

Hundreds of new "WG-6's" are installed every year, and give their owners steady, dependable service, in the foundry, the shop, the mine or on the construction job.

BULLETIN 2077-E



A "WG-6" at the "Big Four" Shops, Harrisburg, Ill.

SULLIVAN MACHINERY CO.
409 Gas Bldg., Chicago

ALLEN

Whatever your special requirements there's an "ALLEN" Riveter to meet them.

These machines are designed in a variety of types and for the fastest and tightest riveting, with the least consumption of power.

They have made good for more than 40 years.

We invite your enquiry for full particulars.

JOHN F. ALLEN CO.
Pioneer Builders of Riveting Machines.
372 Gerard Avenue New York

RIVETERS

Little Giant Power Hammers

Belt or Motor Driven

25 lb., 50 lb., 100 lb., 250 lb., 500 lb. and 1000 lb. Models

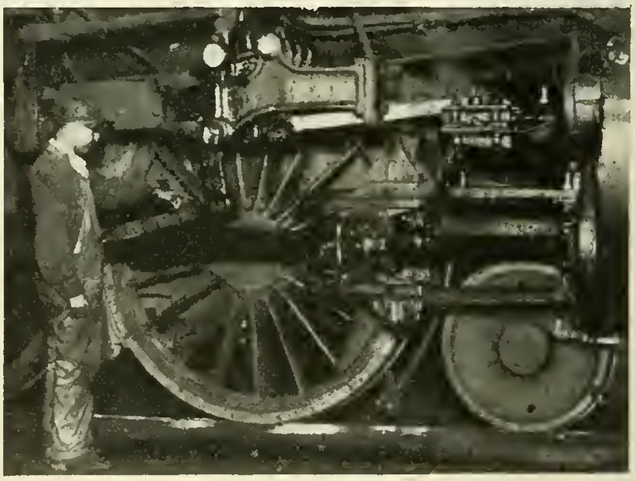
Guaranteed
FOREVER
against defective material and workmanship

Sold on 30 days trial

Special dies furnished for all form-forging work

Sold by all Jobbers

Little Giant Company
Established 1876
249 Rock St. Mankato, Minn.



One of the valve motion parts

that are subjected to severe strain and wear is the pin connecting the forward end of the eccentric rod to the gear connecting rod.

This pin, as well as all other valve gear wearing parts, should be case hardened to prevent failures and reduce cost in maintenance.

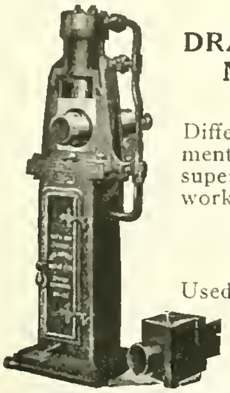
American Gas Furnace Carbonizing Machines are especially designed to perform this work by a new process which case hardens every piece to a uniform depth.

When gas is not available, or the use of fuel oil is preferred, machines will be equipped for oil firing.

AMERICAN GAS FURNACE CO.
Gas Engineers and Manufacturers
Main Office and Works Elizabeth, N. J.

The Draper Manufacturing Company

2417 Wright St., Port Huron, Mich.
Petrolea, Canada



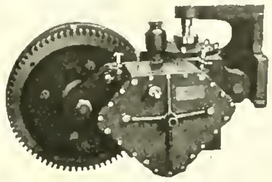
Exclusive makers of

DRAPER IMPROVED PNEUMATIC FLUE WELDERS and SWEDGERS

Different models to suit any requirements. For repairing both small and superheater flues; also for light forging work.

FLUE RECLAIMING ATTACHMENTS

Used in connection with the Flue Welder for welding long ends on flues and for repairing splits and flaws in flues.



FLUE RATTLERS

BALL FINISHING TOOLS

For repairing superheater ball joints.

PNEUMATIC LOCOMOTIVE TURN-TABLE MOTORS

Write today for descriptive booklets and prices

A large stock of parts for the above machines makes it possible for us to supply promptly your requirements for repairs.

GISHOLT

Rebuilt Machines

Turret Lathes

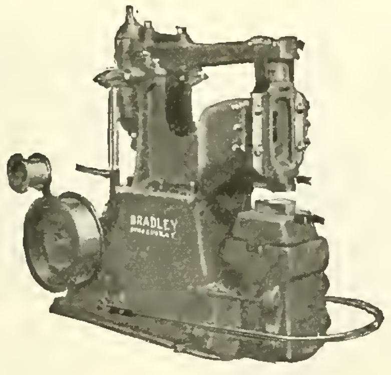
Three 28-in.—3½-in. Spindle Bore
One 24-in.—2½-in. Spindle Bore
Four 24-in.—4¼-in. Spindle Bore
Two 24-in.—6¼-in. Spindle Bore

These lathes have been entirely rebuilt in our own shop with same jigs and fixtures used when first built. We guarantee them to be as accurate as new machines.

Boring Mills

One 60-in. Vertical Boring Mill
One 36-in. Used Vertical Boring Mill
One 36-in. Rebuilt Vertical Boring Mill

GISHOLT MACHINE CO.
11 S. Baldwin Street
MADISON, WISCONSIN



The BRADLEY For Power

Husky—to stand pounding without flinching.

Enduring—to stand the demand for long service.

Easy Control—to meet the need for convenience.

Smooth Running—to insure high quality work.

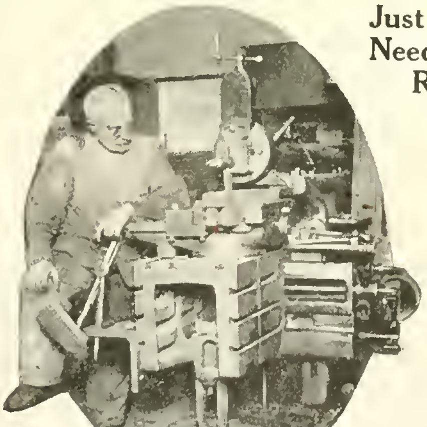
Made in 4 styles and 32 sizes. A style and size for every forging requirement. EQUIPPED for BELT or MOTOR DRIVE.

Write for further details.

C. C. BRADLEY & SON, Inc.
432 N. Franklin St. Syracuse, N. Y.

Wide Range of Adaptability

Just What You Need for the Roundhouse



A 32" shaper is seldom used on 32" work—yet the G & E 32" Shaper is just what you need for the roundhouse. It has a very wide range of operation, capable of handling efficiently and economically the large variety of jobs incident to roundhouse operation.

With enormous power for slow, long, heavy cuts, and high speed for accurate, light finishing cuts—the G & E Shaper meets every requirement.

YOU SEE THEM EVERYWHERE

For seventy years this company has specialized in the making of shapers. Our Engineera are constantly studying working conditions to develop new and desirable features. G & E Shapers have been tried by time and unshaken by service.

Write for full particulars

GOULD & EBERHARDT
"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY
ESTABLISHED 1833 NEWARK, N.J. U.S.A. CHANCELLOR AVE.

A Cool Running Drill

not only protects the hands of your mechanics but the total of your production sheets

UNITED STATES
Portable Electric
DRILLS

"The Good Mechanic Knows"

DRILLS GRINDERS BUFFERS REAMERS

The UNITED STATES
ELECTRICAL TOOL CO
CINCINNATI, OHIO

District Sales Offices and Service Stations

Boston, Buffalo, Chicago, Cleveland, Columbus, Detroit, [illegible], Kansas City Mo., Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Toledo

Complete stocks carried in all service stations

Ask for cotalog 20-N
Just off the press!

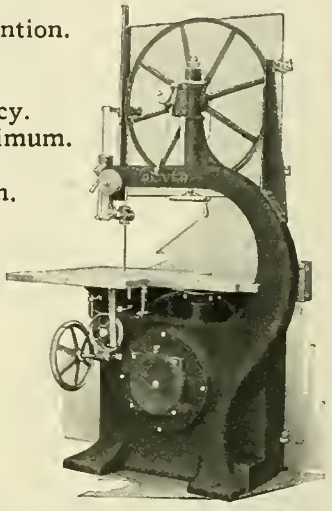
"Oliver" Electric Band Saws

Features

1. Ball Bearings.
2. Beltless.
3. Simple.
4. Requires Less Attention.
5. Saves Power.
6. Saves Floor Space.
7. Maximum Efficiency.
8. Vibration at Minimum.
9. Minimum Noise.
10. Built 30-36-38-Inch.

Other "Oliver" Electric Machines

- Saw Benches
- Swing Saws
- Surfacers
- Jointers
- Lathes
- Sanders
- Boring Machines
- Mortisers
- Grinders
- Glue Heaters



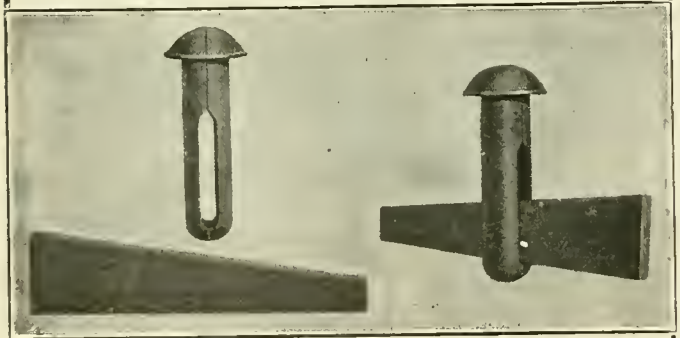
Motor-on-Shaft Band Saw

Oliver Machinery Co.
Grand Rapids, Mich. U. S. A.

REDUCE YOUR BOLTING EXPENSE ONE-HALF BY USING OUR

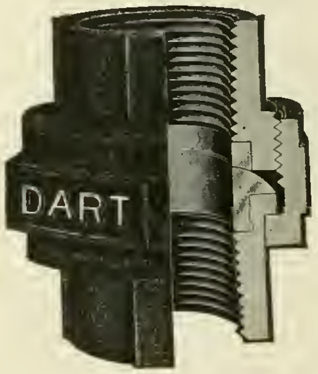
Special Fitting Up Bolts

ALL SIZES—ANY LENGTH



KEY-BOLT APPLIANCE CO.
MANUFACTURERS
Factory and Offices
ORCHARD PARK, N. Y.
U. S. A.

DART UNIONS



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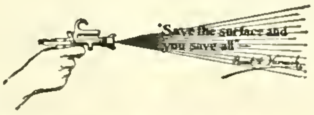
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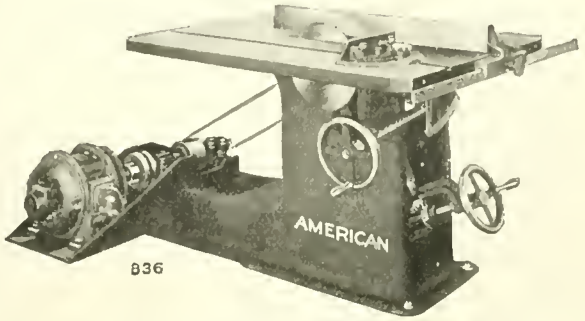

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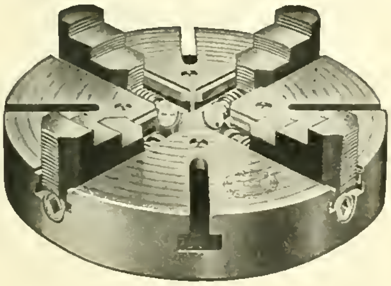

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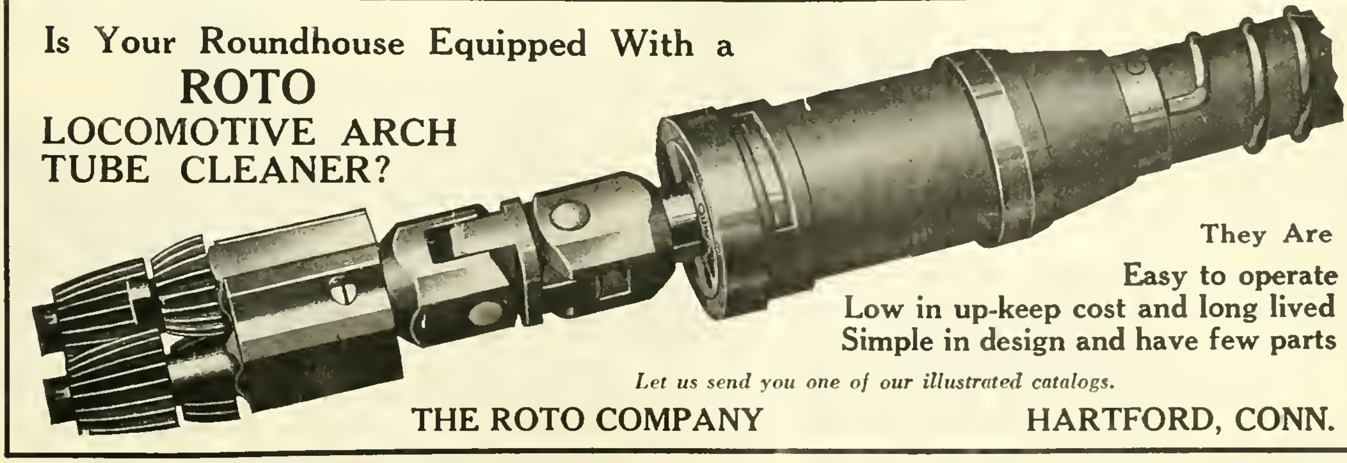

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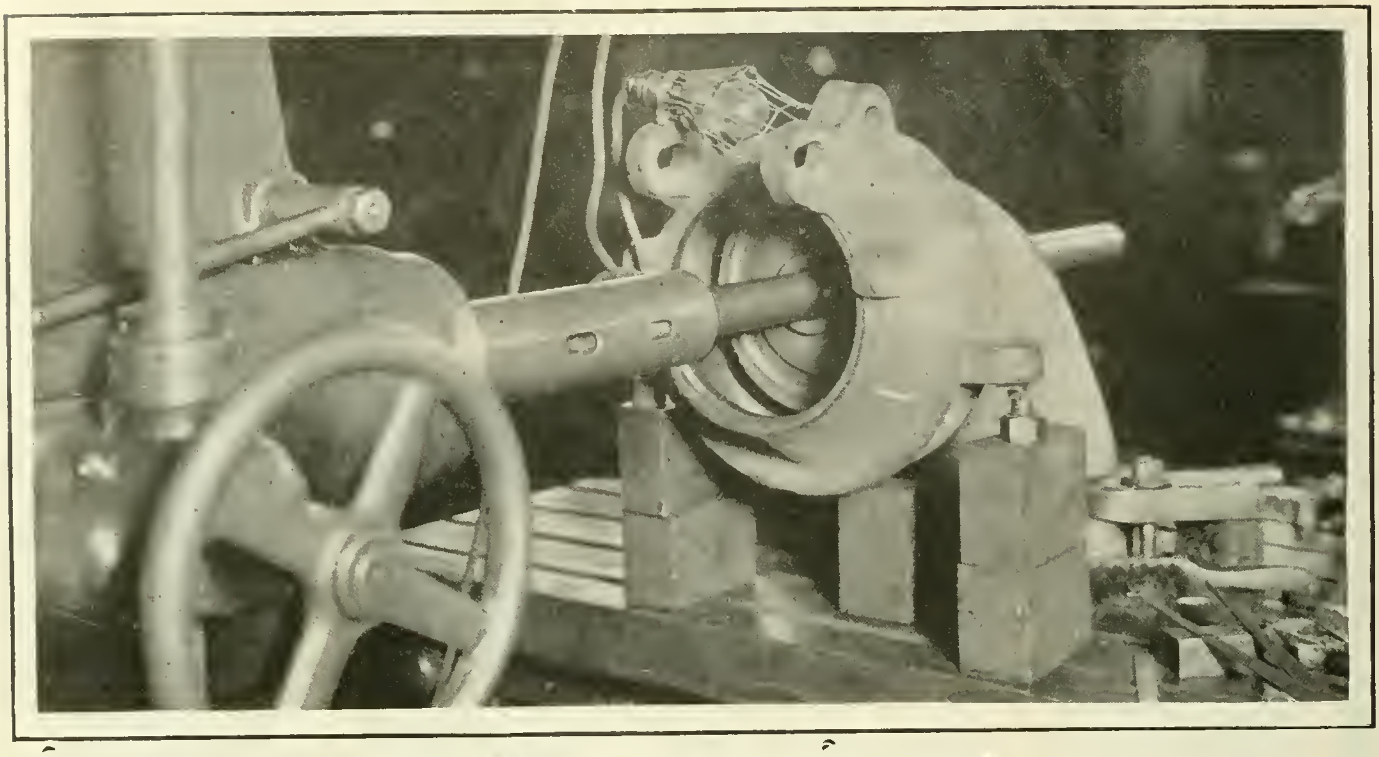

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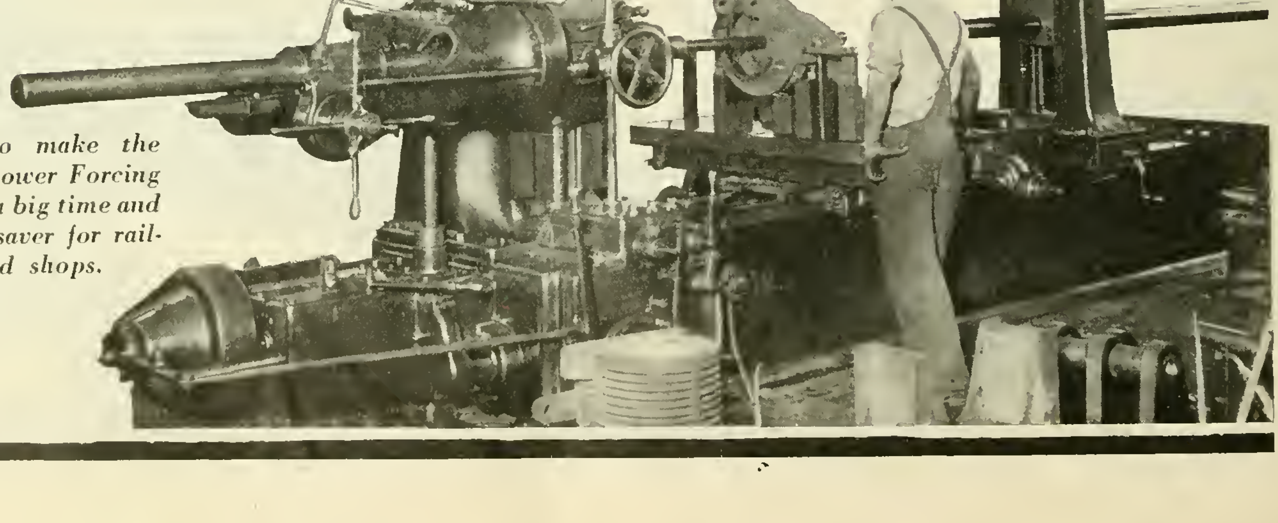

Railway Mechanical Engineer

Volume 97 DECEMBER, 1923 No. 12

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FEATURES OF UNUSUAL INTEREST IN FUTURE ISSUES

COMPETITIONS

Competition on Paint Spraying closes January 1.

New competition on the Relation of Equipment Design to the Facility of Repairs and Cost of Maintenance closes February 1.

Announcement of the winners of the Competition on Engine Terminals will appear in the next issue.

CONVENTION — CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION

The proceedings and one of the papers presented at the convention are given in this issue. The other important papers will appear in the January issue.

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Railway Mechanical Engineer

Volume 97 December, 1923 No. 12

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Car Inspectors' Convention

Elsewhere in this issue is a partial report of the Chief Interchange Car Inspector's and Car Foremen's convention held at Chicago October 3, 4 and 5. Owing to delay in receiving the stenographic report of the proceedings they could not be published in the November *Railway Mechanical Engineer*, but the entire discussion of interchange rules and one of the papers are included in this issue. We expect to publish the rest of the papers together with the discussion which followed each and the discussion of billing rules in the January number. Car inspectors and car foremen should study the proceedings of their association carefully, and while those unable to attend the convention can never really get the inspiration which comes from meeting fellow workmen face to face and discussing mutual problems, the next best thing is to study the discussion and profit by the suggestions made. They have an important bearing on the safe and efficient operation of over two million freight cars in the United States alone.

Competition—Equipment Design and Maintenance

The large percentage of railroad revenues that must be expended by every road for the maintenance of its locomotives and cars in proper operative condition is well known by all officers and is doubtless recognized also to a considerable extent by the mechanics whose duty it is to make the actual repairs. The whole organization of the mechanical department and its activities center around the work of equipment maintenance. Shops, enginehouses and car repair facilities are provided largely for maintenance purposes. While it is unnecessary to direct attention to the relationship between the magnitude of expenditures for equipment maintenance and the general cost of operation, there is an aspect of the situation that is of interest to every man in the mechanical department; that is, the connection which exists between the design of cars or locomotives, and the facility with which repairs can be made, and the costs for maintenance. The common practice of placing orders only when the need for new equipment is so urgent that the quickest possible delivery date is the factor given the greatest attention does not always admit of the closest attention being given to details of design. As a result, the cost of maintenance is ever after more than it might have been had the design been a better one. The men who have to repair a broken locomotive frame or maintain poor foundation brake rigging on a freight car are in a position to find out and recognize the mistakes that are made in what was possibly a hurriedly prepared design. These are points often seen even more clearly by the men in the shops or on the repair tracks than by the mechanical engineer or draftsman. The vital question is what can be done to secure better designs and thus reduce the time that cars and locomotives are held out of service on repair tracks or in shops while repairs are being made. The facility with which repairs may be made or a reduction in the frequency of repairs will greatly reduce costs. The importance of the matter is such that the *Railway Mechanical Engineer* is offering a first prize of $50 and a second prize of $35 for the two best articles received on or before February 1, 1924, telling of what has or can be done to secure improvements in design to facilitate a reduction in the cost of maintenance. Additional articles which may be used in our columns will be paid for at space rates.

The Apprentice Competition

The judges had unusual difficulty in deciding upon the winners in the apprentice competition, which closed September 1, because of the uniformly high grade of the articles submitted and because of the widely varying viewpoints of the young men. For instance, there were several entries from Canadian railways where "old country" methods are apparently being followed in turning out thoroughly trained mechanics—five years being the time of indenture. Then there were a number of articles from the Santa Fe, where an apprentice system has been developed far in advance of that on most roads, due to the abiding faith in young men and the vision and optimism of John Purcell and Frank Thomas. Many other articles were received from roads with standards of apprentice training extending from those of the Santa Fe down to no standards at all, except possibly that something called by the name of an apprentice course is being maintained. The judges hardly expect all of our readers to agree with their decisions—there is too great a diversity of viewpoints, and the judges had difficulty in reconciling their own viewpoints. One thing is certain, however, and that is that the young men make some mighty constructive suggestions.

The first prize of $35 was awarded to W. L. McGowan, machinist apprentice, Atlantic Coast Line. The second prize of $25 was awarded to Harrison Lee Price, Atchison, Topeka & Santa Fe, Ft. Madison, Iowa. Many of the other contributions were of an exceedingly high grade and will be reproduced in whole or in part in forthcoming issues. The judges, however, recommended that honorable mention be made of the following: Earl D. Austin, machinist apprentice, Chicago, Milwaukee & St. Paul, Galewood, Ill.; F. O. Robinson, machinist apprentice, Canadian National Railways, Fort Rouge shops, Winnipeg, Man.; John M.

Wyle, boilermaker apprentice, Erie Railroad, Jersey City, N. J.; Clifford Strock, machinist apprentice, Pennsylvania System, Sunbury, Pa.; and Elwood Thalman, carman apprentice, Atchison Topeka & Santa Fe, Albuquerque, N. M.

In all, 62 articles were submitted in the competition. These came from 20 railroads and from 59 shops. One could not help but be impressed, after reading the manuscripts, with the fact that the mechanical departments have some mighty fine material in training. The question is whether mechanical officers and foremen, with the possibility of making a strong and lasting impression for good upon these boys at a critical age, will make the best of their privilege and opportunity. A careful reading of some of the articles would seem to indicate that some roads, at least, are falling far short of the mark. What can be done to awaken them? For at least a quarter of a century this publication and its predecessors have kept pounding at this question—in season and out of season. We have brought every possible argument to bear. We have described and commented upon the best and most advanced practices of apprenticeship wherever we could find them. You could not accuse us of being impractical, of being visionaries and theorists, for we pointed to real, practical results. It is true that there has been some response—that some substantial progress has been made. But how pitiably slow the progress has been when we consider how much has been at stake!

It is not the small roads with limited resources that are failing—some of them are doing splendid work. Some of the great roads with large resources, and with everything to gain by developing better trained and more loyal employees, are at fault. It would be too strong to say that they are sound asleep, but, on the other hand, they are far from being fully awake to their responsibilities and opportunities.

We have tried to get constructive suggestions from the apprentices themselves in order to break through the walls of indifference. The boys have rallied to our call. They have supplied us with some mighty good ammunition. We shall start to shoot it in our January issue.

Standard Cars Still a Live Issue

The failure of the proposals to adopt the Car Construction Committee's car designs as the recommended practice of the Mechanical Division to carry the necessary two-thirds votes of the membership, was announced by the Mechanical Division on November 22. On the proposition to adopt the designs for single-sheathed box cars, the vote stood 1,061 yes, 650 no, and 1,060 not voting. Similarly, for the double-sheathed car designs the vote was 1,028 yes, 955 no, and 790 not voting. On the three classes of Type W truck designs, the vote was 986 yes, 995 no, and 790 not voting; while on the Type Y designs, the vote was 1,112 yes, 869 no, and 790 not voting. The votes in all cases are on the basis of one for each one thousand cars owned or controlled, and two-thirds of the votes cast are required in favor of the proposals for their adoption as recommended practice. The General Committee has announced that the real objections to the designs have been reduced to a few items and that the propositions have been transmitted to the Committee on Car Construction for review and return to the General Committee by December 7. The General Committee then plans to submit the modified recommendations to the membership at a special meeting for further discussion followed by another letter ballot.

The *Railway Mechanical Engineer* has maintained that these designs should be adopted and sees no reason for changing this positon. It further believes that little can be gained by referring the whole matter back to a new committee, which would have to start practically at the beginning and develop new designs for submission to the Mechanical Division. But, with a knowledge of the principal objections to the designs as they now stand, obtained as a result of the letter ballot, the committee should be in a position intelligently to meet the desires of the required majority of the voting members without impairing the integrity of the fundamental designs which they have developed. Considering the apparent lack of complete understanding of the designs indicated by the number of members not voting, the action of the General Committee in not dropping the matter following the results of the letter ballot but in pushing it forward for further consideration in modified form at a time while the interest in the subject is lively, is worthy of the utmost commendation.

Results of Shop Management Competition

The judges have had great difficulty in deciding upon the prize winners in the Shop Management Competition, which closed in September. Among the papers presented were several splendid ones, especially when considered from the viewpoint of constructive suggestions. The first prize of $75 has been awarded to Frank J. Borer, freight shop foreman of the Central Railroad of New Jersey, at Elizabethport, N. J. Mr. Borer is known to the readers of the *Railway Mechanical Engineer* because of his participation in competitions and the preparation of a number of special articles during the past 12 years or more. The second prize of $50 has been awarded to M. H. Williams. This, also, is a familiar name to readers of the *Railway Mechanical Engineer* because of the splendid articles which have appeared under that signature in recent years; the article on Standardization of Locomotive Repair Parts in the June issue of this year is a noteworthy example. It is only fair to say that the name is a *nom de plume*, the author preferring for certain reasons not to write under his own name. These prize articles, as well as several of the other contributions which are of high quality, will be published during the coming months.

Fuel Economy and the Mechanical Department

Railroad officers may be roughly grouped into two classes with respect to their attitude toward the objective of locomotive maintenance expenditures. On the one hand there are those who look upon these expenditures as a necessary evil that should be reduced to a point below which there will be an actual failure to operate. In its extreme this attitude gives little consideration to the locomotive as the factor responsible for the creation of one of the largest items of operating expense through its consumption of fuel, but considers it only as a machine, which, so long as it will move trains with a reasonable degree of reliability, is completely fulfilling its function. On the other hand are those who regard maintenance expense as something in the nature of an investment, from which more should be obtained than the mere ability to keep the road in operation. These officers are willing to increase maintenance expenditures beyond the dead line fixed by the requirements of reliability if for each additional dollar expended more than a dollar can be saved in some other of the numerous operating expense accounts.

That the latter attitude is essential to real fuel economy is clearly suggested in the prize-winning paper in the International Railway Fuel Association contest, which will be found on another page of this issue. Point is given to the suggestion by the specific case which is cited, wherein the special attention to roundhouse maintenance which was received by a certain locomotive while in the hands of a regularly assigned crew had a noticeable effect on the fuel bill for months after the locomotive had been placed in pool operation and had ceased to receive more than the average attention from the mechanical department.

This example is a striking bit of evidence that a high standard of maintenance is effective in increasing fuel economy. But before a practical program for the promotion of fuel economy can be adopted by the mechanical department, there must be specific knowledge of the extent to which such an improvement may be effected by a given increase, for instance, in the amount of effort expended in the elimination of air leaks into the front end, or the frequency with which boiler tubes are blown out or piston and valves pulled for the renewal of packing rings. These and other defects are frequently reported day after day without attention and the officer or supervisor responsible for this condition probably in no case can cite facts on the basis of which he can prove that any saving in maintenance which he is effecting thereby, is not actually a loss to his company. On the other hand, were he boldly to attack the situation and effect a marked increase in his standards of maintenance, would he be any better able to bring up definite facts to prove a net saving in case his policy were subjected to criticism?

Even on railroads where the importance of fuel economy is recognized to the extent that it is entrusted to the supervision of a fuel department, there is much working at cross purposes in this respect. Mechanical officers, being judged largely by their maintenance costs, are naturally interested primarily in the one side of this question and in many cases the fuel department confines its viewpoint too closely to the other side. They therefore become partisans and the course actually taken depends far more on the personal ability of one or the other of the officers to have his way than upon the economics of the situation with which they are dealing.

The facts required for a common sense settlement of this question should not be difficult to obtain. If accurate statistics of unit expenditures for maintenance and fuel consumption are not available a few simple tests to determine the cost and net results of varying standards of maintenance in the important items affecting fuel economy would provide the basis for the exercise of sound judgment in fixing the final policy and would bring about a spirit of intelligent cooperation where antagonism is now too frequently in evidence.

The Value of Questions

Most men hesitate to ask questions about their work, either because of fear of displaying ignorance or from pure mental laziness. Whatever the cause, the problem of increased personnel efficiency is largely solved when employees can be interested in what goes on around them to the extent of asking questions. Not only are experienced employees benefitted by asking questions but new men can thus acquire knowledge rapidly and be of more value to themselves and to the company which employs them.

Realizing these facts, the Chicago, Burlington & Quincy has recently evolved a plan whereby questions can be asked anonymously by car department employees and submitted to a special committee which answers them, subsequently publishing questions, answers, and in most cases the reasons for the answers, in monthly educational bulletins distributed to the entire department (except laborers). While to date this plan has been applied only in the car department the educational committee has received and answered 70 questions indicating the interest already aroused, and arrangements are now being made to carry on this work in the motive power department.

Briefly the plan consists of distributing post cards among the men, to be filled out with questions regarding any phases of the work which puzzle them and then deposited in a question box at the local shop point. The men's names are not shown, and this brings out many questions which would not otherwise be asked. All questions are referred to a committee of four general car foremen and car inspectors, and the answers, therefore, are made by practical men, expressed in language which shop men can readily understand. Both the questions and answers are printed in bulletin form, perforated so that they can be kept on file and later bound. Each question is numbered and followed with the letter A, B, C, D, or E to indicate whether it relates to air brakes, safety appliances, coach cleaning, shop practice, trainyard inspection, etc.

At several points shop meetings have been arranged for the purpose of discussing the questions and answers, and these meetings are encouraged as they have proved of material value not only to the workmen but to the supervision on account of suggestions brought out. This question and answer educational plan is decidedly interesting and holds much of promise as a means of affording mechanical department employees a better understanding of their work.

Grinding in Railway Shops

The rapid development of the grinding machine as a shop machine tool has brought about many radical changes in shop methods. There is no question but that economy and superior results can be obtained by grinding on many classes of work. It has enabled a number of shops to standardize and to institute real production methods and to eliminate the old and expensive methods of doing a job at a time. A locomotive has from 15 to 30 valve motion pins and bushings ranging in size from 1¼ in. diameter and 4 in. long to 3 in. in diameter and 8 in. long, and from two to eight side rod knuckle pins and bushings and a large number of other motion parts. The customary method of repairing these parts has been by turning, filing, emery papering, etc. A large number of railway shops now make use of the gap grinder for finishing piston rods. In some shops the bearing surfaces of valve motion pins are ground to standard diameters at the time of manufacture, and the companion bushings are internally ground to plug gages. These parts are made in lots ranging from 100 to 1,000. These examples are typical of the kinds of work on which the grinding machine should be used, wherever the possibilities of standardization insure production volume. Decided savings in time and money have resulted in shops where this has been carried out. The utilization of grinding machines in the smaller shops is necessarily limited on account of the usual practice in obtaining supplies from the central or main shops. This concentration of manufacturing at the large shop, however, increases the possibilities for the grinder at these points.

What Our Readers Think

Three-Cylinder Locomotives on the Reading

Philadelphia, Pa.

To the Editor:

The description in the November issue of the three-cylinder engine for the New York Central calls to mind the engines with which the Reading was experimenting a dozen years ago. The aim with these engines was different from that of the New York Central, but they gave a good account of themselves. They were built for passenger service, the aim being to get an engine to run nicely at extreme speeds. This is a valuable characteristic on some of the Reading lines, where the speed limit is 90 miles an hour, and the enginemen have to be called down from time to time for exceeding it considerably.

There were three of these engines, two Atlantics and one ten wheeler. One Atlantic was new, the other and larger was rebuilt from a two cylinder engine as part of an extensive campaign of rebuilding all the fast power into three-cylinder engines. The ten-wheeler was new. As the new three cylinder engines were different in general dimension from anything the Reading then had, and were also the first passenger engines to be equipped with piston valves, a common two-cylinder Atlantic and ten-wheeler were built, with cylinders to give about the same tractive force as the three-cylinder engines. The two-cylinder engines were about 7,000 lb. lighter than the three-cylinder.

The machinery of these engines impressed the observer as being very fine. The outside cylinders drove on the second pair of driving axles, and had Walschaerts valve gear, the inside cylinder drove on the front axle and had a Joy motion. The crank axle was made in a single piece. It was possible, and expedient, to make the stroke only 24 in., which, of course, helped to make the engines fast running. On account of their experimental nature all the workmanship on the engines was excellent.

Comparative tests of the two- and three-cylinder engines seemed to show a slight economy of fuel on the part of the latter, about six per cent. Any figure showing the fuel consumption of individual runs in this service is open to suspicion, as the engines burned anthracite egg. It is possible to make long runs with this fuel without putting a scoopful of coal into the firebox from one end of the trip to the other. Under these conditions the figures arrived at depend on the testers' ability to judge the fire at the start and at the finish. One of these engines had the reputation of being able to handle a very hard train from Philadelphia to Jersey City without doing any firing on the run. There seemed no doubt that these engines were easier on the fire than were the corresponding two-cylinder engines. This was in part due to the easier action of the exhaust, and in part to the lessened swaying of the engines. The fire was not torn up so much, nor was there the tendency to shake the coal away from the side sheets into the center of the firebox. Any decrease in fuel consumption would seem attributable to this cause, or to lessened back pressure due to more favorable action of the exhaust nozzle.

The engines ran well in service, further designs were prepared and preparations made to rebuild the lighter power, but they would not stay running. Sooner or later they would have a hot driving box and have to be taken out of service. It was said that the journal would actually get red. They would not run on grease, and a force feed system of lubrication was installed. It was the general impression that the trouble arose from the more uniform turning moment of the three cylinder engines, as the shafts were not slapped back in the boxes as in a two-cylinder engine, and the lubricant did not have so much chance to work around. This trouble with the driving journals was unique; no two-cylinder engine showed it.

Once the journal had been burned and re-turned on that account, or the engine put through the shop for general repairs, there was trouble getting it running again. First one and then another box would run warm, and most likely some of the journals would have to be re-turned again before the engine would finally be broken in. It was always a matter of several days, or even a week, light running before the engine could be trusted with a train. It seems that there might have been less trouble of this sort if it had been anticipated in the original design.

The engines had the regular form of driving boxes, with a bearing only on the top. The load on a driving journal, particularly when working hard, comes pretty well down toward the lower edge, and the oil film must have trouble in building up the needed pressure in the small space allowed. With the ordinary engine, with the shaft knocking back and forth at each revolution, this does not matter, as the oil has plenty of chance to flow in under no pressure. But with these engines it did not get this chance. If the bearing had been made to cover part, or all of the lower half of the journal, much better results could have been expected as the actual unit pressure would have been much lower. The oil pump also did not seem to give the best results. It pumped only a small quantity of oil at each stroke, being driven off the valve gear, and the feeling was that the engine ran a long way before the oil started to get on the bearing. This pump, of course, needed some looking after, and in the hands of a strange engineman was not likely to get the proper attention. It is hardly necessary to say, since oil is the thing dearest to a railroad company, that oil for these bearings was given very grudgingly. In this connection there was a curious thing. When breaking in one of these engines it seemed almost imperative to put a lot of tallow in the driving box cellars. This seemed to make them run cool where the regular oil never would.

Failure of the crank shafts got to be rather common, and this, together with the trouble of breaking the engines in, and the constant hot boxes, made their cost of maintenance rather high. The man responsible for their introduction left just when the experiment was well under way, and the rebuilding of more engines or the building of further new ones was not carried on. After further changes in the department, about the time that new cylinders would have ordinarily been applied—this company puts in new cylinders rather than attempt to bush down the old ones—the engines were rebuilt to correspond with the two-cylinder engines. There is no doubt, however, that in many respects they were the finest engines the company had.

George L. Clouser.

College Men in Railroad Shops

Pittsburgh, Pa.

To the Editor:

As a special apprentice I was very much interested in Alfred H. Burnham's article in the October number of your magazine, page 677. In my opinion Mr. Burnham places too much stress on the social features of his training, the "rubbing elbows with industry," and not enough on the practical engineering training he is receiving. The absorption of knowledge pertaining to the parts of locomotives, freight cars and passenger coaches and the various methods by which they are made and put into their respective places, is the biggest opportunity the shops offer him; because so long as he is earning his livelihood in the railroad world he may have plenty of positions that will never bring him into contact with the labor question, but he will always have need of some portion of his shop experience.

Likewise I think his ideas concerning the way the company can best use his services when his "time has been served" are rather vague. In my estimation the special apprentice is of use to the company in any one of three classes of service. If he is most interested in the mechanical features of the shops, as, for instance, the construction of locomotives, he belongs to the engineering class. If, on the other hand, his ability lies in the elimination of wasteful methods of shop production, he should be graded in the efficiency class. Finally, there is the executive or managing class, in which he should be placed if he shows any aptitude for administration.

The company should transfer the graduate special apprentice from one of the above classes of service to the other until it finds out the one in which he shows the most ability.

Sidney H. Pratt.

Special Apprentice, Baltimore & Ohio, Glenwood, Shops.

Power Laboratory, Mechanical Engineering Department, The Pennsylvania State College

Broader Training Needed for College Graduates

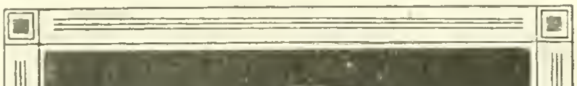
Should Acquire a General Knowledge of Other Departments and Phases of Railroad Work

By E. B. Fields*

Special Apprentice, Atchison, Topeka & Santa Fe, Albuquerque, New Mexico

WITHIN the past few years the railroads have evinced an ever increasing willingness to employ college graduates in all departments. At the same time there has been a constant enlargement of facilities and advantages for utilizing and developing the accomplishments and training acquired in college. Consequently, the railroads today offer to the college man a field of unlimited opportunity. There are places to be had in all branches of the service for those men who are willing to make the most advantageous use of their knowledge of science and theory by adding to it a knowledge of practical things acquired in actual service.

To be more specific, the Santa Fe, in whose service the writer is engaged, offers unusual opportunities, particularly to those men who are mechanically inclined. This railroad has a splendid course of intensive training, intended to convey to the man a thorough and practical knowledge of the work required to keep the motive power and rolling stock in good condition.



E. B. Fields

The course is essentially a shop course, consisting of actual work at all of the important operations involved in the construction, maintenance and repair of locomotives and cars. It includes one year of machine work, one year of locomotive erection, and one year of diversified experience in the departments directly connected with the work of the first two years, and in addition, car work, road work and special work, such as tests, etc.

A close personal interest is taken in the man to see that he acquires, to the full extent of his ability, that knowledge of the work which will make him a useful part of the organization—an asset to the road. Most of the railroads have that idea in view when they attempt to train the college man in practical things.

Training Not Broad Enough

There are, however, one or two essentials lacking. While the man acquires a thorough general knowledge along mechanical lines, there is little opportunity to learn about the other departments of the road, such as operating, financial, maintenance-of-way, etc. While he is obtaining the fundamentals of maintenance of equipment, he learns little or nothing of such things as determination of costs, length of service of equipment, construction of and improvements in buildings, road, machinery, and other equipment.

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* Mr. Fields was graduated from Pennsylvania State College in 1922; he took the course in Railway Mechanical Engineering. This article received honorable mention in the special apprentice competition which closed September 1. The first prize article was published in the November issue, page 737.

The special course could be improved by modifying it so as to include sufficient time spent in the other departments to acquire a general knowledge of the inter-relation of all the departments. It is not necessary that the man familiarize himself with the financial statistics of the road, but he should have some idea of the cost of repairs and what revenue is expected from the rolling stock. This is the only method of classifying the equipment and is the basis of future additions and betterments.

This additional training need not be included in the apprenticeship period served by the college men. In fact, it might be a good plan to arrange that it be optional with the man: if he wishes to acquire the additional experience, let him do so; or even better, the option might be allowed to those men showing the greatest aptitude during their course. The man might thus be inspired to strive to greater efforts during his apprenticeship.

Take Him Into Your Confidence

In addition, would it not be a good thing if the man were allowed some part in the organization—a voice in the local management? Allow him the privilege of attending such meetings as foremen's meetings, safety meetings, betterment meetings, etc. Allow him some freedom in the use of those powers of observation and methodical organization, which he supposedly has developed in college, to the solution of the problems of development and enlargement of plant facilities and increase in production. His ideas might result in important advantages to the particular road of which he is a part. It is not intended that he should have a vote in the determination of policies; but since the main idea of the training is to fit the man for a position of responsibility, managerial and executive, it would seem wise that he should receive some insight into such matters along with the other training. Even though some of his ideas might be contrary to the general policies, he could be shown where he is at fault.

How may the college man's services be utilized to most advantage by the railroad? That is a question that cannot be answered in general. It is rather individual personal characteristics which determine a man's ability to render service. But by obtaining the additional training, along with the general knowledge of things mechanical, he should be most valuable by specializing in the branch at which he is the most apt, or in which he is the most interested.

Two Unique Experiments in Co-operation

The Employee Representation System on the Pennsylvania and the B. & O. Agreement with the Shop Crafts

TRANSPORTATION'S fundamental need—better relationships between the management and the men—was the major topic for consideration at the Sixteenth International Conference of the Transportation Department of the Young Men's Christian Association which was held at St. Louis, Mo., November 15-18. In connection with this part of the program two interesting addresses were made, covering important and unique experiments in co-operation which are now being made on a large scale. Co-operation as involved in the employee representation system on the Pennsylvania was described by E. T. Whiter, vice president of the Pennsylvania Railroad at Chicago, and the Baltimore & Ohio experiment with organized labor was touched upon by William H. Johnston, president of the International Association of Machinists. Mr. Whiter's paper dealt with mutual co-operation between the public, the employees and the owners, but space limitations have made it necessary to consider only that part dealing directly with co-operation between the employees and the managements. Abstracts of the addresses of Messrs. Whiter and Johnston follow.

Co-operation Through Employee Representation

By E. T. Whiter

Vice-President, Pennsylvania Railroad, Chicago

Railroad employees are responsible for the proper performance of their daily jobs. More so than in any other industry they largely supervise themselves. On the Pennsylvania Railroad, for instance, over 240,000 employees are scattered through 13 states and the District of Columbia. It is not possible to supervise every man. Yet, discipline is essential and the proper performance of the job depends in large measure on the employee's attitude toward it. Loyalty alone is a great determining factor in making good or bad service.

Contented Employees a Big Asset

Railroad management realizes today that contented, healthy employees, mentally and physically, are one of the greatest assets a railroad can have. It recognizes the virtue of every man's aspirations to better living conditions, to an education for his children, and to independence in old age. And with these aspirations it sympathizes. They make for good citizenship, and in order to help in advancing these ends the Pennsylvania Railroad has established what is known as the Pennsylvania Railroad Employees' Provident and Loan Association. It is directed by employees, elected by employees; certain of the company's officers act as advisors, and the expense of conducting its operations is borne by the company. The fund enables employees to purchase stock of the Pennsylvania Railroad by cash payments or payments on the installment plan; it enables them to borrow money, if in need; it enables them to buy or build homes; it furnishes the opportunity to establish savings accounts; and it enables any who wish to do so to make deposits which will increase their pensions when retired, but wholly in addition to and entirely independent of the pension which the company gives to every employee without cost when he or she is retired at the age of 65 or 70 under the rules of the pension department. Officers and employees are alike mutual supporters of the Provident and Loan Association, which marks a decided step forward in a co-operative sense.

There is a growing desire on the part of both railroad managements and their employees to co-operate in all matters affecting their responsibilities to each other and to the public which they serve. Some of you are no doubt familiar in a general way with the success which we have had on the Pennsylvania in effecting a plan of co-operative action between officers and employees. Because it typifies in actual

"And, lo, the star, which they saw in the east, went before them till it came and stood over where the young child was.

"When they saw the star, they rejoiced with exceeding great joy." Mat. 2.9,10.

practice the kind of co-operation that is essential in our business, let me give you a short outline of what it is and what it means.

A Closer Contact With Employees

For many years our management has been seeking closer contact with the employees, because it was recognized that the employee had a right to have and should have more than a mere "payday" interest in his job, and that he should have a voice in matters directly concerning his welfare.

As far back as 1907 the management realized that a carefully considered treatment of labor questions was necessary if the company wished to thrive as a successful institution. As an initial effort there was organized a committee of officers of the railroad, to sit as an appeal body of complaints filed with the general manager by the employees, and to act as counsel in advising the general manager as to the merits or demerits of particular cases.

We have, in the last three years, put in effect a comprehensive plan, the keystone of which is a joint committee for each general class of employees, which is the highest authority on the railroad in the determination of all questions affecting wages, working conditions and discipline. These committees are composed of an equal number of employee representatives, elected by secret ballot, and of management representatives. If a two-thirds vote cannot be had, the committee itself decides how a final determination shall be reached. No executive officer of the company, or the board of directors even, has veto power over the decisions of these joint committees.

When we first began to change our managerial attitude toward the problems arising in connection with letting the workmen help manage on questions concerning their interests, many questions arose as to what would be the general effect of the changed relationships as affecting supervision and discipline. Considerable hesitancy was shown on all sides by supervisory officers toward adopting industrial policies which might have a tendency to weaken that disciplinary control which must at all times be exercised by management, from the lowest to the highest supervising officer.

This new relationship between management and men on the Pennsylvania Railroad System has not meant abdication of purely managerial functions. It *does* mean that our employees, by slow, short steps, taken over a considerable period of time, beginning as early as 1907, have been given an increasingly larger voice in determining those questions which arise in the course of their daily work which involve differences of opinion between the management and employees.

Progress by Evolution

It has been realized by those who have participated in these discussions that the problem of the extent of employee participation must come by evolution, and progress only as changing conditions warrant. It meant that when the management began to invite the co-operation of the employees in the settling of questions in which they were closely interested and concerned, the employees themselves must be broadminded enough, experienced enough and well enough balanced to recognize their responsibility in the handling of those matters. These results are being realized.

By some this new relation in industrial management is mistakenly called "industrial democracy"; sometimes it is called "a company union"; again it is called "letting the workman help you manage." But to us on the Pennsylvania Railroad it is known as "employee representation,"—and it is just that very thing, with all that the words imply. Management has not abdicated its right to promulgate any orders or instructions or to impose discipline in its best judgment, and management transmits the decision of reviewing committees, which it is in good faith bound to obey.

One of our officers, a superintendent, who has had many years' experience as an officer of the company under the old regime, and who now meets committees regularly each month in accordance with the plan set up, when asked recently whether he would welcome a return of the old order, declared emphatically that under no circumstances would he want to return to the old order or relationship existing between employer and employee. He pointed out that never in all his many years' service as an officer had he ever experienced such willingness to co-operate, nor such actual co-operation between men and management, as was taking place today under our employee representation plan. He stated he hoped we would never go back to the old order, that men knew their officers better today, that officers knew their men better, and that they had more tolerance of one another's viewpoints, more sympathy for one another's problems, because management was acquainting the employees with its problems and vice versa, and out of it all was growing a bond of unified, friendly understanding such as had never before existed.

The Pennsylvania Railroad has brought about this co-operative spirit by dealing directly with its own employees, and regardless of the fact that the United States Labor Board, I am sorry to say, has endeavored unsuccessfully to do everything it could to force the Pennsylvania to recognize certain labor unions as representing its employees, and against the expressed wishes of the employees themselves.

Co-operation—Organized Railroad Labor's Contribution

By Wm. H. Johnston

President, International Association of Machinists

Co-operation is a word much used, but little understood. If I am boss, and want you to help me, I may ask you to "co-operate." But when you ask me to do something you desire in return, I tell you to put on your hat and shut the door from the outside. This is not co-operation. It may have the "operation," but it doesn't have the "co." Co-operation implies equality on both sides. It is not a matter of charity, it is a matter of mutual work for mutual advantage.

Two people do not co-operate if one of them does all the work and the other has all the advantage. Two people cannot co-operate if one of them is master and the other is servant. I do not mean that a railroad man should not obey the orders of his official superior, but I mean that the relation between the two should be like the relation between a public executive and a citizen rather than like that between an emperor and a subject. It is necessary to have executives. But it is necessary also to protect the rights of the citizen. That is the reason we have codes of law, and speak of a government of law rather than a government of men. Our national government is a great co-operative enterprise.

Co-operation is, therefore, something stronger than a mere vague desire of a formless mass of people to help each other. It requires organization, an organization intelligent enough to make laws, and strong enough to enforce them. It requires organization which will define the relationships between executives and men in such a way that both may retain their equality while performing their respective duties, that the rights and privileges of both may be respected, and, consequently, that both may be free to co-operate with each other and render the maximum of service to the general public.

Where the Union Comes In

Here is where the union comes in. It furnishes an essential part of the co-operative organization. Bear in mind that absolute monarchies may have laws as well as republics. The difference is that in one case all the law comes from above, and in the other the people have a say. A railroad with no unions would be like an absolute monarchy. It would have organization, but this would not be an organization in which true co-operation is possible. But a railroad which makes agreements with unions may be compared to a republic. The voluntary organizations of the men through those selected for that purpose represent their wishes and needs. The railroads through management represent their wishes and needs. The agreement between these two on wages, hours, working rules, and so on, is the code of law which protects the rights of both. It is the basis of organized co-operation.

It may seem strange to some that a union should be spoken of as an organization furthering co-operation between management and men. Has there not been much friction between them? Have there not been strikes? Of course there have been friction and strikes, but I firmly believe that these are a transitory phase of the relationship. It is only natural that in the beginning the representatives of both should feel their own desires vividly and the desires of the other side faintly. In the beginning, all railroads have operated like absolute monarchies. No absolute monarchy in history was changed into a truly constitutional government without a good deal of conflict between the crown and the people. Power is not given up easily or acquired easily. But in the end, all rulers and executives must come to see that they need help of the true representatives of the governed in the task of government. The union representatives on a railroad, if welcomed and given a fair opportunity to present the desires of their constituents, can help the management to remove causes of dissatisfaction which destroy morale. They may frame a code of industrial law under which the men can work with a feeling that they have had a part in its making and that justice is being accorded them. The men will be free and co-operating citizens of the road, subject to its laws and executives because they recognize their fairness and necessity. With such a feeling a man will work better than with the feeling that he is being driven against his will.

Unions as Co-operators

As long as unions are aggressively fought, they will aggressively fight back. When, finally, it is realized that they have come to stay, they may be tolerated as a necessary evil. The emphasis is still on friction and hostility. But when unions become recognized as a necessary part of the railroad's organism, they are then in a position to exercise their full powers in behalf of co-operation. They can turn to positive purposes. On the basis of justice and confidence, both sides can emphasize the mutual advantage in constructive measures. Because the organizations of labor have, in their former struggles, developed the power to refuse co-operation, they now have the power to exercise co-operation. This phase of the unions' activity is just beginning to come into being. It is a great power for good, and it may help to solve some of the biggest problems of the railroad industry.

I want to emphasize as strongly as I know how the fact that in the task of positive co-operation in the railroad industry there can be no substitute for the genuine unions of the railroad employees. When historians wish to test the character of any government they ask who controls the purse-strings. Who construes the right of suffrage? If the people, then the government is democratic. But if some king or autocratic agency levies the taxes, makes the appropriations and says who shall and shall not vote, then any outward form of democracy is but a sham and a delusion.

I wish to submit for your respectful consideration the nature and structure of our genuine railroad unions in their relation to railroad management as an aid in co-operation. These unions, 16 of them, the transportation brotherhoods, the shop crafts, the signalmen, the telegraphers, the clerks, the maintenance-of-way workers, are purely voluntary and democratic organizations of railroad employees. Taken in the aggregate they encompass in their membership and speak for at least 75 per cent or 1,500,000 of our 2,000,000 railroad workers. They are entrusted by each individual member with authority to safeguard his economic welfare in the industry. This is their primary function. That they have grown and won the confidence of the vast majority of our railroad men testifies not only to their economic necessity from the viewpoint of the rank-and-file but also to their constructive possibilities from the viewpoint of the welfare of the transportation industry.

These organizations have developed leadership, have brought men to the front in whom the membership has implicit confidence, who talk for them, who guide them, who aid them, who are factors in American railroading. In short, you will find that there has grown up in the railroad industry, under the most democratic auspices yet designed by men, not only a group of leaders and representatives of our railroad workers who are trusted by their constituents, but also a remarkable tradition of fraternity, coherence and unity. There is spirit and purpose in these organizations, and they have developed that internal discipline necessary to sustain this spirit and carry forward this purpose.

The spirit and purpose to which I refer derives its greatest support from the interrelation of these organizations, their affiliation with one another, their mutual co-operation. This is what strengthens them, this is what gives the individual member self-reliance and pride in his position as a railroad man. This, perhaps more than anything else, is what safeguards his status, insures his stability and assures him the squarest deal possible in the matter of adjusting wages, working rules and grievances.

Now it is precisely the insurance of this spirit of organized labor, as made possible through affiliation of the workers on one railroad with those of other railroads and industries, which is so bitterly resented by those who profess to hope for lasting co-operation by building on foundations other than those of the genuine voluntary organizations of our railroad workers. But it is exactly the very presence of this spirit and the faculty for carrying through their purposes which places the regular unions in such an unusual position to develop co-operation with management to the highest degree possible. In other words, I maintain that no other type of employees' organization is as well constituted as the railroad unions of organized labor to benefit the railroad industry under a policy of true co-operation.

As I have already indicated, co-operation, when it is sound and enduring, must be absolutely voluntary. No duress, no matter how remotely or indirectly applied, no artificial stimulation, through special financial incentives such as piece work, no intriguing the conventional forms of "non-financial" incentives, profit sharing, or employee stock sales will create lasting voluntary co-operation on the part of the railroad workers. Nor indeed does any artificially created, unaffiliated, undemocratic organization of employees provide the foundation upon which to build real co-operation. In the very nature of things the latter type of organization can and does exist only by managerial fiat. It dare not tolerate in its ranks employees who are loyal to legitimate organized railroad labor. Witness the turmoil on those roads where for instance the shop strike has been disposed of and where so-called company unions are trying to function and where men are obliged to drop their union membership if they wish to enter or remain in the service.

The B. & O. Experiment

Some time ago I said publicly that the International Association of Machinists was searching eagerly for a progressive employer who would, on the basis of full recognition of the union, accept our co-operation for the increasing of efficiency and the furthering of economy in the interest of service to the public. It would be understood, of course, that any benefits accruing to the concern through improved service would be shared justly between the parties responsible therefor. Since that time we, together with the other railroad shop crafts, have found such an employer in one of the great railroad systems of the country—the Baltimore & Ohio. We have made an agreement for mutual co-operation, and have worked out a concrete experiment in the shops, with which both sides are pleased. I think we can now give points in efficiency and economy, in better shop service, in improved morale, to any railroad which relies on piece work or other speeding-up devices, or seeks to circumvent genuine trade unionism.

Briefly I might summarize the development in co-operation on the Baltimore & Ohio, first, as the acceptance by the Baltimore & Ohio management of the standard shop craft unions as the proper agencies representing the shopmen. But instead of being simply tolerated as a necessary evil, with a purely negative attitude toward the welfare of the railroad, they are now regarded as desirable agencies in the stimulation of human efficiency on the Baltimore & Ohio. Thus the ordinary negative attitude which results from the usual status accorded the shop unions by most managements is here displaced by a constructive, helpful attitude toward management.

On the basis of this understanding we have, among other things, placed at the disposal of the Baltimore & Ohio a service to help improve the morale of the mechanical department through our union organizations. It is our purpose to align the locals, shop federation, districts and system federations of the Baltimore & Ohio shopmen definitely behind a constructive program of improved shop, yard and roundhouse operation, better maintenance service, increased production, safety and the elimination of waste. The management on the other hand has assured us that it will do what it can to make this improved maintenance economy count in the direction of steady work the year around. Thus the men need have no fear that better production on their part is going to result in furloughs just that much sooner, as ordinarily happens on railroads where narrow economy, piece work and anti-union policies prevail. And finally it is definitely accepted by both management and shopmen that.

> "The welfare of the Baltimore & Ohio Railroad and its employees is dependent on the service which the railroad renders the public. Improvements in this service and economy in operation and maintenance expenses result chiefly from willing co-operation between the railroad management and the voluntary organizations of its employees. When the groups responsible for better service and greater efficiency share fairly in the benefits which follow their joint efforts, improvements in the conduct of the railroads are greatly encouraged. The parties to this agreement recognize the foregoing principles and agree to be governed by them in their relations."

This quotation is the preamble to the agreement negotiated last May between the Baltimore & Ohio management and the Baltimore & Ohio System Federation No. 30. It reflects the spirit and purpose which guides the individual unions composing this federation in their relation to the Baltimore & Ohio Railroad.

The service we have put at the disposal of the Baltimore & Ohio is of the most superior engineering character. It is under the general direction of O. S. Beyer, Jr., who is retained by us as consulting engineer. Mr. Beyer, aside from his training as an engineer in our best technical schools, his practical experience as a railroad man which he acquired in the service of the industry, has a grasp of the human problems of railroading which is not only necessary but indispensable for the guidance of such a service.

The Underlying Idea

The idea underlying our service to the Baltimore & Ohio may be compared to the idea which underlies the engineering services extended to railroads by large supply corporations which have contracts with these railroads to furnish, let us say, arch brick, superheaters, stokers, or lubricating oils. The union members furnish their services, and also help the road with expert advice as to how to employ those services to the best advantage to all. In response to the recognition accorded us by virtue of the agreement or contract existing between us and the management it becomes peculiarly feasible for us to take steps which will develop greater confidence between management and men, and create, as it were, an all-pervading collective will for the major purposes of railroading; namely, efficient satisfactory service to the public, a fair return to the investors and adequate wages and steady employment for the workers.

The developments on the Baltimore & Ohio, to which I refer, have now been under way definitely since last February. There is not time here to go into the details of these developments. Suffice to say that one of the principal shops of that railroad was selected in which to work out the technique of co-operation under Mr. Beyer's direction. This has now been done and the results achieved are being worked up in report form as a practical object lesson of the benefits to be derived from co-operation. At the same time the general labor policy upon which co-operation on the Baltimore & Ohio is based is being brought home to every representative of management and every union representative as well as to every shopman all over the system. So that when this new policy is thoroughly understood it simply becomes a matter of taking definite practical steps to carry it over into the multitudinous daily actions and relations which constitute railroad maintenance operation.

Conclusion

In conclusion, let me emphasize just two important things. First, although we have been intensively active on the Baltimore & Ohio for barely eight months, and the surface, so to speak, has hardly been scratched, the effect of the new policy of co-operation on that road is clearly manifesting itself in the splendid service the road is rendering the public, the high economy with which it is being operated and the excellent morale which prevails through the rank-and-file. These facts are statistically demonstrable, especially when we compare the Baltimore & Ohio with some of its competitors who maintain a different labor policy. Second, I want to say that we, the legitimate, standard, genuine unions of the shopmen, are more than eager to offer the same positive co-operation to any railroad management which is intelligent enough and courageous enough to see the inevitable logic of events and one whose railroad conditions are ripe for such co-operation. I maintain that such a management would never again, as long as it retains its good senses, desire to see the affiliated shop crafts effaced from the scheme of things on its road.

A Suggested Basis of Proportions for Driving Axle Keys

By H. J. Coventry

Mechanical Engineer, Harry Vissering & Co., Chicago

Driving axle keys, being a small item and in the nature of a security device rather than a means of sole fixing of wheel to axle, have not, perhaps, received much attention, hence it has been considered sufficient to make the key dimensions of width and thickness bear some relation to the axle diameter and to base standard sizes accordingly. That this method is not entirely correct will be appreciated when it is remembered that a driving axle must be designed for combined torsion and bending. Obviously, the key is entirely independent of the bending of the axle and takes only the torsional shear force. Hence a particular key might be quite suitable for entirely different diameters of axles.

For practical reasons and in order to limit the number of sections of key steel stock it is inevitable that some keys would be more heavily stressed than others but, if a suitable basic stress is adopted, any divergence above or below will not be detrimental.

In the diagram, Fig. 1, let

T = force at periphery of wheel in pounds
F = force acting on key in pounds
d = diameter of axle in inches
D = diameter of wheel in inches
b = breadth of key in inches.
t = thickness of key in inches
l = length of key in inches
Length of key is usually made ¼ in. less than wheel seat.

Take shear stress at 10,000 lb. sq. in. and bearing pressure at 25,000 lb. sq. in. for high grade steel.

Area to shear = $b \times l$

Area to bearing = $\dfrac{t \times l}{2}$ assuming key is sunk for half its thickness in the axle.

$$\text{Then } F = 10{,}000\ bl \ldots\ldots (1)$$

$$\text{and } F = \frac{25{,}000\ tl}{2} \ldots\ldots (2)$$

$$\text{from which we find } t = \frac{10{,}000}{12{,}500}\ b = .8b \ldots\ldots (3)$$

As the key or keys in one wheel will only be required to transmit half the total work of the cylinders, we may take *T* equal to half the tractive effort. (For Mallet engines, take half the tractive effort developed by one set of cylinders.)

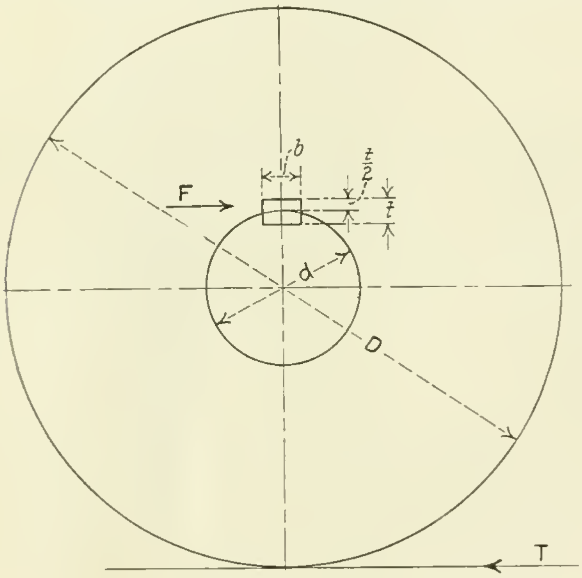


Fig. 1

$$\text{From the principle of moment } F \times \frac{d}{2} = \frac{Te}{2} \times \frac{D}{2}$$

$$F = \frac{Te\ D}{2d} \ldots\ldots (4)$$

where Te = tractive effort in pounds. Substituting the value of F in equation (1)

$$\frac{Te\ D}{2d} = 10{,}000\ bl$$

$$\text{and} \qquad b = \frac{Te\ D}{20{,}000\ dl} \ldots\ldots (5)$$

We now have the breadth of key as a function of four variables, and while this formula gives correct values its use would entail a different key for almost every case. A process of averaging has therefore been adopted, reducing the value of *b* to a function of *Te* and *D*.

From a large number of existing engines representing over 60 different sets of values for tractive effort, axle diameter, wheel diameter and seat, a table has been made, a sample of which is given in Table I.

Key width *b* was calculated in each case by equation (5). The values of the product of *Te* and *D* and *b* were then plotted as shown on Fig. 2.

It will be noticed that while the plotted points are considerably scattered, they do tend in a general direction, and this is estimated by the straight line drawn among the points.

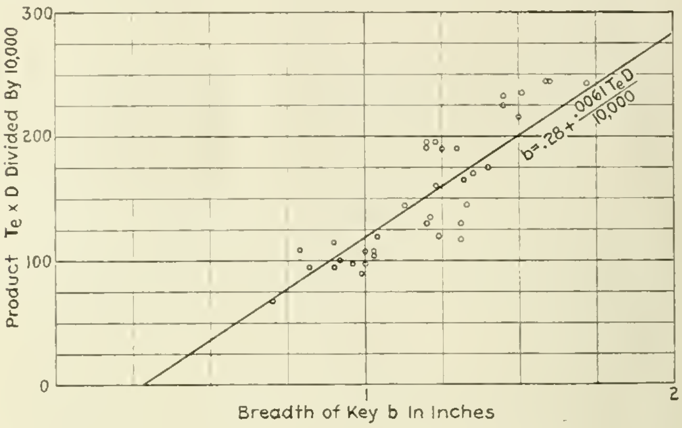


Fig. 2

The law to a straight line graph is

$$b = a + c\ Te\ D$$

where a and c are constants.

Taking any two simultaneous values for *b* and *Te D* from the line, we may find the value of *b* or the equation of the line. This comes to

$$b = .28 + .0061\ \frac{Te\ D}{10{,}000}$$

From this equation, the values of *b* have been calculated and the nearest practical size taken. A sample is shown in Table II and the complete list made from this working is given as Table III.

Table I

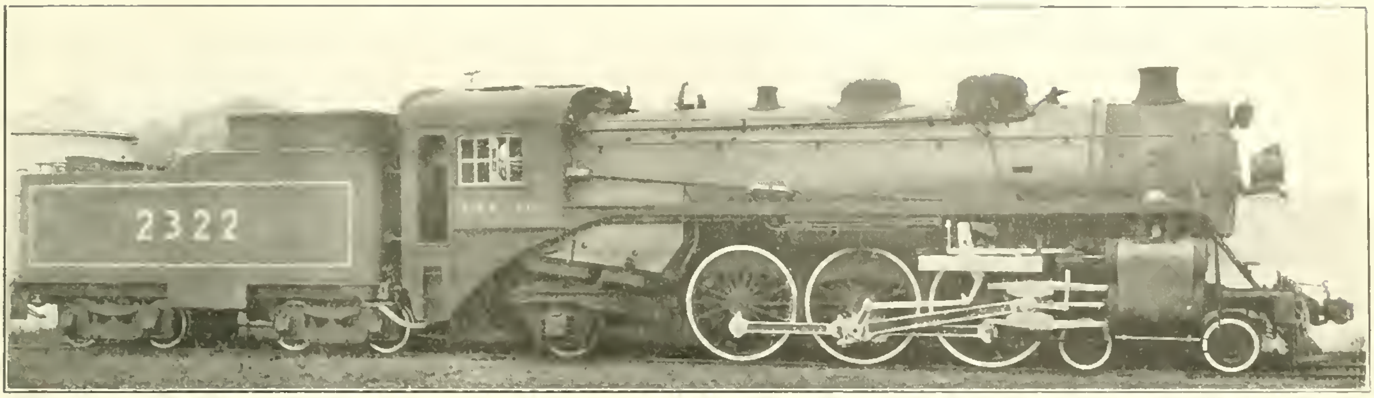
Engine	Te	d × l	D	Te × D	b
A	27,200	8¾ in. by 7½ in.	63	1,710,000	1.35
B	41,946	9¼ in. by 7¾ in.	51	2,140,000	1.5

Table II

Wheel diameter	Tractive force	Calculated key width	Key size	Number of keys
51 in.	20,000 lb.	0.9 in.	1 in. by ⅞ in.	1
63 in.	40,000 lb.	1.82 in.	⅞ in. by ¾ in.	2
63 in.	75,000 lb.	3.16 in.	1½ in. by 1¼ in.	2
75 in.	35,000 lb.	1.85 in.	⅞ in. by ¾ in.	2

Table III

Wheel diameter	Tractive force	Key size	Number of keys
51 in.	20,000 lb.	1 in. by ⅞ in.	1
51 in.	40,000 lb.	⅞ in. by ¾ in.	2
56 in.	15,000 lb.	⅞ in. by ¾ in.	1
56 in.	20,000 lb.	⅞ in. by ¾ in.	1
56 in.	25,000 lb.	1⅛ in. by ⅞ in.	1
56 in.	30,000 lb.	1¼ in. by 1 in.	1
63 in.	15,000 lb.	⅞ in. by ¾ in.	1
63 in.	20,000 lb.	1 in. by ⅞ in.	1
63 in.	25,000 lb.	1¼ in. by 1 in.	1
63 in.	30,000 lb.	1½ in. by 1¼ in.	1
63 in.	35,000 lb.	⅞ in. by ¾ in.	2
63 in.	40,000 lb.	⅞ in. by ¾ in.	2
63 in.	45,000 lb.	1 in. by ⅞ in.	2
63 in.	50,000 lb.	1⅛ in. by ⅞ in.	2
63 in.	55,000 lb.	1¼ in. by 1 in.	2
63 in.	60,000 lb.	1¼ in. by 1 in.	2
63 in.	65,000 lb.	1½ in. by 1¼ in.	2
63 in.	70,000 lb.	1½ in. by 1¼ in.	2
63 in.	75,000 lb.	1½ in. by 1¼ in.	2
75 in	15,000 lb.	1 in. by ⅞ in.	1
75 in.	30,000 lb.	1½ in. by 1¼ in.	1
75 in.	35,000 lb.	⅞ in. by ¾ in.	2
75 in.	40,000 lb.	1 in. by ⅞ in.	2
75 in.	50,000 lb.	1¼ in. by 1 in.	2
79 in.	20,000 lb.	1¼ in. by 1 in.	1
79 in.	25,000 lb.	1½ in. by 1¼ in.	1
79 in.	30,000 lb.	⅞ in. by ¾ in.	2

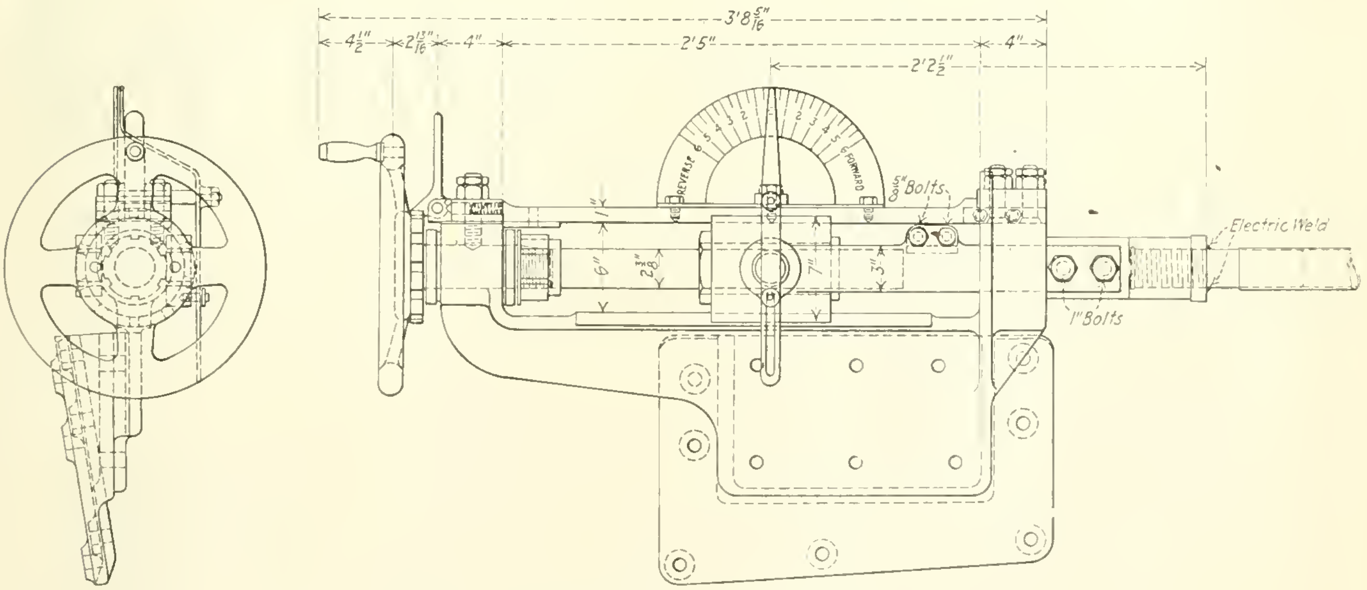


Class G-3c Pacific Type Locomotive for the Canadian Pacific

Canadian Pacific Standard 4-6-2 Locomotive

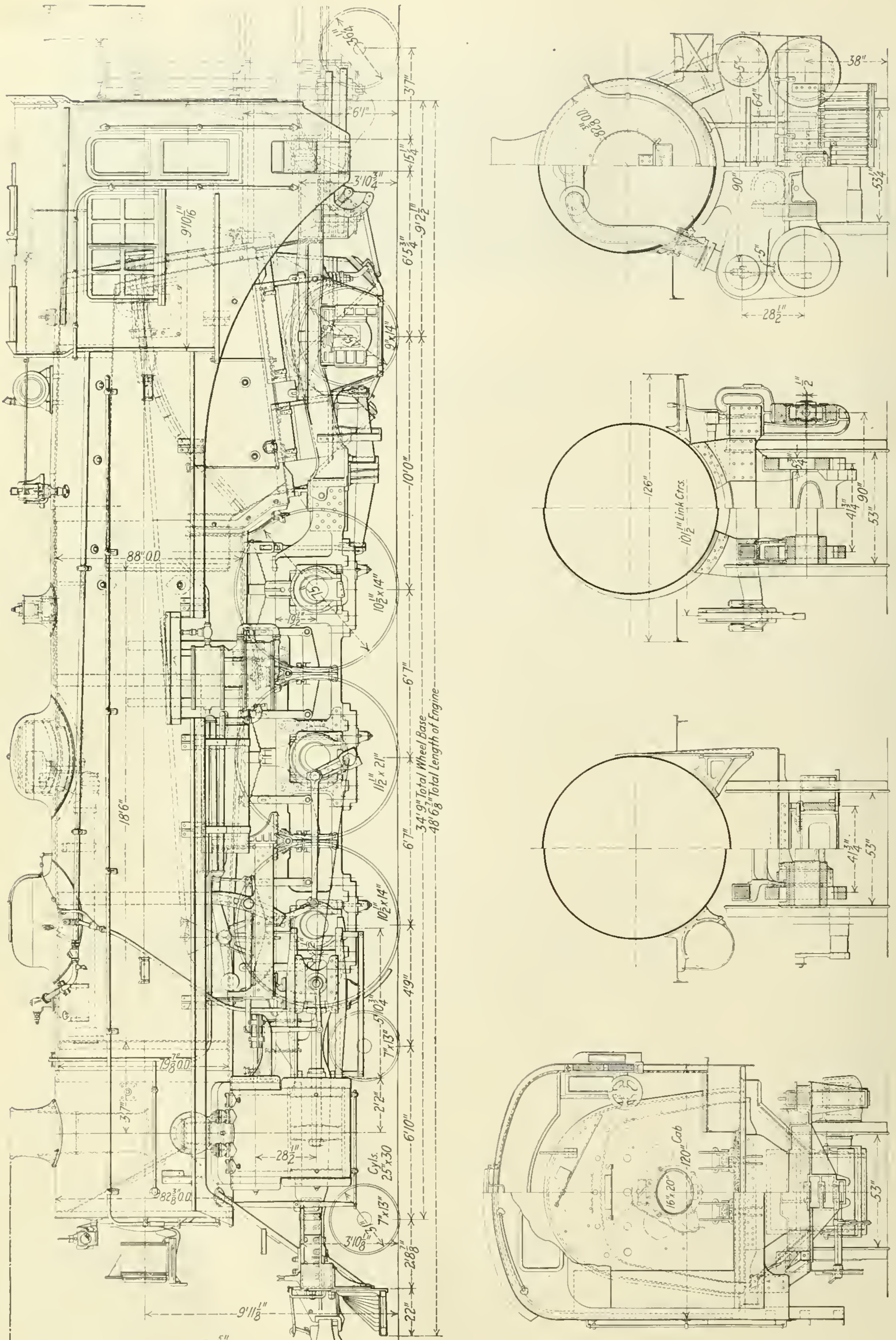
Heavy Pacific Type with Well-Proportioned Boiler—Interesting Trucks and Many Improvements in Details

IMPORTANT passenger trains on the Canadian Pacific have been handled for many years by locomotives of the Pacific type with driving wheels of 75 in. and 70 in. diameter. For quite a period locomotives having a tractive force of from 30,000 lb. to 35,000 lb. were sufficiently powerful to meet traffic conditions, but an increasing number of passenger cars to a train, greater weights of the cars and a desire to furnish first-class service made it necessary to increase materially the power of the locomotives. After a thorough study of the situation, two new designs of Pacific type locomotives were brought out in 1919 to meet the requirements of operation even in severe winter weather and to conform to the limitations of bridges and right-of-way restrictions. The two designs were similar. One, known as Class G3, had 25-in. by 30-in. cylinders, 75-in. driving wheels and a tractive force of 42,600 lb. The other, known as Class G4, had 24½-in. by 30-in. cylinders, 70-in. driving wheels and a tractive force of 43,700 lb. In the period of 1919, 1920 and 1921, the Canadian Pacific built at the Angus shops, Montreal, 10 locomotives of Class G3, numbered in the 2,300 series, and 18 locomotives of Class G4, numbered in the 2,700 series. Both classes were given long tests under all kinds of conditions and on many divisions. As a result of these extended tests, which included careful observations of the actions of all parts of the machinery and boilers, a somewhat modified design, known as Class G3c, has been completed and adopted as the standard Pacific type for heavy main line passenger trains. Sixteen locomotives of the new design have been built this year by the Montreal Locomotive Works and are now in service.



A Screw Reverse Gear Gives Close Adjustment of Cut-off

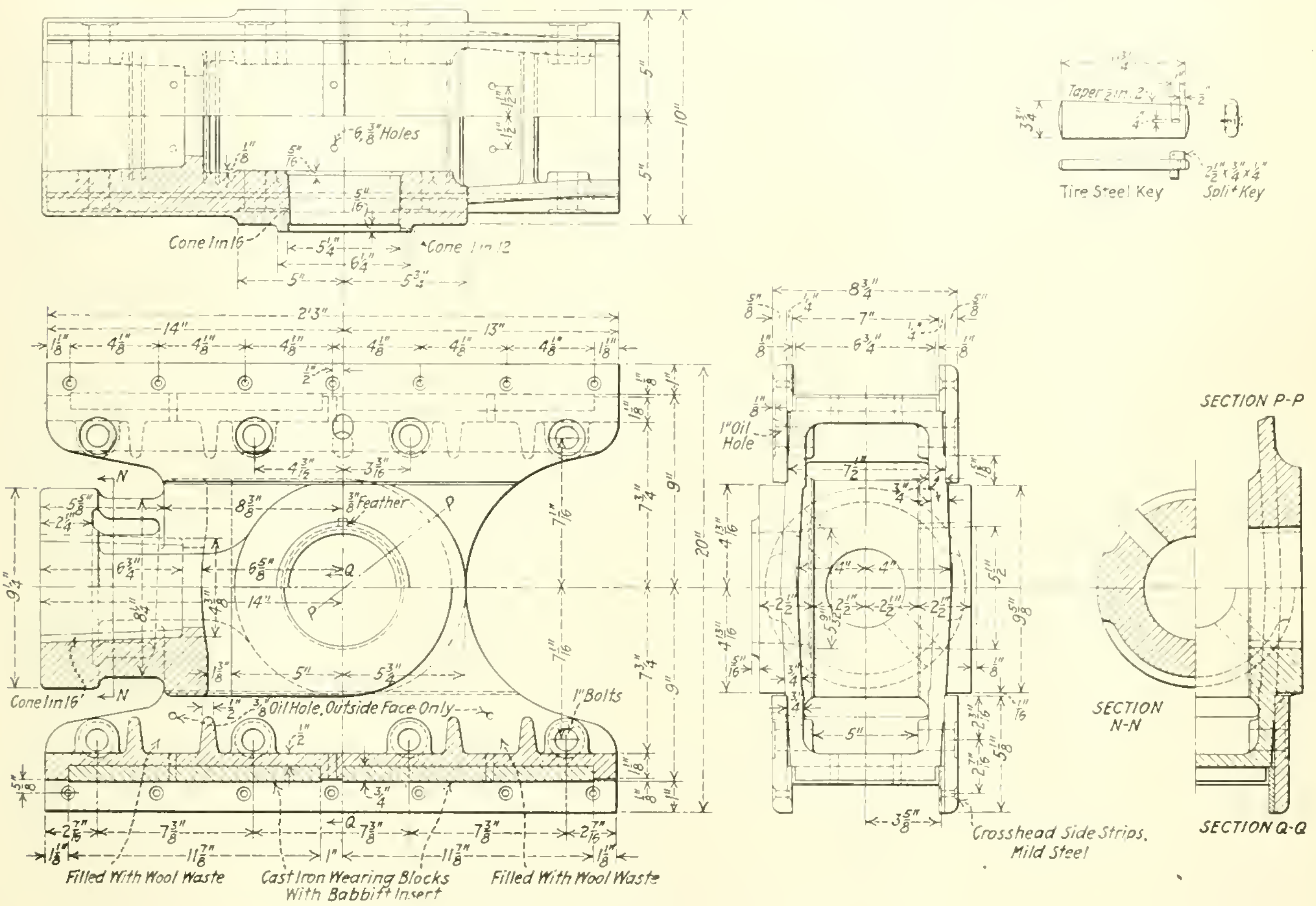
These new passenger locomotives which are numbered 2310 to 2325 inclusive, have 25-in. by 30-in. cylinders, 75-in. driving wheels, 2,252 cylinder horsepower, and a rated tractive force of 42,600 lb. The weight in working order of the engine alone is 300,500 lb., of which weight 181,500 lb. is on the drivers, 60,000 lb. on the front truck and 59,000 lb. on the trailing truck. These weights give a factor of adhesion of 4.26 and a locomotive weighing 133.7



Standard Pacific Type Locomotive of the Canadian Pacific lb. per cylinder horsepower. The tender is of the rectangular water bottom type, weighs 188,500 lb. in working order and carries 8,000 Imperial gallons (9,600 U. S. gallons) of water and 12 tons of coal.

Ample Boiler Capacity Provided

Adequate boiler capacity is of prime importance if a locomotive is to handle satisfactorily passenger traffic on the Canadian Pacific where trains of 12 or more heavy passenger cars are not unusual. In many places the movements of other trains and, in fact, the successful operation of a division, depends upon passenger trains being kept on schedule. While reserve boiler capacity is always an advantage, it becomes of prime importance when the thermometer is below zero, the coal is frozen and mixed with snow and an increasing demand for power to meet greater frictional and train resistances comes at a time when a large amount of steam is required to heat the train and to run the air compressor at an increased speed to supply air for the extra brake pipe leakage. An appreciation of these conditions led to the adoption of a boiler which has a capacity of 101.8 per cent when calculated by Cole's ratio. All boiler details have been carefully proportioned—grate area, firebox volume, heating surfaces, gas area and air admission areas. The engines are consequently free steamers and have demonstrated their ability to furnish ample steam to meet all requirements.



The Crosshead Is Fitted with Detachable Side Strips

In accordance with previous Canadian Pacific designs, the boiler is of the straight-top, extended-wagon-bottom type with a combustion chamber 26 in. long and radial stays. The steam pressure carried is 200 lb. per sq. in. There are 205 tubes, 2¼ in. diameter, and 38 flues, 5½ in. diameter, and 18 ft. 6 in. long. The evaporative heating surface is 3,530 sq. ft., which includes 298 sq. ft. in the firebox, combustion chamber and arch tubes and 3,232 sq. ft. in the tubes and flues. The type A superheater has a heating area of 830 sq. ft.

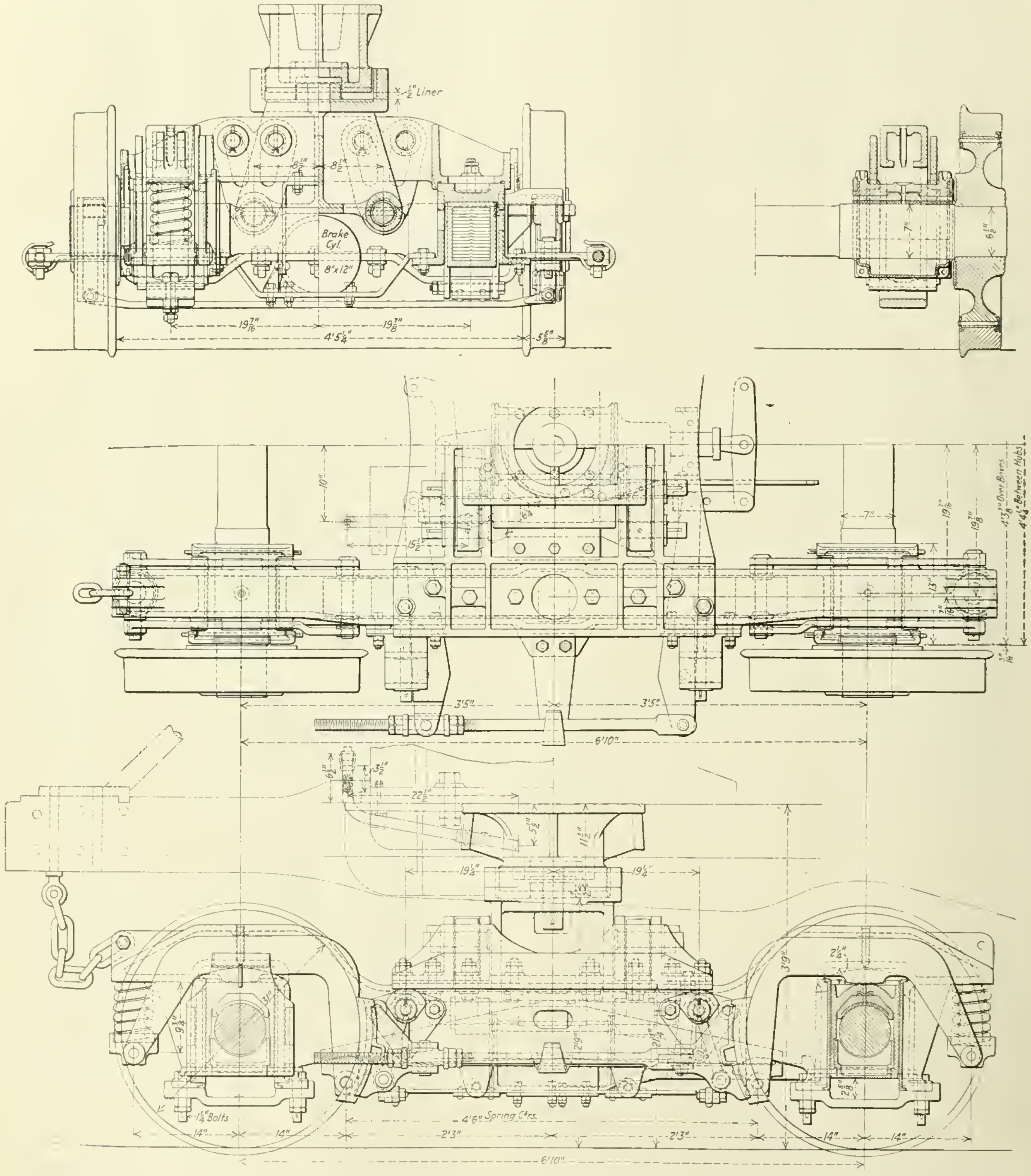
The barrel of the boiler has three courses, the first one having an inside diameter of 78¼ in. The dome, which is 33 in. inside diameter, is located on the second course. This simplifies the seam construction and shortens the dry pipe.

The firebox is 111⅛ in. long by 84⅜ in. wide inside, which gives a grate area of 65 sq. ft. The firebox door opening is flanged with a large radius and projects through the flanged opening in the back head, the two sheets being riveted together in accordance with successful Canadian Pacific practice. The Security brick arch is carried on five 3-in. tubes placed well above the mud ring at the front end. The grates are of the butt-finger type, no special dump grate being provided. The brackets, which support the grate bars, also carry the ash pan. Firing is done by hand. The fire door is of the air-operated butterfly type, Franklin No. 8. The boilers are fed by two Hancock No. 10, type A inspirators.

Engine and Running Gear

The cylinders are of an unusually substantial design, double bolted together and provided with a flange at the back through which pass bolts which hold the cylinders to special lugs on the front frame extension. The 14-in. piston valve is operated by a Walschaert gear.

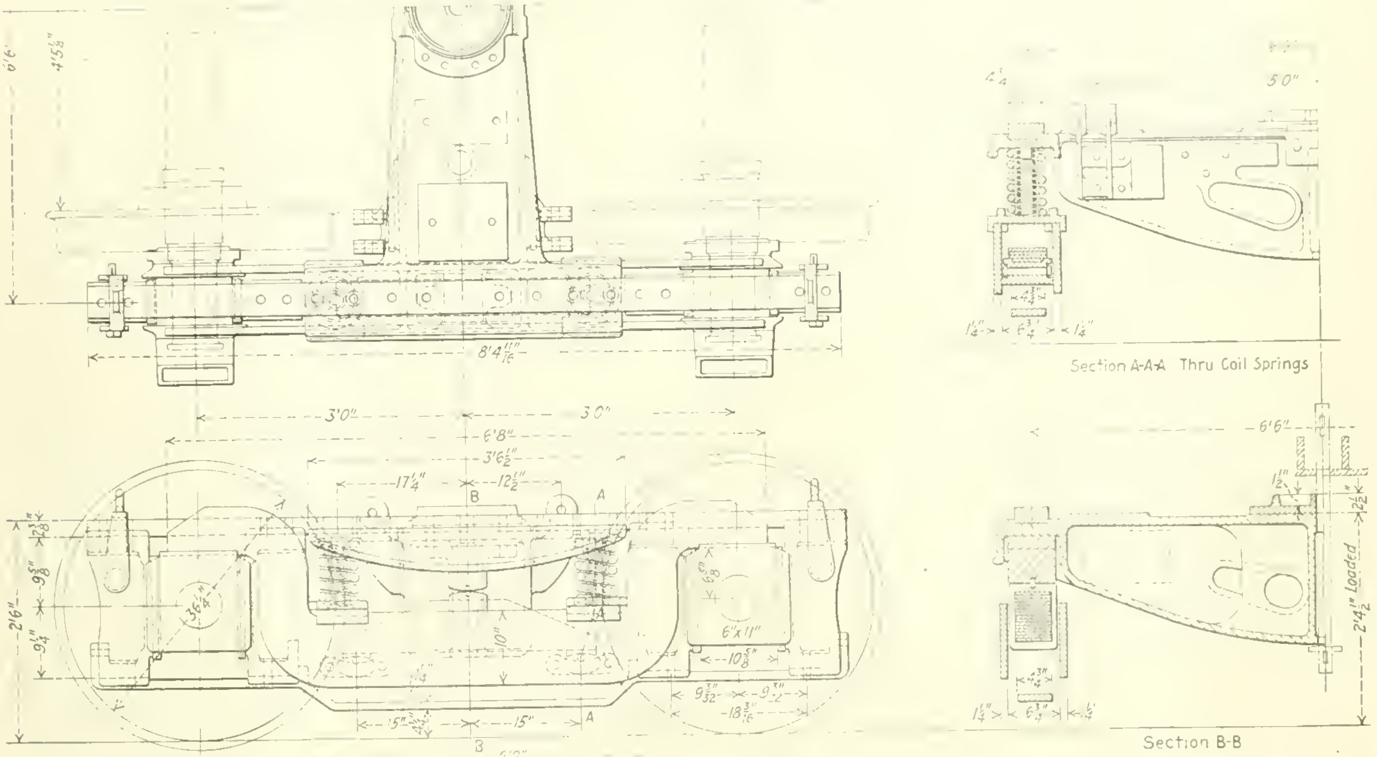
The frames are of the single front rail type, of vanadium cast steel, specially heat treated. At the back they are attached to a Commonwealth cast steel cradle casting. These are the first locomotives on which a one-piece cradle casting has been used in conjunction with a Vaughan trailing truck. This type of trailing truck has been the standard on the Canadian Pacific for many years, and when used with a Commonwealth cast steel cradle affords an unusually large space for the ash pan and furnishes excellent accessibility. The large ash pan is fitted with doors which swing closed by gravity.



Front Truck for Canadian Pacific 4-6-2 Locomotive

The three drivers on a side and the trailing wheel are equalized together, a long equalizer being used to connect the spring hanger back of the third driver with the forward spring hanger of the trailing truck wheel. The spring hanger back of the trailing truck wheel is held in tension by a strong coiled spring underneath the truck frame. This method of equalization is considered to be largely responsible for the excellent riding qualities of these engines.

Another factor in the riding qualities is the design of the front truck, which is shown in one of the drawings. The two cast steel side frames of channel-shaped section are bolted to a substantial center casting. The journal box pedestals are integral with the side frame, which also contains a spring seat and a pocket for the semi-elliptic spring. The design has been changed somewhat from that used formerly and permits of an easier application of the springs. Equalizers resting on the journal box connect the ends of the semi-elliptic spring to spring seats at the outside corners where coil springs transmit the thrusts to the side frame. The wheels are steel tired, 31 in. diameter, and have cast steel centers. The journals are 7 in. by 13 in. The journal



Four-Wheel Tender Truck for Class G-3c Pacific Locomotive

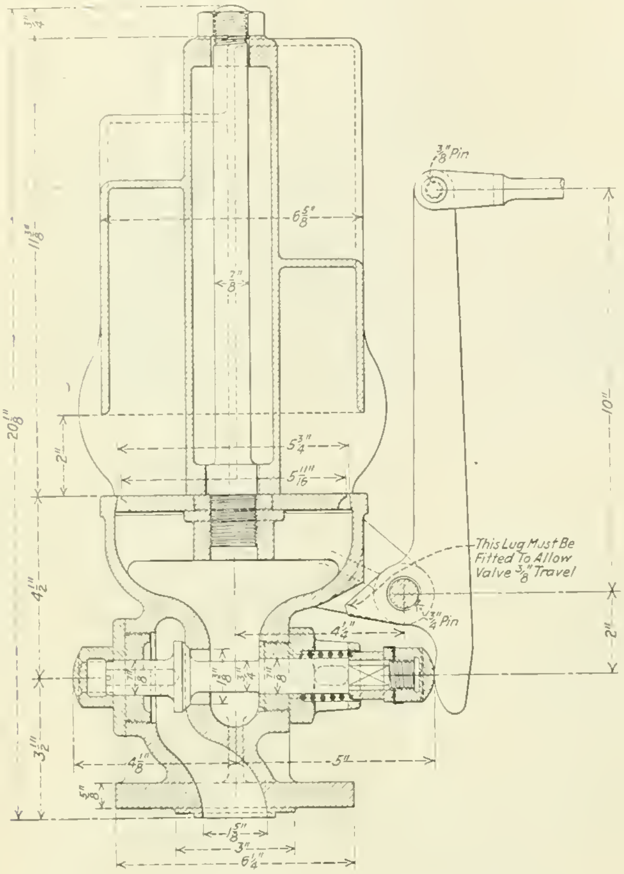
Taple of Dimensions, Weights and Proportions

Railroad	Canadian Pacific
Builder	Montreal Loco. Wks.
Type of locomotive	4-6-2
Service	Passenger
Cylinder, diameter and stroke	25 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Cut-off in full gear, per cent	85
Weights in working order:	
On drivers	181,500 lb.
On front truck	60,000 lb.
On trailing truck	59,000 lb.
Total engine	300,500 lb.
Tender	188,500 lb.
Wheel bases:	
Driving	13 ft. 2 in.
Rigid	13 ft. 2 in.
Total engine	34 ft. 9 in.
Total engine and tender	67 ft. 1 in.
Wheels, diameter outside tires:	
Driving	75 in.
Front truck	31 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main	11½ in. by 21 in.
Driving, others	10½ in. by 14 in.
Front truck	7 in. by 13 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	St. top—extended wagon bottom
Steam pressure	200 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	78¼ in.
Firebox, length and width	111⅛ in. by 84⅜ in.
Height mud ring to crown sheet, back	5 ft. 6¼ in.
Height mud ring to crown sheet, front	7 ft. 2½ in.
Arch tubes, number and diameter	5—3 in.
Combustion chamber length	26 in.
Tubes, number and diameter	205—2¼ in.
Flues, number and diameter	38—5½ in.
Length over tube sheets	18 ft. 6 in.
Gas area through tubes	4.6 sq. ft.
Net gas area through flues	3.26 sq. ft.
Total gas area through tubes and flues	7.86 sq. ft.
Air inlet through grates	20.54 sq. ft.
Air inlet to ash pan	9.4 sq. ft.
Grate type	Butt finger, no dump
Grate area	65 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	258 sq. ft.
Arch tubes	40 sq. ft.
Tubes	2,224 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,530 sq. ft.
Superheating	830 sq. ft.
Comb. evaporative and superheating	4,360 sq. ft.
Tender:	
Style	Rect. water bottom
Water capacity	8,000 imp. gal.—9,600 U. S. gal.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 per cent	42,600 lb.
Cylinder horsepower (Cole)	2,252 hp.
Boiler horsepower (Cole) (est.)	2,293 hp.
Speed at 1,000 ft. piston speed	44.6 m.p.h.
Steam required per hour	46,840 lb.
Boiler evaporative capacity per hour	47,640 lb.
Coal required per hour, total	7,320 lb.
Coal rate per sq. ft. grate per hour	112.5 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	60.5
Weight on drivers ÷ tractive force	4.26
Total weight engine ÷ cylinder hp	133.75
Total weight engine ÷ boiler hp	131.2
Total weight engine ÷ comb. heat. surface	69
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	101.8
Comb. heat. surface ÷ cylinder hp	1.94
Tractive force ÷ comb. heat. surface	9.78
Tractive force × dia. drivers ÷ comb. heat. surface	734
Cylinder hp. ÷ grate area	34.61
Firebox heat. surface ÷ grate area	4.58
Cylinder hp. ÷ gas area (tubes and flues)	286
Grate air inlet ÷ grate area, per cent	31.6
Ash pan air inlet ÷ grate area, per cent	14.45
Firebox heat. surface, per cent of evap. heat surface	8.4
Superheat. surface, per cent of evap. heat. surface	23.5
Tube length ÷ inside diameter	110.5

boxes are fitted with double-faced cast brass liners and hub liners are also applied to the wheels.

Other Interesting Features

The crosshead has been improved by the application of side liners on each side as shown in one of the drawings. These detachable side liners facilitate the renewal of the side wearing strips.



Improved Chime Whistle with Horizontal Valve

The reverse gear is of the screw type commonly employed on this road. The screw is 2⅜ in. diameter and has a double left-hand thread of 1½ in. pitch, which permits of a finely graduated adjustment of the cut-off.

A new type of whistle has been applied to these locomotives. It is of the four-chamber chime type, and is provided with a flange by which it is bolted on. The valve is horizontal and can be removed without disturbing the bell.

The cab is of the railroad standard enclosed vestibule type, while the location of fittings and piping has been given careful attention. Large lockers have been provided for the convenience of the engineman and fireman. The cylinders and the air compressor are lubricated by a Detroit force feed lubricator. Other specialties, not mentioned, include Pyle electric headlight, Westinghouse 8½-in. cross-compound air compressor, Barco joints in air and steam piping between engine and tender, King piston rod and valve stem packing and Franklin grease lubrication of driving box journals.

Tender

The tender has been redesigned with a one-piece bottom. The swash plates are of corrugated form instead of plain sheets with stiffening angles as ordinarily applied. Another improvement has been to remove the tank well operating valve rod from the coal space; the valve is now operated from the front of the tank well. The design of the coal space is such that the coal slides forward to the shovel plate and thus reduces the labor of the fireman. The frame is a Commonwealth cast steel design.

The trucks are of the four-wheel equalizer type. The wheels have steel tires, 36¼ in. diameter, and cast steel centers and the journals are 6 in. by 11 in. The truck bolster and the pedestals are of cast steel. An opening through the bolster permits the brake rod to pass through instead of underneath as on previous trucks. An excellent cushioning is obtained by the employment of a longitudinal, semi-elliptic spring and two coil springs on each side.

The accompanying table gives the principal dimensions and proportions of these locomotives, which are interesting for their careful design, careful attention to proportions and attractive appearance.

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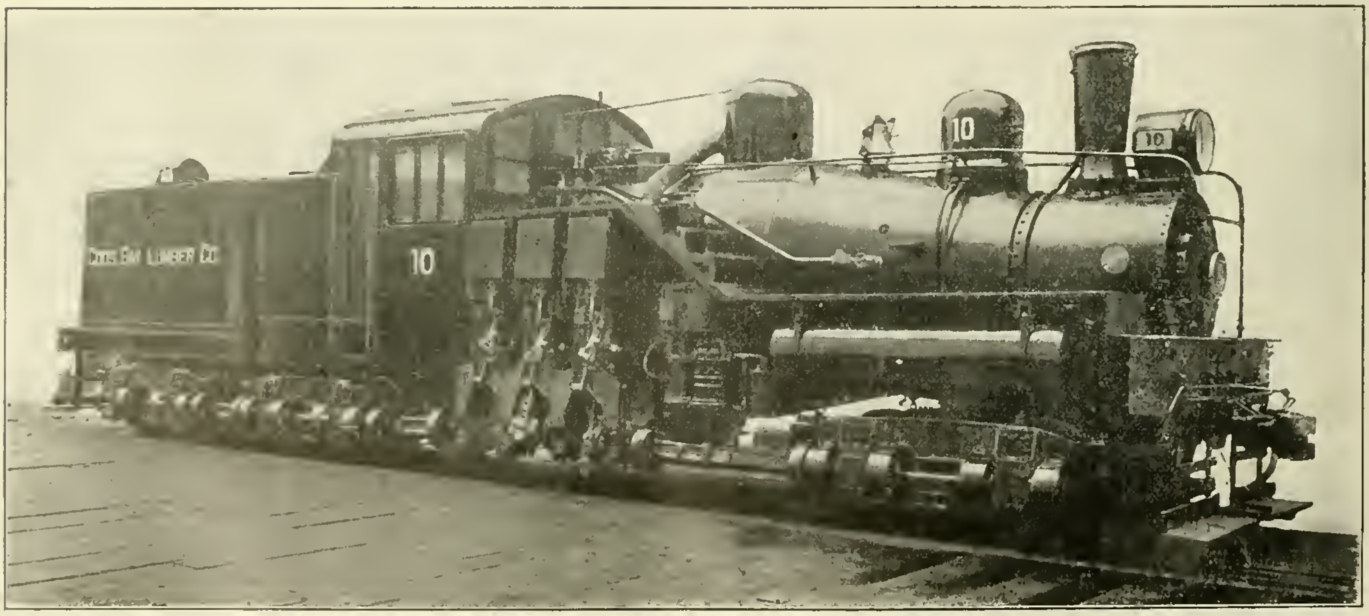

Geared Locomotive Built by the Willamette Iron & Steel Works, Portland, Oregon

The Fundamentals of Fuel Economy

Paper Showings Wasteful—Systematic Education and Careful Selection of Employees Essential

By W. L. Richards
Locomotive Engineman, Union Pacific, North Platte, Nebr.

[*Abstract of a paper which won the prizes in the International Railway Fuel Association contest for the best paper on fuel economy submitted by an engineman, fireman, conductor, brakeman, or switchman. It deals with the fundamentals of the subject in a constructive and suggestive manner.—Editor.*]

THAT the performance of any work whatsoever requires an expenditure of energy is an accepted fact; it is also a commonly accepted axiom that heat is the source of all energy, that is, that no work can be accomplished or power furnished without first providing heat. All sources of power and energy may be finally traced to heat.

Railroads are engaged in the business of transportation, i.e., the carrying of articles of commerce and persons from one place to another. To do this requires the provision of the necessary energy; hence the primary business of railroading is the business of furnishing energy to move things of weight.

To furnish this energy requires heat, and fuel is the principal source of this heat.

There are two ways in which the consumption of fuel may be lessened. The first is by lowering the amount of energy necessary to do a given piece of work; the second, by getting a greater amount of energy from the fuel consumed. As both are controlled by those who are in charge, it would seem to be logical to say that three elements enter into the economical use of fuel, namely, operation, mechanical and personnel. It is from these three viewpoints that the subject will be considered.

Operation

In the operation of a railroad from a fuel economy standpoint, we are mainly concerned in the first way of saving, that is, in reducing the amount of work necessary to perform the service required. Under this head comes the reducing of road grades, the elimination of unnecessary car and engine mileage, the making up of trains so as to reduce the tractive effort to haul them, the rating and providing of locomotives with trains which show the least fuel consumption per ton per mile hauled, the doing away with unnecessary terminal and road switching, the careful making up of time-table schedules so that the runs over the district concerned can be made with uniform speed and effort; the prompt handling of freight and passenger traffic so as to minimize delays and the avoidance of every train stop possible.

Perhaps much has been accomplished along the lines mentioned in the preceding paragraph, but there undoubtedly remains a great deal yet to be done before we can say that we have reached satisfactory results. Take the matter of yard or terminal switching; I have in mind a case on a well managed railroad wherein a chief dispatcher had two trains made up at a certain terminal and they were run as made up to the end of that chief dispatcher's jurisdiction, but, at the terminal where another chief dispatcher took charge of the movement, these two trains were ordered remade up in a manner that required 65 switches handling from 9 to 45 cars at each switch. It took two hours and twenty minutes of a full yard crew's time and burned at least two and one-half tons of coal. This is, perhaps, an exceptional case, but there are many, many cases of less magnitude happening on our best railroads every day, nearly all of which could be avoided if the trains were made up in the first instance under instructions that took into consideration the movement of all cars clear through to destination or to the end of that line—instructions which succeeding yard masters and chief dispatchers were bound to respect.

The Evils of "Paper Showings"

There is also another phase of operation which is reflected in the fuel consumption of a railroad and that is what is commonly known as making a "paper showing." It is practised in nearly all departments and seems to be demanded by the system of accounting now in vogue.

This "paper showing" often appears in keeping up the tonnage showing of a district, wherein one locomotive is sent out heavily loaded, followed, perhaps, by one running light because the power is needed at the other end of the district and the "light" is not charged against the tonnage per train of the district. Tests show that to have run two small trains instead of the heavy train and the "light" would have resulted in the saving of considerable fuel and in either case the other expense for crews, etc., would have been the same.

The amount of coal issued to locomotives is sometimes overcharged to make up for the shortage in the weight of coal between the mines and point of consumption, in order to keep from showing up this loss. But the practice does not gain us one pound of additional fuel. It would be much better to make a true and exact charge, letting the shortage show and taking steps to correct it if large. By so doing, we save ourselves a loss and also know that the records of actual fuel consumed were accurate.

Boards of directors and stockholders may have to be asked to look a little further into the future and give a little more leeway to the management in order to accomplish what appears to be necessary to the real saving of fuel. I refer to the practice of trying to show high net operating revenues at all seasons of the year. On most of our roads the business is seasonal and when the traffic is at the highest point mechanical forces are increased without stint in order to keep every available locomotive at work. But, at best, only the work absolutely necessary to keep the engine in service can be done, as it cannot be held idle long enough to be put in first class mechanical condition. As a result much fuel is wasted; in fact, the matter of fuel economy is generally lost sight of during these periods. Then just as soon as business slacks and gross revenues begin to fall, mechanical forces are reduced in an effort to keep up the percentage of net revenue, with the inevitable result that the roads enter into another rush with the power in as poor condition as before.

At its best, this is a poor policy and is only "robbing Peter to pay Paul." When business began to fall off, had the full mechanical forces been kept at work until every locomotive had been put in the pink of condition, the money spent then would have been more than saved in the next campaign because when engines are idle more work can be accomplished for the same expenditure. Furthermore, many thousands of tons of fuel could be saved for the reason that each machine would enter the rush in an efficient fuel-saving condition and could be maintained in that condition.

The policy outlined would also result in a further saving, as mechanical forces would be kept at a more constant level throughout the year. The filling of the shops with undesirable help during stress periods could be avoided and the cost of labor turn-over thereby reduced. This, of course, is not strictly fuel economy but would be a direct result of it.

Mechanical Factors

Although fuel is used in every department of a railroad, by far the largest percentage is that consumed by its locomotives. A locomotive is a very wasteful machine at its best as far as fuel is concerned. During the government operation of the railroads, a bulletin issued by the Director General gave the amount of heat usefully applied to drawbar pull by the average locomotive as only six per cent of the total amount of heat in the coal consumed. This means that for every 100 lb. of coal burned only 6 lb. is really saved to do the work required. From this fact it is easy to learn that we must devote our attention mainly to our engines if we are to save fuel in a mechanical way.

This bulletin gives the largest amount of heat loss as that passing out of the stack—52 per cent—and it is to overcoming this high percentage that the mechanical department should devote the major portion of its efforts. This means that every attention should be given to valves and cylinders; the cages of the former (the modern piston valve being under consideration) should be bored true and kept in that condition, as should also the cylinder walls, and both should be fitted carefully with rings of the proper size with just the right amount of spring in them to make their movement steam tight. If any of the live steam gets by it increases our percentage going out the stack, and this cannot be permitted if we are to save fuel. The setting of locomotive valves is a moot question and therefore careful experiments should be made by each road to determine the setting that is most economical for its requirements and when once the standard is determined, the valves should be run over as often as may be necessary to maintain it. Lame engines are to be avoided as fuel wasters.

The next great loss is that of unburned gases passing out the stack, this loss being given at 14 per cent. It is to this factor that attention should be given after the exhaust loss has been reduced to a minimum. For every ton of coal burned in a locomotive, from 10 to 14 tons of air are required to be drawn into the firebox to furnish the oxygen necessary for combustion. This air, remaining only a few seconds, must be heated to a high temperature, its various gases combined with other gases liberated from the burning coal and the greatest possible amount of the heat thereby generated transferred to the water to form steam. We must have the required amount of air to make the gases burn with the greatest amount of heat, but given that amount, more causes waste, for we have to heat more than is necessary and it is thrown out the stack again, a total loss. Things which cause more air to be drawn in than necessary and therefore to be avoided are steam and water leaks in the firebox; too straight a passage, causing failure of the air to properly mix with the gases of the coal; too limited a heating surface for the hot gases to come in contact with, and also allowing these metal surfaces to become coated with scale or soot. A leading authority says that a metal surface coated with 1/16 in. of scale or soot will transmit 14 per cent less heat than a clean surface of the same material. These figures will give us an idea of just how important it is that accumulations of this kind be avoided. Brick arches are a great aid in the mixing of gases in the firebox and should be maintained in good order and of proper size.

Keeping Power Tuned Up

Economical locomotive practices are so well known that it should be unnecessary to go into full detail in a paper of this kind. The whole secret lies in putting the machine in *good* condition according to the facts we know and then *maintaining it in that condition.* The writer feels we must do this to accomplish real fuel economy and that too little attention has been paid to locomotive upkeep in the past. The order must go out to let nothing interfere with keeping the motive power in prime, efficient condition. This will prove to be a move of utmost economy in the long run, as the following will witness.

On a certain district of a well known road, there was an engineman who knew his business operating what is known as a regular engine. The district foreman in charge of the engine was the engineman's son and, in order to please his father, he paid marked attention to the work that was done on this particular engine. As a result it was probably in a better condition than any other locomotive on that road. Then came an order placing that engine in the pool. Every engineman on the district then ran it in his turn and it received no more than the ordinary attention. But for a period of nearly two years thereafter it was known as the lightest fuel user on the district. As a result of being put in fine condition at the outset, it saved enough coal in the ensuing two years to pay many times over the initial extra cost of being put in that condition.

There is one item that must be touched upon, however, and that is the matter of sand for locomotive use, which perhaps should have been spoken of under Operation. At any rate, it has much to do with fuel economy and should receive more attention. Many a powerful locomotive has been allowed to spin and slip along for hours almost helpless, wasting coal and water—it takes fuel to pump water—for the want of a little sand under the driving wheels. On our heavy power, sand boxes should be enlarged and the best type of sander for the economical and sure use of sand be made a part of the engine equipment.

Sanding engines by hand is also a fuel waste because it takes an additional amount of coal to make up the long delay and, therefore, mechanical sanding devices should be maintained wherever sand has frequently to be taken on.

Policy of Improvement Too Conservative

On the whole, railroads have been just a little too conservative in adopting new and improved devices in engine operation to accomplish a great deal in fuel saving. Locomotives show less improvement for the time since being adopted for general transportation use than any other machine in general use for the same length of time. This has probably been due to two causes; first, the cheapness and plentifulness of fuel, and second, the difficulty inventors have encountered in getting new devices tried out. A more progressive policy should be now adopted and new inventions of promise be tried out carefully with a view to being put in use if practical or to developing them and remedying the faults of the inventor's idea.

I know of a case where a certain type of tank-valve was causing a fuel loss by reason of stopping up easily and interfering with the feed water supply. A new type of valve was given a thorough and exacting test lasting for seven months. It proved its superiority over the old valve in every particular but failed to be adopted on the road concerned because other roads serving the same territory were using the same old type and it was deemed best not to change for that reason.

This is illustrative of the attitude that must be gotten away from. If any improvement is to come, someone must cut a little red tape and do some pioneering.

What has been said under the heads of Operation and Mechanical pertains for the most part to train and engine operation. While these are the principal fuel users, there are other departments where fuel is used, and, consequently, where fuel may be saved by the application of the two principles outlined—the saving of energy by the elimination of needless work and getting the most out of the fuel actually used. A light burned when not needed, a shaft running when not being used and heat turned on when more windows are opened than needed for ventilation are some of the many ways in which needless work is performed; an efficient boiler or steam plant, well maintained and fired by skilled men is one way of getting the most out of the fuel used. All departments should be watched by competent supervisors, all power waste eliminated and methods revised with a view to lessening the work performed wherever and whenever it can be done without loss of efficiency.

Personnel

Although, in looking into the question of fuel economy, consideration has been given first to the matter of operation and then to the mechanical features, it is not intended to convey the impression that they are of more importance than the human factor in this great problem. Given operating conditions that practically approach the ideal, given mechanical attention that is almost perfect, we shall still register a failure in accomplished results unless we have employees who are intelligent and who have attained that degree of skill and interest in their work that will cause them to take full advantage of every opportunity afforded to save fuel. In order that we may have a set of employees who will measure up to the required standard, it would seem that we must approach the subject in two ways, i.e., education and selection.

Education

As many of the men who will have to do with the saving of fuel are old employees already in the service, the method of selection cannot be applied to them and the effort will, necessarily, have to be confined to education. The older employees are naturally conservative, that is, they do not change the habits of a lifetime easily and, therefore, the effort to educate them, to induce them to drop the old, wasteful habits and to take up the newer, more economical ways, will have to be carefully considered lest it do more harm than good. The writer believes the subject should be handled by the use of gentle and constant persuasion rather than by disciplinary measures so far as the older employees are concerned. In the case of the new employee, such as firemen, brakemen, apprentices and all who enter the service where they may go to higher positions, the educational feature should be made compulsory by means of carefully graded progressive examinations relative not only to the particular line of work in which engaged, but also that which pertains to the saving of energy and fuel.

The story of coal, its origin and use, how its elements may be combined with those of the air to produce heat, how the different combinations produce the different gases with their varying degrees of heat when burned, reads like a romance if written in a simple manner, free from technical expressions, so that the ordinary reader may understand. If the problem of combustion could be written up by some authority in story form like Dr. Woods Hutchinson has written the story of many human ills for the Saturday Evening Post I am sure that the tale would be full of lasting interest for all employees, young and old, and would eventually result in the saving of many tons of fuel annually. As one of the means of saving fuel, let us see if we cannot find such a writer and then carry his story to every man having to do with the burning of fuel.

In the matter of compulsory fuel education among the younger employees, particularly enginemen and firemen, they should be required to acquire a technical knowledge of combustion to a degree that will enable them to handle fuel in an economical way at all times and to know the reason for such handling. A large percentage of fuel waste is due to ignorance of the simplest laws of combustion. If we can dispel this ignorance and impart knowledge in its stead, this knowledge will cause action on the part of employees that will be almost automatic and which will go far in the matter of fuel saving. Men do not habitually do the things that they know to be wrong, so if we can educate them as to the right thing, they will, in course of time, almost unconsciously do that which is proper and right, which in this case, would be to handle fuel in a saving manner.

The educational features should be provided by the company and they should be carefully considered in order to make them as entertaining and as interesting as possible. Text books of easy grade, lectures, moving pictures, slides, etc., should be provided, as well as class instruction at regular and stated periods. These means of instruction once provided, there should be no hesitation in requiring those concerned to give full attendance and to keep up the required grades at the periodical examinations.

Selection of Employees

The writer believes that every railroad should have an employing department, the head of which should be an officer of general authority and who has been carefully, yes, very carefully, selected because of his knowledge and judgment of men. This officer should have assistants—not necessarily persons employed exclusively for this purpose, for many times an officer in other lines would meet the requirements—located in every terminal, whose duty it would be to keep in close touch with the youth in his community and who would talk to and register the names of those likely to make desirable employees. Then when the time came to increase the number of employees during seasonal rushes of business, the new men to enter the service could be taken from the selected lists instead of being grabbed haphazard from those happening to present themselves for employment.

It is my observation that once a person of the less desirable class is allowed to begin work, such person is rarely eliminated and the entire personnel of the road suffers during his or her term of employment. It is imperative that steps be taken to prevent the entrance of this class of labor.

For myself, I believe the time has come when some of the intelligence tests should be used in examining an applicant for service on our railroads. The Binet test and its modified forms, as demonstrated by its use in the Army, undoubtedly gives a very definite line on the native intellect of any individual and, given a high degree of mentality, education will easily develop a highly desirable worker. Lacking in primary intelligence, instruction may develop those qualities which the applicant has, but cannot increase the amount of mentality originally possessed. Intelligence is desirable in all classes of employment but is particularly needed in train service employees because they are often away from direct supervision and in time of stress must have that degree of thinking ability that will enable them to act on their own initiative, doing exactly the right thing and doing it quickly, if they are to be successful for themselves and for the road they represent.

While the idea of raising the standard of the personnel of a railroad is here presented with the thought in mind of saving fuel thereby, it should be apparent to all that the advantage gained will by no means be limited to that alone, but will permeate every line of activity of a transportation system.

The giving of prizes to those making the best records in fuel saving is not advocated. They are often awarded on a very narrow margin between worthy contestants, so narrow that chance or a slightly favorable advantage often determines the result. They are thereby almost disheartening to those who failed to gain them, but whose effort was equally creditable. Small bonuses that can be earned by a majority of the employees concerned are, perhaps, more fair. But, then, the thought comes that if the conditions of award are such that the major portion can win, the minority, working under the same conditions and drawing equal compensation, should be *required* to earn the bonus. Thus it, too, becomes of doubtful value. If the need of a stimulus is felt, it had best be in the nature of profit-sharing in the savings effected. However, still better than this would be the investment of any amount available for gifts in a manner that would make for a still larger saving of fuel.

Summary

Summarizing, then, the following is offered as a means of securing the utmost in fuel economy:

Operation

Reduce grades where feasible. Generally, this is being done as rapidly as possible for other reasons than that alone of fuel saving.

Eliminate unnecessary car and engine mileage and terminal switching by the appointment of a committee on each railroad, headed by a general operating officer, to study these questions and put in effect all economies possible; the committees of connecting lines to meet to consider wasteful practices regarding deliveries of cars to each other.

Overhaul the system of comparative statements and accounts so as to present no incentive to make movements that consume fuel but do not give any actual earnings. Do away with making certain overcharges to counterbalance shortages. Let the shortage show and make every effort to eliminate it, frankly acknowledging that which cannot be overcome. Make every fuel charge true and exact so that the records will mean something.

Give careful attention to the make-up of train schedules, calling in representative engineers and conductors on the districts under consideration to give advice as to the proper distribution of time, so the run may be made with the least effort.

Overhaul and rebuild locomotives during the slack season. Discontinue the practice of keeping a locomotive in service until a certain number of miles have been made regardless of excessive consumption of fuel due to worn out fireboxes, flues or machinery.

Organize fuel committees—or maintain them where already organized—one for each terminal, composed of local officials and a member from each branch of the service, meetings to be held at stated intervals to receive fuel saving suggestions, act on them and see to the enforcement of those adopted; one or more delegates from each terminal committee together with division officials to form the next higher or division committee to handle fuel matters that are beyond the jurisdiction of the terminal committees, the whole to be headed by a central fuel committee, composed of general officers, this committee to make findings in all cases that have failed of disposition in the lower committees and to have general jurisdiction over all.

Mechanical

Maintain locomotives in prime condition, paying particular attention to cylinders, pistons and cylinder packing; valves, rings and cages, as to fit; keeping the valves square; allowing no leaks either in firebox or front ends; keeping front ends airtight. Use the brick arch in firebox wherever possible.

See that tenders have sufficient coal carrying capacity without being loaded to a point where coal falls off to be wasted. Keep decks in smooth, level condition so the fireman may easily get just the amount of coal wanted on the scoop. Maintain a stop board on the right side of the shoveling sheet to keep coal from spilling out the gangway.

Water valves in injectors should have stems packed tight enough so they will stay where set. Feed water supply under perfect control makes for less fuel consumption and, in this connection, the use of one injector that has sufficient capacity to supply the boiler is more economical than the use of both where this is frequently necessary. In the one case the supply is steady and easy to fire against; the other requiring "slugging" to overcome uneven supply.

Draft appliances and grates should be of such design and adjustment as will best take care of the particular kind of fuel being used; boilers and flues kept free from scale; the latter also to be kept free from soot by frequent cleaning.

Where roundhouse facilities are short, additional house room should be provided as soon as possible. Enormous quantities of coal are uselessly consumed keeping engines alive and from freezing up during cold weather when they must be kept out of doors awaiting orders.

Close touch should be maintained between yard masters, train dispatchers and roundhouse forces to avoid getting engines under steam a long time before they are needed.

Heating and power plants should be of a size that will give the required supply without being forced, skillfully fired and well maintained. The dense black smoke rolling from most of the railroad plants indicates that (a) the plant is being forced, (b) is not being fired properly or (c) is in poor condition; any or all of which should be remedied.

All kinds of steam leaks should be stopped. They are frequently found on passenger trains, locomotives, heating plants—in fact, wherever steam is used.

Lights of all kinds consume fuel. See that none is in use when not needed. Have plenty of ventilation for health's sake but do not try to heat all outdoors during cold weather.

Education and Selection of Employees

Both old and new employees must be taught the rules of fuel conservation and be required to use them and obey their teachings. Persistent carelessness in the use of fuel should be treated the same as any other infraction of the rules.

The best means of instruction should be provided by the company and pains taken to make it pleasant for the employees required to take it. It should be made available at convenient hours, interfering with their earning time not at all, and with their recreation hours as little as may be consistent with the knowledge they must acquire.

Firemen and the younger engineers and shop apprentices in the machine and boiler departments should be required to have some technical knowledge of the science of combustion. This is equally desirable on the part of the older employees, but making it a rigid requirement would probably cause a degree of hardship that should be avoided. The situation, as to the old employees, will soon work itself out satisfactorily as they will gradually leave the service and, while in the service, they will pick up and use much of the fuel knowledge of the younger men.

The education of the younger and new employees should not be left to chance. Their remaining in the service should be dependent on attaining certain markings as to grade, these markings to be determined by periodical, progressive examinations.

Prospective employees should be selected in advance of their employment by means of an employing department. This does not mean that experienced men are not to be taken on as new employees. On the contrary, they are often valuable acquisitions to the service but should be required to pass the same requirements as new men and, furthermore, they should furnish satisfactory personal as well as railroad references.

New employees should be taken on probation with the understanding that they are in no sense a permanent part of the organization unless they show an aptitude for the work. It is an injustice to the individual as well as to the railroad to allow him to continue long in the service as a square peg in a round hole. Lack of success as a railroad man does not necessarily denote lack of ability and many a railroad failure has been highly successful in other lines. Consequently, both should be willing to sever connections for the good of each other.

Prizes and bonuses for excellent fuel records are to be discouraged.

The writer has faith in the use of an intelligence test in employing new men.

Service of 50 Per Cent Cut-off Locomotives*

The Simplicity of Two Cylinders Combined With Advantages of Compound and Three Cylinder Types

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Mechanical Engineer, Pennsylvania System

The 50 per cent cut-off locomotive may be defined as one which, in expansion ratio, approximates the compound locomotive, in uniformity of torque practically equals the three-cylinder locomotive, and in simplicity of parts is the same as an ordinary two-cylinder locomotive. The advantages which it provides are materially lower water rates and hence lower coal rates per indicated horsepower. The maintenance cost will be no greater; in fact, it may be slightly less on account of more uniform torque.

Since for certain advantages in any mechanism, it is usually found that there are certain features not so good as in the mechanism replaced, it is natural to inquire what is sacrificed. The piston pressure will have to be at least 25 per cent greater than for a locomotive with 90 per cent cut-off, which involves an increase in weight of reciprocating parts and counter-balance. This cannot be avoided. When the locomotive comes to rest with such a crank angle that all of the steam for starting must pass through only one of the auxiliary ports, it will take about half a minute in the worst case to build up pressure equal to boiler pressure in the cylinder. This does not happen with sufficient frequency to be taken into account on road engines.

The functional design features which differ from the ordinary locomotive and which involve little difference in cost and weight, are an increase of steam lap on the valve, a small auxiliary port cut through the valve bushing—one at each end of the steam chest—and a change in the ratio of the lap and lead lever to suit the increased lap.

Based on operation on the road, the average saving of steam in heavy service is at least 20 per cent. If an 80 per cent boiler is used, the coal saving should also be 20 per cent, but with a 100 per cent boiler the coal saving will be greater.

The increase of reciprocating weights, which is the only factor of a negative nature that need be considered, will be closely proportional to the increase of piston pressure. The revolving weights for the main wheels will also be increased, since the back end of the main rods and the main crank pins must withstand the increased piston pressure. The side rods, being designed to slip the drivers, require no modification as the weight on drivers need be no greater. These weight increases amount to about 1⅛ per cent of the total weight of a heavy Mikado locomotive.

If the increased piston pressure is obtained by increasing the boiler pressure, the weight of the boiler will be increased by an equal amount. To keep the same weight of locomotive, there will have to be a reduction of 1⅛ per cent if the pressure is not increased, or of 2¼ per cent when the pressure is increased, which will necessarily have to be taken from the size of the boiler. A reduction of 10 per cent in heating surface and the other features governed thereby, will fully meet this requirement.

From experience with simple engines, we know that the lowest water rates obtain between 20 per cent and 50 per cent cut-off. We also know that for starting, a cut-off of at least 80 per cent should be available. Train resistance, which the power of the locomotive must overcome, is large for starting, but drops quickly with increase of speed up to about 2½ miles an hour, and then gradually increases with increasing speed. The auxiliary port permits a cut-off of 80 per cent, but being restricted in size, its effect begins to diminish immediately after starting and to a large extent is neutralized by wire-drawing at about 2½ miles an hour.

Fuel and Water Rates

The formula for the pulling power of a locomotive consists of a coefficient representing the per cent of boiler pressure P available as mean effective pressure, which may be represented by the letter C and the engine constant $PD^2L \div W$, which may be represented by the letter V. The coefficient C is governed by the expansion ratio E and when drawbar pull for starting is involved, it is customary to use 90 per cent of the value that would obtain for theoretical calculations, based on the work done in the cylinders. For simplification P will represent gage pressure and not absolute pressure in this discussion. Drop in pressure, effect of cylinder clearance and back pressure will not be included. This procedure will not affect the results materially, since we are dealing with comparisons. These comparisons shall cover locomotives of the same type, weight and power, which will permit ignoring engine resistance, and base power comparisons on cylinder work only.

The formula for tractive force referred to above is $T = CV$. The value of C for the drawbar pull of a simple locomotive in starting is universally taken as .85. For tractive force, based on work in the cylinders (not at the drawbar) $C = \dfrac{2}{E + 1}$. For a cut-off of 90 per cent, $E = 1.111$, whence $C = .947$. Similarly, for cut-off of 80 per cent, $C = .889$, and for 50 per cent, $C = .667$.

The increase of 25 per cent in the value of V for the 50 per cent cut-off locomotive may be obtained either by increased cylinder dimensions, or by increased pressure, or by both.

The following assumptions are based on data, which is indicative, but not conclusive: For a locomotive with 90 per cent cut-off, C is .947 for starting, and at about 12½ miles per hour it is .85. For the 50 per cent cut-off locomotive, it is .889 for starting, .80 at 2½ miles per hour, and .667 at about 12½ miles per hour.

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*From a paper read before the New York Railroad Club, November 16, 1923.

To clearly show the difference between the two principles, in concrete form, let us assume the design of a Mikado locomotive to weigh 320,000 lb. in working order, which will have 90 per cent cut-off, 27-in. by 30-in. cylinders, 200 lb. boiler pressure and a maximum evaporation of 50,000 lb. of water per hour.

From formulations given by Professor Arthur J. Wood of Pennsylvania State College, in his book entitled Locomotive Operation and Train Control, the calculated formula for tractive force when worked to full boiler capacity for this locomotive is $T = 1{,}356{,}486 \div (10.121 + V)$, in which V = speed in miles per hour. The corresponding 50 per cent cut-off locomotive of equal weight would have 250 lb. boiler pressure, and a maximum evaporation of 45,000 lb. of water per hour. Its calculated formula for tractive force would be $T = 1{,}261{,}440 \div (7.451 + V)$.

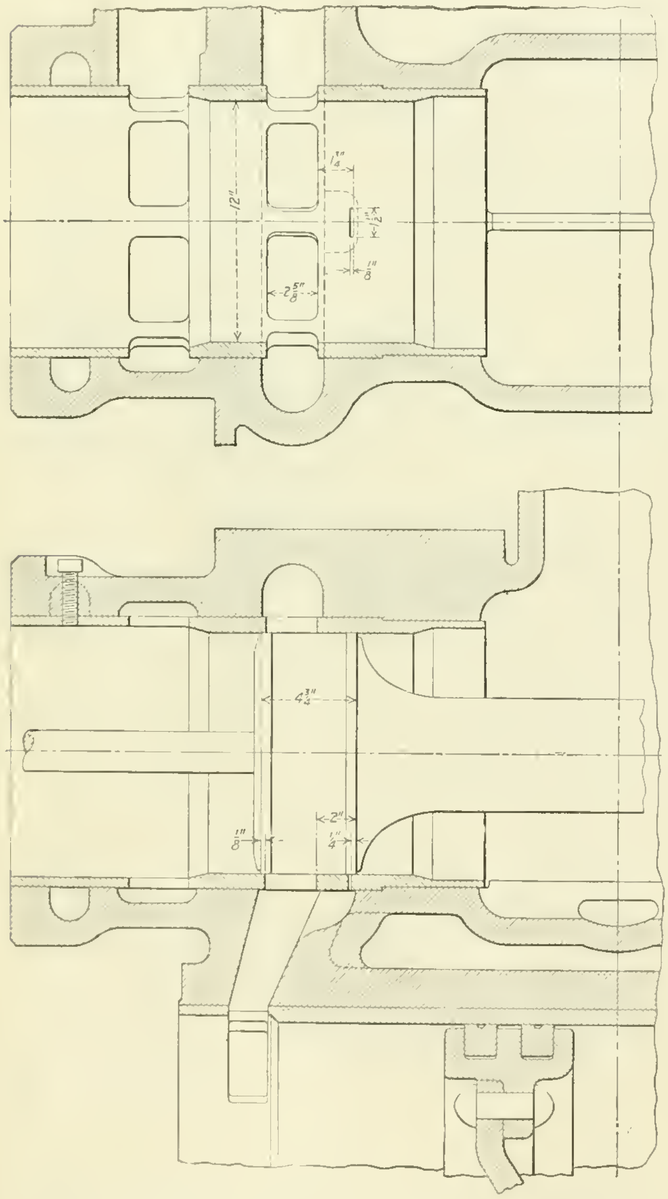

Fig. 1—Location of the Auxiliary Port in the Valve Bushing

Fig. 2 shows these tractive effort curves for comparison. The transition curve connecting the line for less than boiler capacity with the full boiler capacity line is empirical.

For full gear operation, when hauling heavy loads, it is readily seen that the relative steam consumption of the 50 per cent cut-off locomotive is 1.25 x .50 ÷ 90, or .694, a saving of 30.6 per cent of steam. For such operation, this would permit making the boiler 30 per cent less in value than that of the ordinary locomotive. Since on the equal locomotive weight basis it need only be 10 per cent less the excess boiler, for slow freight full-gear operation, will produce a coal saving greater in per cent than the water saving.

The water saving indicates that the 50 per cent cut-off locomotive working in full gear can go 44 per cent further before it must stop to take on water. From the tests of the Decapod 50 per cent cut-off locomotive, the formula developed for the ratio of the water rate to the coal rate is $W \div C = 10.622 - .000104125W$. This formula will answer for the comparison we wish to make, because the coefficient of the second term varies inversely as the value of the heating surface. The comparative formulæ would then be for the ordinary locomotive, $W \div C = 10.622 - .000104125W$, and for the 50 per cent cut-off locomotive, $W \div C = 10.622 - .0001157W$.

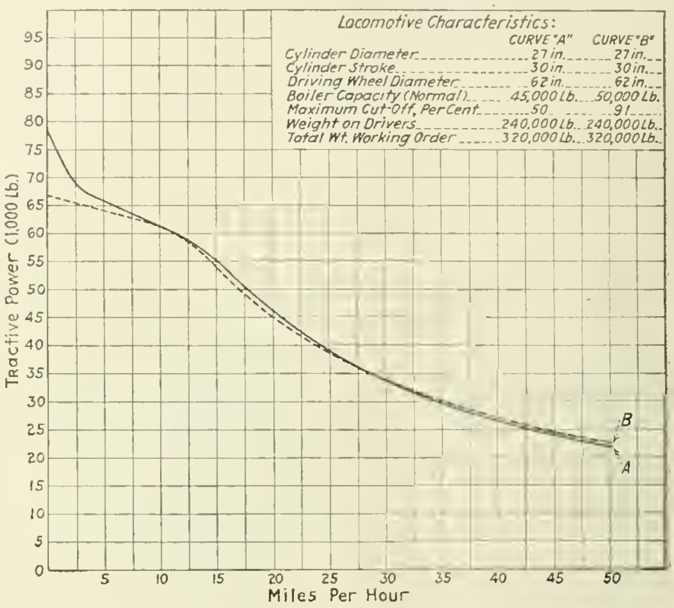

Fig. 2—A Comparison of the Tractive Force Produced by Locomotives, One with Full Stroke and the Other with Fifty Per Cent Maximum Cut-Off

If $W = 50{,}000$ for the ordinary locomotive and 30.6 per cent less, or 34,700 for the 50 per cent cut-off locomotive, $W \div C$ for the former is 5.42 and 6.61 for the latter, indicating a coal consumption for the latter of 57 per cent of that of the former, or a saving of 43 per cent, or an increased radius of operation, before taking on coal of 75 per cent. This is the extreme economy, which cannot be realized as an average in any kind of service, except possibly in shifting service.

Let us now investigate the water and coal saving, when both locomotives are working to full capacity at 20 miles per hour. For this speed, the formulæ for tractive force give 45,034 lb. for the ordinary locomotive and 45,952 lb. for the 50 per cent cut-off locomotive, which, therefore, furnishes slightly more power with 10 per cent less steam and coal. By placing the values for T for the two locomotives equal to each other in the formulæ for tractive force and solving for V, it will be found that the 50 per cent locomotive with a 90 per cent boiler will furnish more power for all speeds up to 28.46 miles per hour, at which speed they are equal in power, but the former uses 10 per cent less fuel and water.

Torque

The torque for the 50 per cent cut-off locomotive is practically as uniform as that of a three-cylinder locomotive with crank axle. A careful analysis of the ratio of maximum to minimum tangential pressure for a three-cylinder and a two-cylinder locomotive, both with 50 per cent cut-off, resulted in a ratio of 126¼ per cent for the former and 126⅔ per cent for the latter. Another analysis for the same ratio for two-cylinder simple locomotives, one with 90 per cent cut-off, and the other with 50 per cent cut-off, and main rods 7⅓ times the length of the crank arm, resulted in a ratio of 158 per cent for the former and 131 per cent for the latter.

Figs. 3 and 4 show the tangential turning force exerted on the wheels of the Mikado locomotive, assuming a ratio of length of main rod to crank of 8.6. Fig. 3 represents that for the 90 per cent cut-off locomotive, giving a maximum torque of 125.3 per cent, and Fig. 4 that for the 50 per cent cut-off locomotive, giving a maximum torque of 113.6 per cent. For the latter this would permit an increase in cylinder pressure of 10 per cent without increasing the danger of slipping.

No hard and fast rules can be formulated on account of variations in main rod and crank lengths, but from studies thus far concluded, the indications are that the ratio of maximum to minimum tangential pressure is at least 20 per cent greater at 90 per cent cut-off than at 50 per cent cut-off. At speed, for earlier cut-off points, the uniformity of torque depends mainly on careful arrangement of the valve events, based on the weight of reciprocating parts.

Uniformity of torque decreases the possibility of slipping, and tends to decrease the wear and tear of the machinery to some extent. Consequently, the ratio of cylinder tractive effort to weight on drivers may be increased, or with the same ratio, the slipping will be materially decreased.

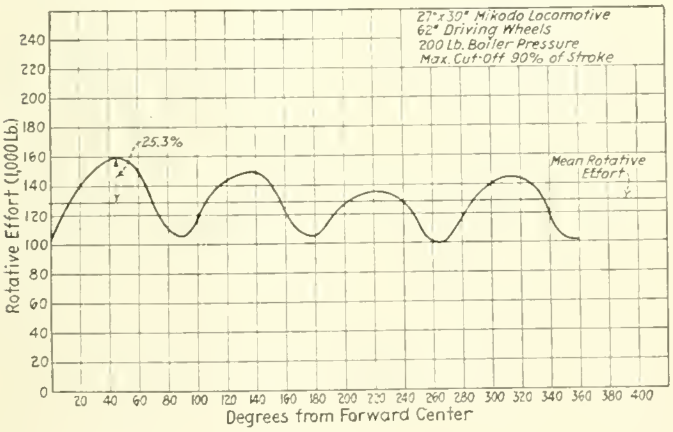

Fig. 3—Tangential Force Curve for Locomotive with 90 Per Cent Maximum Cut-Off

We may expect an average saving of about 20 per cent in favor of the 50 per cent cut-off locomotive for slow speed and heavy service; a saving of 10 to 15 per cent in fast freight service, and a saving of nearly 10 per cent for medium loads and high speeds.

The increased reciprocating weights must be given due consideration. For slow speed, the effect thereof is of little importance. For high speed, these increased weights are much more important. For high speed passenger service, it may be assumed that the negative effect of the 25 per cent increase of reciprocating weights balances the positive effect of a possible 10 per cent saving in coal and water.

On the other hand, when considering slow speed freight service, the effect of increase in reciprocating weights is negligible and the saving of 20 per cent of coal becomes paramount.

Four or five years ago extensive tests were made of a 50 per cent cut-off locomotive on the locomotive test plant at Altoona, Pa., which were described in Pennsylvania Test Department Bulletin No. 31.* The locomotive tested was a 2-10-0 type designed to be capable of furnishing 25 per cent more power than the 2-8-2 long cut-off locomotive, with which it was compared. Both locomotives were hand fired, were equipped with Type A superheaters, and had no feedwater heaters. These locomotives may be compared for economy, which is not affected by capacity. The maximum thermal efficiency for the 2-8-2 was 7 per cent and for the 2-10-0 was 8.1 per cent.

In the tests of the 2-8-2, including only four tests above 60 per cent cut-off and none in full gear, the average coal per indicated hp. was 2.83 lb. In the tests of the 2-10-0, of which 30 per cent were at 45 per cent and greater cut-off, the average coal per indicated hp. was 2.57 lb., a decrease of 9.2 per cent, on a basis very unfavorable to the 2-10-0. This shows that, under adverse conditions for the 50 per cent cut-off locomotive, it still shows a material saving over the long cut-off locomotive at its best points of operation.

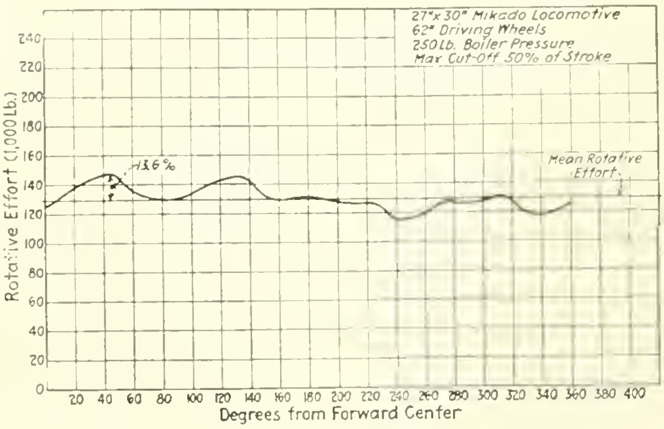

Fig. 4—Tangential Force Curve for 50 Per Cent Cut-Off Locomotive

The advantages in economy of the 50 per cent cut-off locomotive can best be seen from Figs. 5 and 6, copied from Bulletin No. 31, on which the steam rates at 140 r.p.m. have been transferred from Fig. 6 to Fig. 5 and, correspondingly, the 40 r.p.m. line and the full gear cut-off line from Fig. 5 to Fig. 6. The full gear cut-off line is marked "55 per cent cut-off" because it represents a higher mean effective pressure than would be realized at 50 per cent cut-off.

The following remarks relate only to values between 40 r.p.m. (7.38 miles per hour), and 140 r.p.m. (25.83 miles per hour) and tests at water rates not less than 30 per cent of boiler capacity. From Fig. 5 it will be noted that the highest water rate per indicated horsepower is 19.5 lb., which rate cannot be exceeded with the 50 per cent cut-off locomotive regardless of how the locomotive is operated. From Fig. 6 it will be seen that a water rate per indicated hp. of 31.8 lb. can be reached with the 90 per cent cut-off.

Slow freight locomotives are often operated for extended periods of time in full gear and shifting locomotives are seldom operated otherwise than in full gear. It is customary to provide shifting locomotives with relatively larger grates on this account. From these tests, it is clear that a 50 per cent cut-off shifter should save at least one-third of the water which would be used by a long cut-off shifter. This would increase its radius of operation per unit of water by 50 per cent, would permit reducing the grate area by more than one-third, and, if the boiler is not otherwise changed, would increase the water evaporation per pound of coal for the same power by 25 per cent. The coal saving would be more than 45 per cent. At higher speeds and other cut-off points, the saving in water and coal is less.

From these diagrams it is possible to compare any kind of operation and determine the economy. The important

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*For a description of these tests see the *Railway Mechanical Engineer* for April, 1920, page 193.

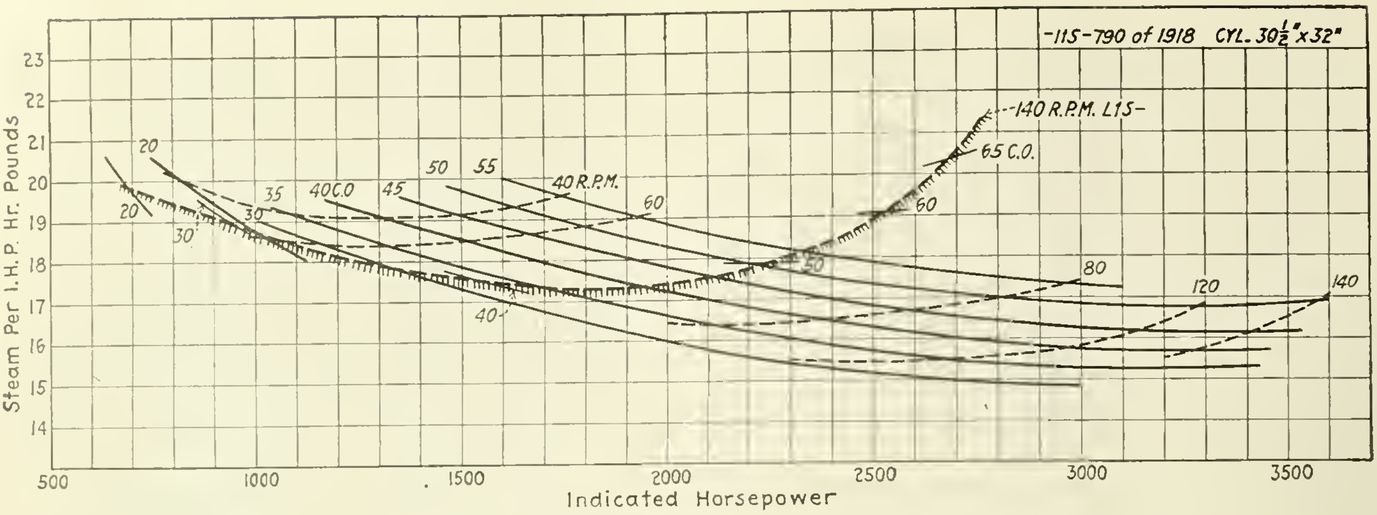


Fig. 5—Water Rates of a Decapod Locomotive with Fifty Per Cent Maximum Cut-Off Compared with the Water Rate of a Mikado Locomotive of the Ordinary Type at About 26 Miles an Hour

feature that they disclose is that the locomotive crew is absolutely prevented from working at uneconomical water and coal rates.

In Fig. 5 the heavy broken line, representing the 2-8-2 locomotive at 140 r.p.m. shows that the best water rate is 17.3 lb. per indicated hp. Correspondingly, the 2-10-0 indicates a minimum rate of 15.3 lb. per indicated hp., or 11.6 per cent less. Hence the tests indicate a saving of water from 11.6 per cent to 38.7 per cent, showing that the estimates in the fore part of this paper are conservative.

The actual coal saving is dependent on the value of the boiler used on the locomotive. It will be apparent that, in nearly every case, an oversize boiler can be utilized. This would result in a coal saving greater in per cent than the water saving. The boiler for the 2-10-0 locomotive tested is an undersize boiler. The minimum coal rate for the tests was 2 lb. per indicated hp.-hr. The coal rate did not exceed 3 lb. per indicated hp.-hr. for all water rates less than 52,000 lb. per hour.

Later locomotives of this type were equipped with the Type E superheater, a feed water heater, and a stoker. Tests have been made, but the report has not been completed. The use of the Type E superheater in the same boiler results in greater heating surface. A number of tests showed a coal rate less than 2 lb. per indicated hp.-hr., the lowest being 1.79 lb., or 10 per cent less than the best performance of the hand-fired locomotive with the Type A superheater.

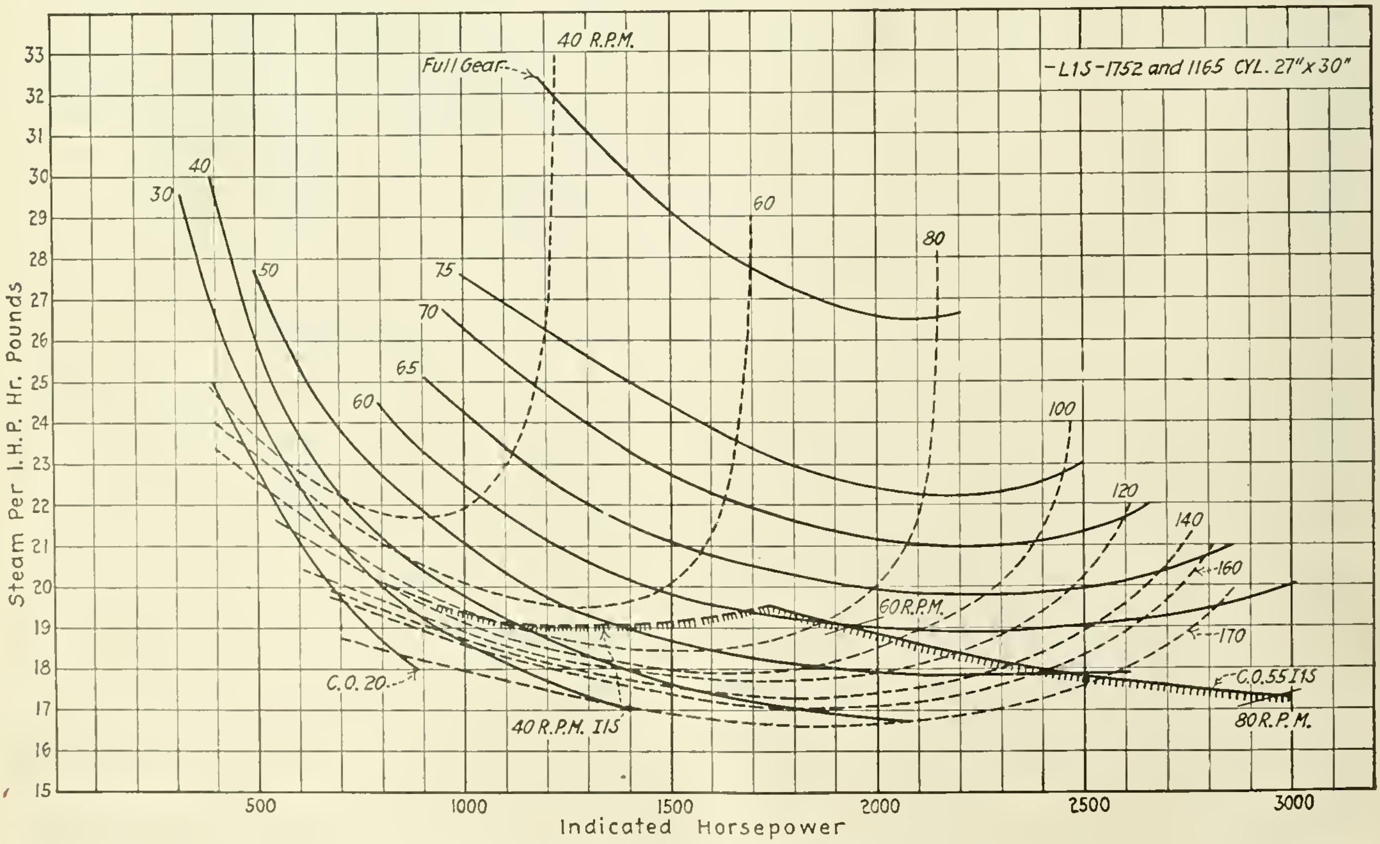
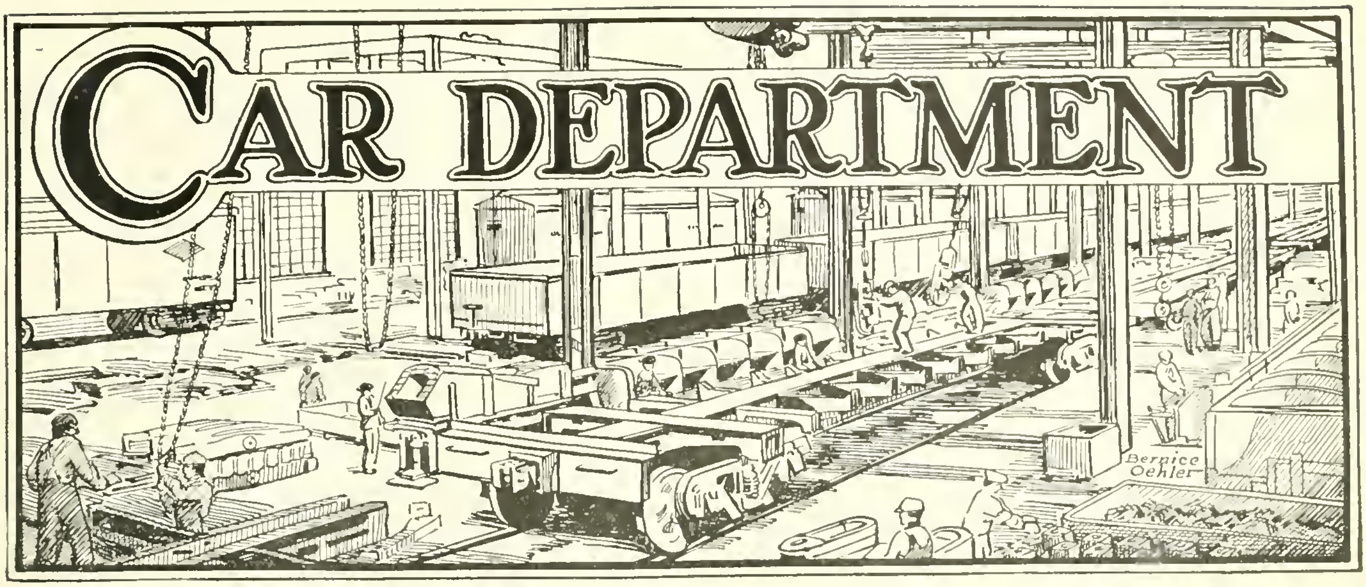


Fig. 6—Water Rates of a Mikado Locomotive of the Full Stroke Cut-Off Type Compared with Those of a Decapod of the Fifty Per Cent Maximum Cut-Off Type at Seven Miles an Hour and at Higher Speeds with Maximum Cut-Off



A Mathematical Law of Impact Between Cars*

Conclusion of a Study of the Time of Draft Gear Closures Which Began in Last Month's Issue

By E. M. Richards

At the conclusion of last month's installment, it will be remembered that, by substituting equation (6) in equation (7) and simplifying, we had arrived at

$$\frac{dx}{dt} = \sqrt{\frac{6g(W_a + W_b)}{W_aW_b}(F's' - fx)}$$

Before this expression can be used in integration, the variable *f* must be expressed in terms of *x*. This can be done as shown in Fig. 2, from the triangular relation that the force *f* at any travel *x* is to the maximum force F^1, for a given impact, at the corresponding maximum travel s^1 (not necessarily the maximum possible travel of the gear) as *x* is to s^1. That is

$$\frac{f}{F'} = \frac{x}{s'}$$

Or

$$f = \frac{F'x}{s'} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

Substituting (9) in (8)

$$\frac{dx}{dt} = \sqrt{\frac{6g(W_a + W_b)}{W_aW_b}\left[F's' - \frac{F'}{s'}x^2\right]}$$

$$\frac{dx}{dt} = \sqrt{\frac{6gF'(W_a + W_b)}{W_aW_bs'}\left[(s')^2 - x^2\right]}$$

We now have a differential equation in terms of the gear travel *x* and time *t* which can be put into shape for integration, thus

$$\int_0^t dt = \sqrt{\frac{W_aW_bs'}{6gF'(W_a + W_b)}}\int_0^{s'}\frac{dx}{\sqrt{(s')^2 - x^2}}$$

$$t = \sqrt{\frac{W_aW_bs'}{6gF'(W_a + W_b)}}\left[\sin^{-1}\frac{x}{s'}\right]_0^{s'} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

$$t = \sqrt{\frac{W_aW_bs'}{6gF'(W_a + W_b)}}\left[\sin^{-1}\frac{s'}{s'} - \sin^{-1}0\right]$$

$$t = \frac{\pi}{2}\,\frac{1}{\sqrt{6g}}\sqrt{\frac{W_aW_b}{W_a + W_b}\,\frac{s'}{F'}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

Now the maximum gear travel, s^1, of the given impact is to the maximum possible travel of the gear *s*, as the maximum resistance of said impact is to the resistance of the gear at its maximum possible travel *s*, viz.,

$$\frac{s'}{s} = \frac{F'}{F} \text{ or } \frac{s'}{F'} = \frac{s}{F}$$

Substituting this and also $\frac{\pi}{2} \times \frac{1}{\sqrt{6\,g}} = .113$ in (11)

$$t = .113\sqrt{\frac{W_aW_b}{W_a + W_b}\,\frac{s}{f}} \quad \ldots\ldots\ldots\ldots(12)\ldots\ldots\ldots\ldots\text{Formula}$$

This formula may also be expressed in terms of work taken up by the gears. To accomplish this, the numerator and denominator of the fraction $\frac{s}{F}$ may be multiplied by $2 \times 2 \times s \times 12$, thus

$$\frac{s}{F} = \frac{2 \times 2 \times s \times 12\ s}{2 \times 2 \times s \times 12\ F} = \frac{\frac{s^2}{12}}{2 \times \frac{sF}{2} \times \frac{1}{12}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(13)$$

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*Since the publication of the first installment of Mr. Richards' article, he has called our attention to two typographical errors in the equations as they appeared in the November issue. Near the top of page 762, where equation (2) is substituted in equation (1), the first parenthesis inside the bracket was misplaced. The equation should read:

$$\frac{dx}{dt} = 6\left[\frac{dS_a}{dt} - \left(\frac{W_aV_a + W_bV_b}{W_b} - \frac{W_adS_a}{W_bdt}\right)\right]$$

In equation (6), shown in the middle of the second column of the same page, two equations are shown as one continuous equation. These should have read as follows:

$$W_aW_b(V_a^2 - 2V_aV_b + V_b^2)\ \frac{gF's'}{6}\ (W_a + W_b).$$

$$(V_a - V_b)^2 = \frac{gF's'}{6}\,\frac{W_a + W_b}{W_aW_b} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

But $2 \times \frac{sF}{2} \times \frac{1}{12}$ equals the work taken up by both gears, or E. Whence (13) becomes

$$\frac{s}{F} = \frac{1}{12}\,\frac{s^2}{E} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Substituting (14) in (12)

$$t = .113 \sqrt{\frac{W_aW_b}{W_a + W_b}\;\frac{s^2}{12E}}$$

$$t = .0327\,s \sqrt{\frac{W_aW_b}{(W_a + W_b)E}} \quad \ldots\ldots (15) \ldots\ldots \text{Formula}$$

The dependability of these formulæ may be tested by comparing the values computed therefrom with the U. S. R. A. test results.

To secure such comparison, the times have been calculated with equation (15). This has been used in preference to equation (12) because the former, due to the quantity E, covering the whole period of closure, tends to average gear curve irregularities, whereas equation (12) does not, as the evaluation of the latter depends upon the ratio $\frac{s}{F}$, which ratio obtains at the end of full gear travel and which may be entirely different on earlier portions of the curve.

This equation (15), by using the values of 143,000 pounds for W_a and W_b, as given on page 82,* may be simplified to

$$t = .0327\,s \sqrt{\frac{143{,}000 \times 143{,}000}{143{,}000 + 143{,}000}\;\frac{1}{E}}$$

$$t = \frac{8.72\,s}{\sqrt{E}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

The values of E used in equation (16) are one-half of those in column 19, pages 122 and 123. These halved values are taken because substantially half of the kinetic energy in the striking car just before impact is taken up by the gears and car bodies at maximum gear travel, for the conditions obtaining in the U. S. R. A. tests. The value of E thus used includes the work done by the car bodies, as already mentioned, which work must be considered, as the car bodies do their share in influencing the time of compression. For the same reason s is taken in the formula as the sum of the yield of the car bodies and the full gear travels; that is, it is the average of the values in columns 12 and 13 plus one-half the values in column 14 on pages 122 to 123.

In this manner were obtained the computed times in Table II. In comparing these with actual test values, it should be remembered that the formulæ were developed from a straight line relation between gear resistance and gear travel, as shown by curve a of Fig. 1, that the curves of most of the gears do not follow this relation, and that the more they deviate therefrom, the more the two sets of values must be expected to disagree. Notwithstanding these factors, however, it can be seen that in most cases the calculated and test figures check within a few per cent. Accordingly, the reliability of the formulæ is established.

The foregoing formulæ, in addition to furnishing a means of closely calculating time of gear closure, also reveal some very interesting facts about impact.

Gear Travel

For given gears in given cars, the times of all maximum gear closures, whether partial or full, are the same when the resistance-travel curve is a straight line.

This is evident from the following: Equation (11) contains the quantity s, any maximum gear travel for a given impact. As shown in equation (9), however, s and its corresponding gear resistance f vary in the same proportion; consequently, the change in value of each at different gear travels cancel, so that the final result is always the same. This is shown in equation (12), where it is worked out from equation (11), and it can be seen that the time t for any gear travel s is equal to the time to close the gear at full travel s.

For given gears in given cars, the times of maximum closure for various impacts decrease as the gear travel of the respective impacts increase when the travel-resistance curve is upward.

Since, in a straight line relation, where the resistance increases in direct proportion to the gear travel, the time for all degrees of maximum gear closure are the same, as already shown, it stands to reason that when the resistance increases at a greater rate than the travel, as when the curve bends upward, the time of closure for different impacts must decrease as the maximum gear travel increases.

For given gears in given cars, the time of maximum closure for various impacts increases as the gear travel of the respective impacts increase when the travel-resistance curve is downward.

This is self-evident, as it is the opposite of the conditions of the preceding paragraph.

The relation between time and distance of travel to different points along the path of gear travel during a particular impact follows substantially a sine curve.

This is shown by equation (10) and the movement-time curves of the U. S. R. A. tests. This statement must not be confused with the preceding discussion. The present statement concerns the relation between the distance from the start of gear travel up to the various points it passes on the way to maximum gear travel and the time to reach said points during any given impact; the preceding discussion covers a comparison of the times to reach the various maximum gear travels (not necessarily full gear travel) at various impacts and has nothing to do with the time to reach the points passed over on the way to these maximum travels. Naturally, on a particular impact, the gear comes to half maximum travel sooner than the maximum travel itself. As evident from equation (10), the time to reach the half-way point is to the time to come to the maximum point itself as the $\sin^{-1} \frac{1}{2}$ is to $\sin^{-1} 1$, or $\frac{\pi}{6}$ to $\frac{\pi}{2}$. Only when the resistance-travel curve is a straight line, however, is the above-mentioned relation a true sine curve.

Car Weight

For given gears in given cars, the heavier either car is made, the longer the time of maximum gear closure.

This can be seen from the expression $\sqrt{\frac{W_aW_b}{W_a + W_b}}$ in equations (12) and (15). This relation in Fig. 3 is shown with W_a as abscissæ (horizontally) and the comparative time of closure as ordinates (vertically) on the basis of $\sqrt{\frac{W_a}{W_b}} = 1$ when both W_a and W_b are 40,000 lb.; the curves are for car B with weights of 40,000 lb., 90,000 lb. and 140,000 lb., respectively. To prove the above statement, take car B with a weight of 40,000 lb. and car A with 40,000 lb. According to the curve, the ratio is 1; with the weight of car B remaining at 40,000 lb. and that of car A increased to 140,000 lb., the ratio increases to 1.25. In other words, with this increased weight, the time of closure increases 25 per cent.

For given gears in given cars, with the sum of the weights of both cars remaining constant, the time of closure of a given gear is longest when the weight is equally divided between the two cars.

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*This and other similar references in this article are to the pages of the Report of Draft Gear Tests, published in 1921, by the Simmons-Boardman Publishing Company, covering the U. S. R. A. tests.

This can also be seen from Fig. 3. Take the above case with car A weighing 140,000 lb., car B 40,000 lb. and the ratio 1.25. If this weight be equally divided between the cars, each will weigh 90,000 lb. and the curves then show the ratio to be 1.50. In other words, the time increases in the ratio of 1.50 to 1.25. This, together with a number of similar examples, will bear out the statement preceding this paragraph.

For given gears in given cars, the weights of the cars may be interchanged without affecting the time of gear closure.

This is self-evident from the expression $\sqrt{\frac{W_a W_b}{W_a + W_b}}$. It should be noted that, as just mentioned, a change in car weight changes the time of draft gear closure, but, as previously proved, the time for all degrees of closure for a given gear are substantially the same for any particular combination of car weights.

Car Velocity

Car velocities have no influence upon the time of closure.

It will be noted that the mathematical considerations were started by ascribing any velocities V_a and V_b to car A and car B and these velocities soon dropped out of the mathematical expressions, indicating that they had no bearing on the closure time. Stated in other terms, both cars moving around 5, 25, or 50 m.p.h. have the same time of draft gear closure. Similarly, the velocity difference between the cars does not influence the closure time. The greater the velocity difference between cars, of course, the farther in the gears will be driven; but as already proved, the times of gear travels, whether much or little, are substantially the same in each instance. These statements concerning car weight and car velocity are only approximately correct.

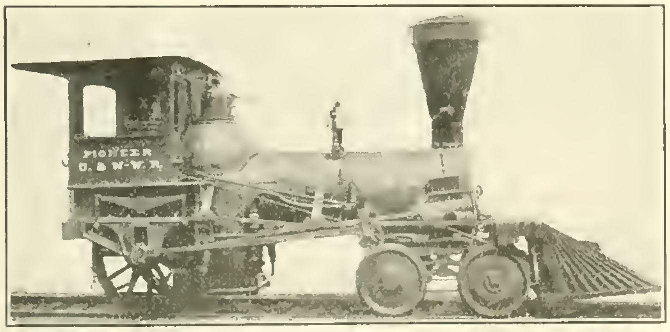
Conclusion

This concludes the studies of the present article. It is worth noting in this connection that all that has been stated concerning impact between cars applies equally well to impact between any two bodies, and, consequently, that this article is in reality a study of impact in the broad realm of general physics itself.

It should be noted further, that for the first time are given herein formulæ for calculating the time of gear closure, a classification of the effects of the dynamic resistance-closure relation of car weights and of car velocities on this time and the comparative times of movement to various points along the path of gear travel during any particular impact.

To the railway man, in particular, the foregoing should prove helpful in studying actions in short and long trains, both with and without the brakes applied, and to the draft gear manufacturer, quite valuable when contemplating gears of new design.

* * *

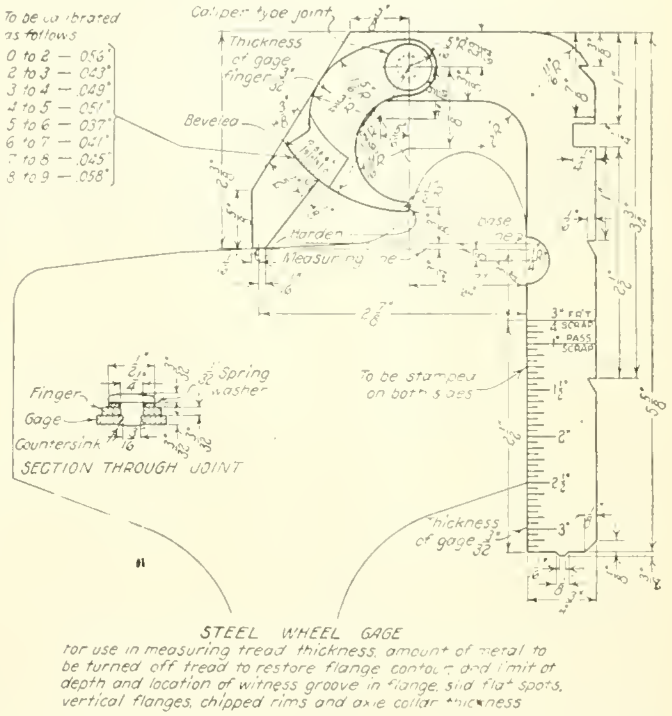


The North Western "Pioneer," First Locomotive to Enter Chicago; It Arrived on Board the Brig "Buffalo" on October 10, 1848

New Standard Gage for Steel Wheels

THE Committee on Wheels of the Mechanical Division of the American Railway Association, in its report presented at the 1923 meeting of the division, recommended the adoption of a new gage for the measurement of service metal on wrought steel wheels to take the place of the then standard gage, which has not been found satisfactory. The methods of application of the gage proposed by the committee were clearly illustrated on pages 458 and 459 of the July *Railway Mechanical Engineer*, in which appeared the report of the Wheel Committee.

In Circular No. DV 321, issued on November 26, 1923, the Mechanical Division announced that this gage had been approved by letter ballot and that the necessary changes in the Interchange Rules, required in connection with its use, have been made and will become effective January 1, 1924. The circular calls attention to the fact that measurements of service metal on wrought steel wheels for billing purposes must be made with the new gage, or an approved equivalent, from January 1, 1924, before which time it will be necessary for the members to supply themselves with these gages.


To be calibrated as follows
0 to 2 — .056"
2 to 3 — .043"
3 to 4 — .049"
4 to 5 — .051"
5 to 6 — .037"
6 to 7 — .041"
7 to 8 — .045"
8 to 9 — .058"
Caliper type joint
Thickness of gage finger 3/32"
Beveled
Harden
Base line
Measuring line
2 7/8"
3" FR'T SCRAP
PASS SCRAP
To be stamped on both sides
1 1/2"
2"
2 1/2"
3"
Thickness of gage 3/32"
5 5/8"
Finger
Gage
Countersink
Spring washer
SECTION THROUGH JOINT
STEEL WHEEL GAGE
for use in measuring tread thickness, amount of metal to be turned off tread to restore flange contour and limit of depth and location of witness groove in flange, slid flat spots, vertical flanges, chipped rims and axle collar thickness

Form of Steel Wheel Gage Recently Adopted by Letter Ballot. The Use of This Gage Is Required by Interchange Rules Effective January 1, 1924

The gage may be secured from commercial manufacturers of gages, or may be manufactured by the railroads themselves. Some slight modifications have been made in the form of the gage since the publication of the report of the committee. The illustration shows in detail the present standard form as adopted by letter ballot.

The Union Pacific has recently been running locomotives on passenger trains, through, between Kansas City, Mo., and Denver, Colo., 640 miles, where four engines had been required. Prior to the change four light Pacific type locomotives were used on 15-coach trains with changes at Junction City, 140 miles from Kansas City; Ellis, 163 miles farther, and Sharon Springs, 127 miles; thus leaving a run of 210 miles into Denver for the fourth locomotive. The light type Pacific engine has been replaced by a heavy type.

Car Inspectors and Car Foremen Compare Notes

1923 Convention Listens to Inspiring Addresses and Discusses Billing and Interchange Rules

THE feature of the 1923 convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held October 3, 4 and 5 at the Hotel Sherman, Chicago, was unquestionably the interesting addresses delivered before well attended sessions. These addresses, together with the discussion which followed them, were not only interesting but inspiring as pointing out practical means by which members of the association can cooperate in overcoming wasteful practices and improving the efficiency of railroad operation. The first address was on "Lubrication," by M. J. O'Connor, special mechanical inspector, N. Y. C., T. A. Ward, district freight claim agent, N. Y. C., presented a paper on "Prevention of Loss and Damage to Freight," and there was a joint paper on "Maintenance of Equipment," by A. S. Sternberg, master car builder, Belt Ry. of Chicago, and F. C. Shultz, chief interchange inspector, Chicago. A. J. Mitchner, division general car foreman, Michigan Central, and W. J. Owen, chief interchange inspector, Pekin, Ill., read the papers on Car Inspection which won first and second prizes in the *Railway Mechanical Engineer* contest.

Election of Officers

On the last day of the convention the following new officers of the association were elected for 1924: President, W. T. Westall, special inspector, N. Y. C., Cleveland, Ohio; first vice-president, C. M. Hitch, district master car builder, B. & O. Cincinnati, Ohio; second vice-president, W. P. Elliott, general foreman, Terminal Railroad Association, East St. Louis, Ill., and secretary, A. S. Sternberg, master car builder, Belt Railway of Chicago.

Four new members were elected to the executive committee as follows: G. J. Charlton, general car foreman, O. S. N., Buffalo, N. Y.; E. G. Chenoweth, superintendent car department, C. R. I. & P., Chicago; J. G. Bannon, general car foreman, C. P., West Toronto, Ontario, and A. G. Richards, traveling car foreman, Chicago & Alton, Bloomington, Ill.

Since changes in the rules of interchange become effective January 1, 1924, the discusion of these changes will be published complete in this issue, most of the addresses being printed later.

Discussion of Interchange Rules

With A. Armstrong, president of the association, in the chair the first question raised was regarding the scope of the discussion.

C. F. Straub (Reading, Pa.): I want to offer this motion, as a preface to our proceedings, in regard to discussion of the rules. The motion was made that all previous documents, opinions or discussions of committees reported to individual railroads by the secretary of the Mechanical Division, and not later incorporated in the rules as part of such rules for interpretation of same or reported as arbitration cases, shall be disregarded. Also, that all questions decided shall be by vote in open meeting to show the approval of this Association, and shall be reported by the secretary to the proper committee of the Mechanical Division, A. R. A., for action at the next annual meeting or otherwise, and such approval by this Association shall be recognized as just a proper practice until the decision in regular form has been announced by the Secretary of the Mechanical Division.

The motion was duly seconded and carried.

Rule 2

The Committee recommends that section (b), third paragraph, of this rule be modified to read in accordance with proposed form shown below

PROPOSED FORM—A leaky tank car shall have stenciled *on both sides,* in letters three inches in size, adjacent to the car number, the words "Leaky Tank. Do not load until repaired," and the owner shall be immediately notified. Stenciling must not be removed until the tank is repaired.

REASON—To improve the rule in the handling of such cars by requiring the stenciling to be shown on both sides of car.

F. W. Trapnell (Kansas City, Mo.): I understand that while we are using this pamphlet which was the proposed form from the Arbitration Committee to the A. R. A. Mechanical Division for adoption, they were adopted, and they will be practically our rules for the coming year, so I think we ought to leave out that matter of proposed, because that is what they will be.

T. S. Cheadle (R. F. & P.): I noticed on one or two cars recently it was mighty hard to comply with the rules by stenciling adjacent to the number. There are cases where the conditions are such that it is a hard matter to get it adjacent. I suppose if you get it as nearly adjacent as possible it will be satisfactory.

Chairman Armstrong: I think it would be perfectly satisfactory, if you cannot stencil adjacent to the number, to get it as close to it as you can.

"The Committee recommends that a new paragraph be added to section (f) of this rule as follows:

For inside door protection, the car transfer check as shown on page 172, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section G. A. R. A. Car Service Rule 14.)

REASON—To conform to joint recommendation of Committee on Car Service of the Transportation Division, A. R. A. and Arbitration Committee, Mechanical Division, making originating road responsible for absence of or improper inside door protection. This recommendation has been approved by the General Committee of both Divisions and the necessary changes in Car Service Rule 14 were approved at the session of the Transportation Division at Chicago, April 25, 1923."

C. F. Straub (Reading, Pa.): Should we not, at this time, clarify that in some way, so there is a general understanding that this work can be charged for according to rules 101 and 107? I make that as a motion.

T. J. O'Donnell (Buffalo, N. Y.): Our officials had this matter under consideration in our Association. The executives are to act on this at a meeting in a few days; that is, the Executive Committee of our Association, and I wondered whether you have given any consideration to it. The prices that we charge (the twelve roads that I have the honor to work for) are $11 a flat rate for the transfer and $4 for the adjustment of lading, net. Inasmuch as this is in our A. R. A. rules, I am wondering if we should not recommend or at least have an understanding that the labor rates should govern, $1.10 on all such work. The A. R. A. adopted this as a mechanical rule, and I really think there ought to be something from this Association so we will have some stable recommendation to give.

[After an extended argument as to whether this was a mechanical or transportation expense, action was taken as follows.—Editor.]

Chairman Armstrong: We are not getting anywhere, and I do not believe you men want to take up an hour or two discussing this matter. There is a motion before the house that we recommend a flat rate of $3.75 for adjustment and $11 flat for a transfer. This motion has been made and duly seconded.

A. S. Sternberg (Belt. Ry. of Chicago): Eleven dollars for transfer does not enter into the motion; just the adjustment of the lading.

Chairman Armstrong: As many of you who will approve the rate of $3.75 for adjustment of the load, as we have been talking about, for inside door protection, will manifest the same by saying "aye"; contrary, "no."

The motion was lost.

Mr. O'Donnell (Buffalo, N. Y.): I am going to ask if you will consider this motion: The chief interchange inspectors respectfully suggest that the subject matter be referred to the Transportation Division, with the recommendation that an equitable flat rate be adopted, which can be agreed upon by that body and will make the matter more conclusive and simple to handle.

The motion was seconded and carried.

Rule 3

The Committee recommends that section (o) be modified in accordance with proposed form shown below:

PROPOSED FORM—(o) Cars built after November 1, 1920, will not be accepted from owner unless equipped with 6 in. by 8 in. shank A. R. A. Standard Type "D" couplers.

REASON—To prevent the transfer of lading en route and to require car owner to comply with the rules.

A. C. Campbell (N. Y. C. & St. L.): In reference to this paragraph (o): Some railroads are practically rebuilding a great many cars; that is, putting more than 75 per cent of new material in them and stenciling them as being newly rebuilt, and the reason of their doing that is that their center sills probably did not have the proper spread to take a 6-in. by 8-in. coupler, and they wanted to use up their old 5-in. by 7-in. couplers.

We are having trouble with some of these cars being refused from the owners under load, some of them with perishable freight and, under this section as adopted by the Association, they can't be accepted from the owner. They can be accepted in interchange from somebody else on the road, but they would not be accepted from the owner. Is it policy to turn down a loaded car with perishable freight just because they have a 5-in. by 7-in. coupler and they have a new car, whereas they will accept an old car, probably ten, fifteen or twenty years old with a 5-in. by 7-in. coupler that is not in good condition and go right along? I would like to know if the joint inspectors should issue a transfer card against that car and allow it to be transferred.

Chairman Armstrong: The Chair will answer your question as to transfer. There is no provision whatever.

Rule 17

The Committee recommends that a new section be added to this rule to be designated as section (i) and to read as follows:

The application of cast iron wheels cast after June 30, 1924, of nominal weight less than 650.700 and 750 lb., shall be considered as improper repairs.

REASON—To conform to recommendation from Committee on Wheels to prohibit the use of wheels lighter than the standard of the Association.

P. G. Zachretz (Soo Lines): I take it from that, that in making out our wheel repair card we will have to state both passenger car and freight car and the size of the wheels applied; that is, the weight of the wheels applied, in order to give the ruling line the proper information.

M. E. Fitzgerald (C. & E. I.): It isn't necessary for the owner to get joint evidence. The billing repair card will state that information.

The Committee recommends that interpretation No. 7 of this rule be modified in accordance with proposed form shown below:

PROPOSED FORM—(7) Q. No change.

A. The substitution of the Schaeffer patented brake lever connection does not constitute wrong repairs. If such connection is not standard to any of owner's cars, charge for same should not exceed cost of that of owner's standard.

Mr. Straub: I move the secretary be requested to obtain prices for those Schaeffer brake connections, arbitrary prices, so we will know where we stand on those parts.

Chairman Armstrong: I think that will be taken care of by the Price Committee; under the new rules, you will have that, so I do not think it is necessary.

REASON—It is felt that it is reasonable for car owner to accept charge for this device where used by owner even though not yet applied to the particular car in question.

Rule 98

The Committee will designate all paragraphs of this rule with letters for ready reference.

The Committee recommends that a paragraph be added to this rule reading as follows:

If new cast iron or new cast steel wheels are applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand wheels, whether or not a defect card is involved. Similarly, if new A. R. A. standard axle is applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand axle, whether or not defect card is involved.

REASON—Owner receives the betterment and would not be penalized in being billed for same. Also, it creates incentive to apply new material which is preferred by car owner and because it is in line with rule on wrought steel wheels.

Mr. O'Donnell (Buffalo, N. Y.): While it does not enter into the discussion, I think that is one of the best changes that has ever been put in the rules, especially where the fellow gets finicky and starts looking for cut journals. It means about three or four thousand dollars a month in our Association that the delivering line will save on that rule.

Rule 111

The Committee recommends that the following note be added to this rule in order to make it more clear:

NOTE—In cases where annual air brake cleaning is not performed, but triple valve is renewed account of defective body, charge may be made for material only. Also in such case if brake cylinder, brake cylinder piston or non-pressure head are renewed, account of defective, charge may be made for material and labor.

Mr. Jamison: This is the only item that we shall have on rule 111. I do not want to be out of order, but it would give me a great deal of satisfaction if this Association would ask the Price Committee to give us an interpretation in rule 111, or else an item covering the cleaning of what is known as loaded and empty brakes. It is twice the amount of work to clean the brakes on these cars as it is on the ordinary car, and yet we have nothing covering it; there is a variety of opinion and, consequently, a variety of different charges being made. I think if we were to ask that question now, and it were to be submitted to the Price Committee, as soon as possible after the close of this session they would perhaps incorporate it in the new rules.

The motion was duly seconded and carried.

Rule 112

Attention has been called to a misprint in Note 1 to this rule as shown near top of page 161 of the 1922 Code.

This note should real as follows and will be corrected in the first supplement to the rule issued.

NOTE 1—These rules are for the purpose of settlement between carriers and between carriers and private lines, for destroyed or dismantled cars, handled under the rules of interchange, and are not intended to be applied to cars of the same particular types in the accounts of individual carriers.

A. Armstrong
President

W. T. Westall
First Vice-President

C. M. Hitch
Second Vice-President

W. P. Elliott
Secretary and Treasurer

The Committee recommends that a new paragraph be added as the third paragraph of this rule, reading as follows:

Second-hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value.

In addition to the foregoing changes recommended in the Rules of Interchange, the Committee will prepare appropriate revision of rules effected by the recommendations from the Committee on Wheels, if the recommendations of that Committee are approved by letter ballot of the members.

Respectfully submitted,

ARBITRATION COMMITTEE.

Mr. Straub: Inasmuch as the last paragraph refers to a recommendation by the committee on wheels, this question may not be out of order, although it may be covered by the Wheel Committee, the Price Committee or the Arbitration Committee, but nevertheless it is a condition which we sometimes run into. What allowance, if any, shall be made car owner by a company who has ground out slid, flat spots on cast iron wheels and replaced same in car, thus resulting in possible replacement of wheels at car owner's expense at an earlier date than otherwise? The practice is not recognized by the A. R. A., but occasionally performed by some railroad, and car owner should receive some protection.

Mr. Wells: Rule 98 fully covers that, and the car owner is fully protected. It is true the wheels would not have been removed only for the slid flat spots, but, at the same time, the owner is deriving the benefit of the new wheels, and I cannot see any reason why Rule 98 is not optional, because the difference in value will be charged between the defective and the new wheel.

Chairman Armstrong: Do you wish to take up any of the rules other than those quoted in Circular No. D. V. 283, which have just been read?

A. C. Campbell (N. Y. C. & St. L.): I would like to bring up the matter of transfer of cars. A great many loads are billed out from shipping points that are really reconsigned in transfer.

They may be reconsigned a half dozen different times before they go out on the line, especially potatoes and such things as that. These cars come in off the line, and they will be in bad order, which will necessitate transfer of that load which was to go forward. They reconsign that load to the first road and then another, who is going to issue the transfer authority against the originating line that it comes from or against the line that reconsigns to another line? The rule allows that load to be reconsigned as many times as they want to on that bill.

Mr. Schultz: It has always been my personal opinion that if the load had arrived at its destination when it was intended; that is, as far as the delivering line should be responsible for it. But in handling it through the traffic people, they decided the car had not arrived at its destination and was subject to reconsignment, where it was originally loaded and the transfer order should be issued against the originating line.

M. W. Halbert (St. Louis, Mo.): In St. Louis, we have the reconsignment rule. The roads are bringing the cars into the originating line in bad order, when they have not reached waybill destination. What I mean by that, if the car hit the line that is going to handle the car instead of reaching its regular destination it would receive a reconsigned order, and the party accepting the reconsigned order is responsible for the transfer; but if the car had not reached its waybill destination, the originating line is responsible.

To make it a little more clear, the car is billed to a line, and perhaps the billing will show a point on that line, but the car is received and reconsigned to another line. Now, is the road that reconsigned it responsible, or the party to whom we reconsigned the order?

Chairman Armstrong: Mr. Schultz answered the question as to the responsibility of the car being so handled, and I merely bring up the thought that the defects for which the car is transferred are old defects from the originating line and not new defects from the intermediate.

Mr. O'Donnell: When we have a number of cars in our district destined to the switching line, the industrial man on the switching line will reconsign that car with lumber or other commodities, and we always make the road bringing in the car be responsible for the transfer to the second line that transfers it, with the approval of the agent, so they understand it.

Chairman Armstrong: I think it is the general practice.

Rule 107

T. S. Cheadle (R. F. & P.): If I am in order, I would like to ask the question on rule 107. On page 148, item 417 A, it says:

> Underframe, steel (repair type) or continuous metal center sills to which are secured metal body bolsters or metal or wood cross ties, first application or R. & R., includes R. & R. of underframe or continuous metal or continuous metal center sills for removal or repairs to top gusset plates over cross ties, center girders, bolster stiffeners, or other parts of underframe (excludes R. & R. or R. of flooring) (add jacking of car when necessary) 27.0 hours on ordinary car; 37.0 hours on refreigerator car.

This price, as I understand it, covers the R. & R. and the steel underframe to make repairs to the portion mentioned. There have been a number of cases on my line where it was necessary that a steel underframe of this class be put at one end of the car to make certain repairs. I want to ask what, in the opinion of the members who investigated these, should be the charge. Should it be a reduction of one-half, or should it be on a bolt, nut and lock basis, or what charge can be made?

Chairman Armstrong: Will some gentleman answer Mr. Cheadle's question?

M. E. Fitzgerald (C. & E. I.): I think you are entitled to full charge. However, if you saw fit to reduce that charge, I do not believe anyone would kick any in receiving it. I do not think it would exceed the total labor charge, but if you see a manner in which you can expedite the work on your line, you do not need to go into full details of performing the operation.

Loading Rules

Mr. O'Donnell: We have three or four important changes in the loading rules, one in particular that I think Mr. Rogers, of Youngstown, has brought out, proposed revision of Rule 28. This is the proposed form:

> Bearing pieces must never be placed between bolster and end of car, unless special provision is made therefor and detailed instructions given. When there is but one bearing piece on the car, it must be placed at least twelve inches from center of bolster toward center of car.

This is the addition:

> Sliding pieces should preferably be placed over the car body bolster, but in case of flexible material, in order to obtain the required four inch clearance from floor of car, the sliding piece may be placed not more than eighteen inches ahead of center line of bolster on cars of steel or steel underframe construction.

The Loading Rules Committee has put in this recommendation generally for new cars:

> All drop end gondola cars to be equipped for the reason they are replaced, etc.

What I want to bring out is that we are losing a lot of $12 or $15 end gates, due to the fact that when they unload the commodities at the steel plant, they find that in some other part of the car. I think it is an injustice to the owner to lose the end of a good 50-ton car in the way they are being lost, and this appealed to me. Of course, the Loading Rules Committee recognized that fact, but it is deplorable the number of end gates that come home to the owner in that condition.

Mr. Fitzgerald: I would like to get an expression from the chief interchange inspectors as to whether or not, in case of twin or triple shipment of piling, in moving through an interchange, it is found that one of the brake staffs is entirely missing. The rules, of course, provide that you only need one brake shaft in twin or triple movement, and in loading the car they take the brake shaft off and are supposed to fasten it to the car. But assume now this equipment is missing (the brake shaft), is it a cardable defect?

W. R. Rogers (Youngstown, Ohio): I would say if you have removed the brake shaft to facilitate the accommodation of the load, it surely is a cardable defect, in accordance with A. R. A. rule 32.

Mr. Fitzgerald: I do not agree with the gentleman. I would like to get an expression from the chief interchange inspectors as to whether they think it should be cardable in interchange. I am now speaking of the fellow who loads the car, wired it securely to the car, but in transit it has become lost.

Mr. Campbell: In the Twin Cities, we do not card for them unless we know it is a known theft of the brake shaft, because that brake shaft may be somewhere in that load, and I do not see why we should apply for it. We do not in St. Paul.

A. Herbster (N. Y. C.): The rule covers very plainly material missing, removing or cutting out parts of car to facilitate loading or unloading. If you are going to card for missing brake shaft, you have to card for missing door protection.

Chairman Armstrong: Are there any other questions on the loading rules?

S. M. Anderson (No. Pac.): I would like to ask the billing men of the association their understanding of the word "correction," paragraph "C" of rule 92? If the bill is returned having charges in excess of 10 per cent, you may return it, but I would like to know if the bill has to be corrected what the authority will do. It is my understanding that the bill must be corrected in accordance with the rules, but so many of them return them and claim that the authority is sufficient.

Mr. Pyle (So. Pac. of Mex.): We handle a good many cases of this kind. I think it is right under the rules we have. I know we have to return the bill if the amount is more than 10 per cent and insist on the bills being corrected, although I do not handle anybody's bill that way. If I return his bill and it amounts to more than 10 per cent, and he sends me a counter billing authority, I am perfectly satisfied with it.

Livingston Martin (B. & O.): I agree with Mr. Pyle. The A. R. A. recognizes the counter billing authority. At the same time, I believe, technically under this rule, you could force the correction of the bill. But I want to say you are getting awfully technical if a man sends you a counter blank authority and you send a bill back and insist that it be corrected.

Mr. O'Donnell: In loading brick in rough freight cars, would it be permissible, if we find the doorway in distress, to charge the originating road with the cost of putting in the commodity or placing it back so it would not reach the door?

Mr. Schultz: The principal part of the rules regarding how bricks are to be loaded, is based on a 60,000-lb. capacity car. If you try to load 100,000 lb. of brick they won't stay in the car. In case the load exceeds the stated amount and bricks came in contact with the door, is door protection required?

Mr. O'Donnell: I penalize the delivering line when the door is in distress. I feel our association, or the A. R. A. rules permit charging for any such work, irrespective of the prints that Mr. Schultz refers to, but we always report it back to the fellow who loads it to use more caution in loading.

Other Business — New Members

B. F. Jamison (Southern): We are a committee to go out and get new members. I have not done, this year, quite as much as I did last year. I think brother Elliott expected more of me, but circumstances prevented me in some way from doing that. Now those circumstances are changed, and I am going to try to do some real good work on getting members for this association.

The dues are $3.00 a year, no application or initiation fee, and the member receives the *Railway Mechanical Engineer*, to my mind the best publication he could get, for 12 months and a printed copy of the proceedings. During the year, I have heard such expressions as this, "One paper in those proceedings is worth 10 times the membership," and it is. Gentlemen, one copy of the *Railway Mechanical Engineer,* properly used, is worth it, and yet you are going to get 12 copies.

You have a splendid argument. You are not taking away anything from any man when you ask him to join the Chief Interchange Car Inspectors' and Car Foremen's Association and pay $3.00 for his membership; you are giving him something and giving it to him richly.

Chairman Westall: You have heard the remarks made by Mr. Jamison, and I hope all of you feel the way he does, and when you return home that you will not wait until next year to get these members to come into the association, but as soon as you return, go after them and see if we cannot increase our membership next year to ONE THOUSAND.

Lubrication

By M. J. O'Connor

Special Mechanical Inspector, New York Central

Some of the chief interchange inspectors and car foremen on the various railroads have well said that lubrication is a very broad question. For example, the heating of journals is invariably charged to lubrication, whereas we know that the following conditions, which lubrication will not overcome, are conducive to the heating of journals:

(1) Slid flat wheels and shelled wheels, which are caused by air brake conditions.

(2) Broken oil boxes and tipped oil boxes—the latter condition being caused by worn pedestals and oil boxes on passenger equipment cars.

(3) Broken truck springs and weak truck springs under freight cars are also conducive to the heating of journals, as under these conditions we do not have side bearing clearance on the side of the truck.

(4) Excessive slack in draft gear, particularly under freight cars increase service shocks, while cars are enroute in trains, thereby disturbing the conditions in the contained parts of journal boxes under such cars.

Waste Grabs—During the past year, the question has been asked, What is a waste grab?

A waste grab consists of one or more strands of waste that separate from the body of the packing in the journal box, and when this occurs, the waste will, under ordinary service conditions, become wedged between the journal and journal bearing.

The service conditions that contribute in developing a so-called waste grab consist of shocks at high and low rail joints, heavy application of air brakes and fast speed over railroad crossings, these being causes over which we have not positive control. However, during the past few years the following methods have been adopted with a view to keeping down this apparent cause of journal heating.

Journal box packing is applied in one mass, allowing the strands to hang down outside the mouth of the journal box, always adding more packing before placing the hanging strands inside the journal box flush with the inside face of the collar of the journal. This has greatly reduced waste grabs.

The lining of journal bearings also enters into developing so-called wipers or waste grabs, particularly so where the lining is recessed more than 1/32 in. on the side, and, for this reason, only within the past year, we insisted on our bearings being lined along these lines.

The continuation in service of mongrel types of wedges, including the solid back when worn flat, contributes in developing waste grabs, for the reason that such wedges will not allow the bearing to slide laterally with the journal when worn down, so that the full bearing surface of the brass rests on the journal, resulting in excess friction, and where loose strands of waste happen to be on the surface of the packing, most anything may happen under these conditions.

Journal Bearings—During the past year, a power boring machine for use in broaching journal bearings was installed on a coal producing division, where approximately 1,000 cars of coal are loaded per day, and since the installation of this machine, the journal failures, particularly under cars re-wheeled or re-brassed, have been reduced more than 75 per cent.

Journal bearings having end wear more than 1/16 in. on either the collar or fillet end should not be relined. Also journal bearings which show indications of wedge wear on the backs or sides, even though it be but 1/64 in., should not be relined.

Furthermore, journal bearings that are found in condition for re-lining should have the old bearing surface bored, for the reason that the surface, after the lining is removed, is more or less oxidized, and the re-boring is absolutely necessary in order that the tin will properly cling to the surface.

At the present time, the average thickness of the brass back on journal bearings is approximately 7/8 in. minus the babbitt lining. Therefore, it can readily be seen that to obtain a good clean surface in the re-lining of old brasses, it is found necessary to reduce this thickness from 1/32 in. to 1/16 in., and this, in my opinion, further weakens the brass back.

More than a year ago, some passenger equipment cars operating in very fast trains, were equipped with 9 in. bearings, the backs of which were 1 in. in thickness. A close observation was kept of these cars, with the result that after these bearings had been in service one year, making approximately 120,000 miles, they showed little, if any, end wear, and the lining wear was hardly noticeable. Therefore, I believe that increasing the thickness of these bearings 1/8 in. (the thickness being added to the back and sides) is a step in the right direction, as we have found that the present standard journal bearing wedge properly fits this so-called thick back brass.

I would also recommend that the panelling on the backs of journal bearings, which consists principally of the name of the railroad, pattern number and size, be discontinued, these markings to be placed on the sides of bearings, as the present method of marking these bearings on the brass back further reduces the strength of such bearings. It has been found that the stamping of these marks does not, in all cases, produce as good a bearing surface as the bearing with the plain back.

All passenger equipment cars should have truck sides stencilled, showing the station, month, date and year when the boxes were last jacked, bearings examined and boxes repacked, as it has been found, where this practice is in vogue, it affords the railroads who maintain men exclusively to cover this particular feature of the work, an opportunity to know whether or not the journal box and contained parts under such cars are in serviceable condition.

The jacking of journal boxes and examination of bearings should be done at least once every six months, particularly on cars not making a shop movement, this work to be performed where terminal facilities will permit.

Journal Bearing Wedges—Too much importance cannot be attached to the journal box wedges. For example, a few years ago, our railroad was averaging 27 per cent defective journal bearings removed from journal boxes during a certain period, and of this total, more than 60 per cent were removed on account of cracked linings, whereas, during the first six months of this year, notwithstanding that we have about doubled the number of boxes jacked up, the defective bearings have been reduced to 17 per cent and the cracked linings to 31 per cent. Therefore, these improved conditions simply mean more service wear from the journal bearings and less heating of journals.

Use of Material—Great care should be exercised in the handling of the oil used in the lubrication of car journals, for the reason that the oil company who manufacturers this material tells us that the oil used during the summer season is heavy, while the oil used during the cold weather season is of a lighter quality.

Our past experience has fully demonstrated that requisitions for summer car oil should be made March 1, for use in April and succeeding months until September; requisitions for winter car oil should be made August 1, for use in September and succeeding months until April. Winter oils remaining on hand April 1 should be used with summer oil in the proportion of half and half until disposed of.

When consignments of oil are received, that on hand should be placed so it will be used before shipments received later. This obviates the carrying of oils into the season for which they are not intended, and care must also be taken in order to avoid having a surplus of unseasonable oil on hand at the change of seasons.

Cleaning of Oil Tanks—Oil storage tanks must be cleaned every year, and this is best done when changing from one season's oil to another.

In conclusion, I would say that all of the features in connection with lubrication and the care of journal boxes, as outlined, can be obtained only by eternal vigilance and hearty co-operation on the part of the car department forces.

Discussion

Chairman Armstrong: Will you kindly explain or give us some idea of what this boring machine is? I infer, from the paper, that boring is done prior to the relining. This work is done, as I understand it, on old brasses prior to relining. What is the nature of the machine?

Mr. O'Connor: It just bores out the old surface in order to obtain a clean surface.

Chairman Armstrong: That does away with the old and much used method of throwing them into the fire and burning it out.

Mr. O'Connor: Absolutely.

G. P. Zachretz (Soo Lines): The Soo Lines have machines at all of our important stations, where we use them for boring out or broaching out the new brasses to get a perfect bearing; also all good second-hand brasses we put through this machine and bring them back to a proper size for bearings to fit the journal, that is, the A. R. A. sizes. We find that by using this machine, we can bring back a great many second-hand brasses and put them back in stock. That is more particularly true of passenger brasses. When we change wheels under a passenger car, we take those brasses and, instead of trying to fit them, as I have seen people do, we put them through this machine and use them back as new stock.

I would like to ask the gentleman who read the paper if he has found, by actual experience, that the lettering, stenciling on the back of the brass has actually reduced the strength of that brass so that it would noticeably cause cracked brasses?

Mr. O'Connor: Yes, positively. In other words, when those so-called panelings or markings are put on the backs of bearings, they are counter sunk, aren't they? That weakens the brass.

A. Berg (Erie): I would like to ask Mr. Zachretz if, when broaching second-hand bearings, he experienced any trouble of the lining breaking on account of having become hardened while they wear; if in that process he loses any number of bearings?

Mr. Zachretz: I will say, in answer to Mr. Berg, that we have not experienced any such trouble. As a matter of fact, we have taken brasses from passenger service, broached them out and put them back in passenger service with very good results. In our St. Paul yards, we have kept the record of a number of cases where we have treated brasses in this manner, and we have found the brasses would wear out the second pair of wheels and yet be good brasses.

Of course, when we machine that brass out, we lose a certain amount of the babbitt metal, and then when we put that on to another journal and wear another pair of wheels out with it, we are a little leary about machining it a second time and putting it back in passenger service, but we have put such brasses back in freight service and we have not noticed any bad results.

Mr. Spangler (Frisco): I would like to ask Mr. O'Connor if he is broaching second-hand journal bearings and applying them to foreign equipment?

Mr. O'Connor: Positively not.

Mr. Spangler: Has the committee ruled it would be proper to bill the car owner for the broached car bearing?

Mr. O'Connor: Not that I know of.

Mr. Herbster: I just heard a gentleman say he would not think of broaching out a second-hand bearing and put it back on passenger service, but he would on freight service. Now, I do not doubt but he realizes that freight cars run as fast as passenger cars in this country, at least on a good many railroads, and I believe the railroads are going too far in the reclaiming of journal bearings. You cannot take a bad thing and put it back in another thing without causing trouble to somebody else. You may not notice it yourself, but the other fellow does and the fellow who runs the fast trains has trouble with that and a good many more things.

Now, in regard to jacking up freight cars: The company which I represent has done that for sometime on its own cars and had to finally come to it on foreign cars on the fast trains. It is surprising the number of worn, cracked and pitted bearings that we are obliged to remove in order to get the trains over the road in the short schedule they give us.

We take any train that comes into any of our yards from any connection, in fact, from our own rails, and go over it and jack up any number of cars and remove sometimes only one, sometimes none, and, in some cases, eight journal bearings, and perhaps then find a pair of wheels with a seamy journal or an unevenly worn journal. We are trying to do everything possible, in order to get the car over the road, and I would like to see this association go on record as discouraging the reclaiming of second hand bearings.

A. J. Charlton (O. S. N.): I heard Mr. O'Connor read his paper, and there were several things which I think we ought to take exceptions to. First, as I understand, the machine he talks about, using the old brass for the purpose of getting the clean surface to revamp it; the second is to broach the brass to get a crown bearing on the finished brass.

I happened to be in a locality where the company makes it a rule to broach all brasses used, and I think our friend, Mr. O'Connor will substantiate what I say, they have more trouble than the road I represent, which does no broaching whatever.

Mr. Graham (Galena-Signal Oil Company): Some member said that in the spring and in the fall, on account of changing the oil, was the time they had the hot boxes. I think Mr. O'Connor will bear me out in saying that, on the New York Central Lines, since they started to jack up the boxes and examine the wedges and brasses, etc., on their passenger equipment, they have not had any epidemic in the fall or spring, but previous to that they always had epidemics.

If the mechanical defects are kept down, you are not going to have very much trouble with hot boxes on either freight or passenger cars, in my opinion.

D. P. Crillman (M. C.): We very frequently find cars equipped with steel wheels, and one of the wheels turned down practically to the limit. What effect would that have in hot boxes when we have a tipped truck?

Mr. O'Connor: That would be conducive to journal heating, for the reason you would throw the weight on the low wheel. Particularly while the car is enroute on trains. The body bolster would be tipped and the truck would not curve properly. I was glad to hear that brought up.

I talked with a man a month ago on that same condition. On a four-wheel truck, the inside pair were of perfect thickness and the other were of the minimum thickness, and that is surely conducive to hot boxes.

Chairman Armstrong: As has been stated, eternal vigilance is, in my opinion and from the consensus of the discussion, the only thing which will tend to eliminate or reduce hot boxes. We have heard this splendid paper and this discussion. Let us go home and profit by it, let us not forget what we have heard.

Recent Decision of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will prrint abstracts of decisions as rendered.)

Time Limit for Making Repairs

On September 25, 1916, the New York Central issued a defect card covering five metal side stakes bent, one metal end sill bent and one push pole pocket broken, on Bessemer & Lake Erie car 35366. It was reported that this damage was due to unfair usage. On April 28, 1921, the Bessemer made the repairs covered by the defect card and rendered a bill against the New York Central. The New York Central objected to the charge on the grounds that the repairs had been made two years from the date of the first receipt of the car on the home lines. It claimed that the charge should be cancelled. The Bessemer & Lake Erie refused correction, contending that in the case of this car the present two-year restriction upon defect card did not apply to this card as it was issued prior to the establishment of the two-year restriction. It further contended that in this case Rule 5 should not govern as its application would be retroactive and therefore illegal.

The Arbitration Committee decided that the time limit for making repairs, specified in Rules 5 and 94, as well as the time limit for rendering of bills, as specified in Rule 91, became effective at the time these requirements were incorporated in the rules and that they cover all cases regardless of the date of the defect card, billing repair card or joint evidence card. The rules in effect at the date of defect cards for billing repair cards are effective only in so far as prices, responsibility, etc., are concerned.—*Case No. 1273. New York Central vs. Bessemer & Lake Erie.*

Final Cost of Repairs Exceeds Rule 120 Allowance

The Detroit & Toledo Shore Line car No. 249 was forwarded by the New York, New Haven & Hartford to its Oak Point repair yards on November 14, 1920, for repairs, claiming that it was in a decayed condition. Inspection by the New Haven at Oak Point indicated that the car could be repaired within the labor allowed under Rule 120. The New Haven claimed that as the work progressed, hidden defects developed, which brought the labor charges above the allowance under the rules, up to $108. The ultimate charges amounted to $126.48, a bill for which amount was submitted to the Detroit & Toledo Shore Line for payment. This bill was rejected on the grounds that the car had not been reported under Rule 120. Counterbilling authority was, therefore, issued by the New Haven for $55.44, of which $18.48 was applied for labor and $36.96 for material, to bring the amount of labor within the limit prescribed by Rule 120. The Detroit & Toledo Shore Line still declined to pass the bill as rendered, even with the offset authority, claiming that from the nature of the repairs, it was indicated that the car had received rough usage as outlined in Rule 32. It took the position that the footnote of Rule 43 was designed as a protective measure to car owners against the abuse of equipment while in the possession of the handling road, and further that in the functioning of Rule 120, the car owner must, as a basis for decision and in recognition of the protection and equity sought by the rules, be furnished with at least some conclusive evidence to enable a fair, equitable settlement between the parties to the controversy.

The decision of the Arbitration Committee was that "the principal repairs consisted of two center sills spliced at both ends; four center sill fillers renewed; two end sills renewed; two draft timbers renewed, 32 pieces of flooring renewed. The owner's contention of unfair usage is not sustained. The case should be settled on basis of Arbitration Decision No. 1,053."—*Case No. 1,271, New York, New Haven & Hartford vs. Detroit & Toledo Shore Line.*

Where Wrong Repairs Are Claimed Joint Evidence Is Necessary

Wheeling & Lake Erie car No. 29,110 was repaired at the Trenton, Mo., shops of the Chicago, Rock Island & Pacific on June 2, 1920. The billing repair card showed that one Westinghouse H-2 triple valve had been applied to the car. The Wheeling & Lake Erie did not procure a joint evidence card when the car first arrived on its line. However, a billing repair card from the New York Central, dated July 30, 1921, showed that it had applied one K-2 triple valve to the car and an H-2 triple valve, stenciled T. R. 60, R. I., had been removed. This, it was claimed, also showed that the car was stenciled for a K-2 triple valve. The Rock Island refused to issue a defect card to the Wheeling & Lake Erie covering wrong repairs, on account of the absence of a joint evidence card. It also claimed that the New York Central billing repair card could not be considered valid as it was not the billing repair card of an intermediate line. The owners brought to the attention of the Arbitration Committee that it had rendered a decision on November 10, 1921, reading as follows: "If a repairing line knows that it made wrong repairs, it should promptly issue a defect card without requiring joint evidence; defect card should be attached to the car at the time wrong repairs were made." The Rock Island stated that its records in this case were destroyed when the shops at which the repairs had been made were burned. Therefore, it neither denied nor accepted the responsibility at any time, but held that the Wheeling & Lake Erie had no right to present the claim, as it had no admissable evidence to show that the Rock Island was responsible. It contended that the Wheeling & Lake Erie's claim must be denied or else the definite provisions of Rules 12 and 90 should be stricken from the Interchange Code.

It was the decision of the Arbitration Committee that a "wrong triple valve is an item that should have been readily discovered when the car was on the home line, and therefore the New York Central billing repair card cannot be considered under Rule 90 for the reason stated in Arbitration Case No. 1,167. In any such case, however, if the repairing line is convinced that it made wrong repairs, it should not hesitate to use defect card in accordance with the spirit of Rule 87."—*Case No. 1,270, Wheeling & Lake Erie vs. Chicago, Rock Island & Pacific.*

Efficient Tools Used At Milwaukee Car Shops*

Description of Several Tools and Devices of Proved Value in Speeding Up Car Shop Work

By C. Petran
General Machine Shop Foreman, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

A SHOP with up-to-date machinery but not provided with special tools for this machinery will be a dismal failure both in efficiency and productiveness. To get maximum output car shop machinery should always be provided with the best of high speed steels for all wheel borers, axle lathes, coach wheel turning lathes, engine lathes, planers and shapers. High speed drills are essential for drill presses and the best carbon steel for threading dies in bolt cutters.

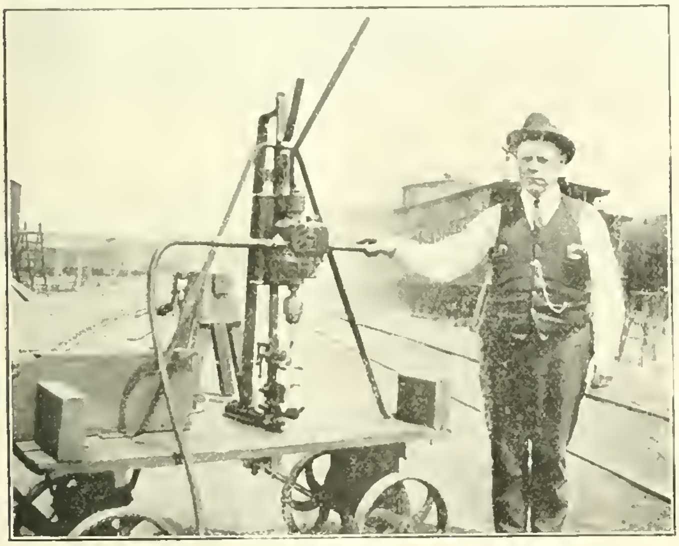


Fig. 1—Lever-Operated Drill Press Can Be Taken to the Job

The following descriptions pertain to special tools and what they have accomplished in production at the Milwaukee shops of the Chicago, Milwaukee & St. Paul.

Portable Hand Lever Press Drill. This tool (Fig. 1), made from a Liberty air motor stand, is merely an improvement on what a machinist would call an "old man." The feed was formerly operated by air but this arrangement proved a failure. As a result the idea was conceived of making a lever-operated drill press. The air feed was replaced by lever attachments with an air motor, capable of drilling up to 13/16 in. holes. The illustration shows the machine as used on the repair tracks and in the coach shop. Here it is taken to the job, instead of the job to the drill press. This type of drill is also provided on benches and posts in different departments.

Rivet Busters. Since receiving the blue print of the original buster we have put on an improved valve, a safety first spring to hold the chisel in place, and removed 21 parts. Originally each buster had over 50 parts to it. Now it has less than 30. These rivet busters reach further under a car and are half the weight of most machines. They also strike a harder blow.

Air Jacks. This jack (Fig. 2) is indispensable on a track that has many cars to jack up. By placing this jack under the draw-bar any light car can be jacked up in a few minutes with two men, thereby eliminating two men and saving half the time.

Double Grinding Wheel Stand. If a casting or forging requires a little to be taken off the end or side, filling and chipping is a long job but with a grinding wheel near at hand the casting can be fitted in a short time. A double-wheel, belt-driven grinder has been developed at Milwaukee for use close to the work and will save much time formerly spent walking to and from the shop grinder or performing the fitting operation with a chisel or file.

Home-Made Sanding Machine. This machine (Fig. 3) is used in the cabinet shop of the wood mill and cost not over $30.00 to make. It has wooden spindles 1½ in. to 7 in. in diameter to fit any radius, also three double face discs 18 in. in diameter. The following table indicates what can be done on this machine and what savings can be expected over hand labor:

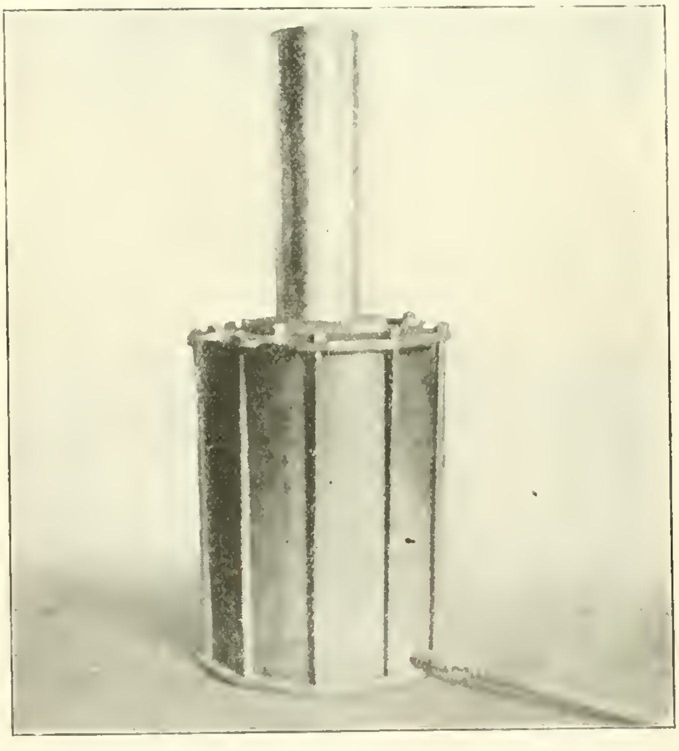


Fig. 2—Pneumatic Jack Which Saves Time in Lifting Cars

Articles	Hand labor each	Machine labor each	Saving each
Berth number plates	$.31	$.05½	$.25½
Drinking cup holders	.19½	.05½	.14
U Connector blocks	.09½	.01¾	.07½
Hopper seats, Mail and Pass	.70	.23	.47
Coach seat ends	.35	.14	.21
Sleeping car step ladders	.35	.17½	.17½
Ceiling bands	.23	.11½	.11½
Electric light fixture bases	.17¼	.05¼	.12

Combination Rip and Cut Off Saw. A machine of this type is used to cut various kinds of parquet work, saving about one-half of the material on account of using very fine saws which are also home-made. There is also considerable saving made on this machine in connection with manufacturing mitre work on various notice frames and folding screens for passenger car equipment which eliminates pushing a large iron-top saw table back and forth. It also does better work, at a saving of about one-half the labor on mitre work.

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*Abstract of a paper read by Mr. Petran before the Chicago, Milwaukee & St. Paul car department staff meeting at Milwaukee, Wis. Pictures of the various tools were thrown on a screen for the benefit of the assembled car foremen.

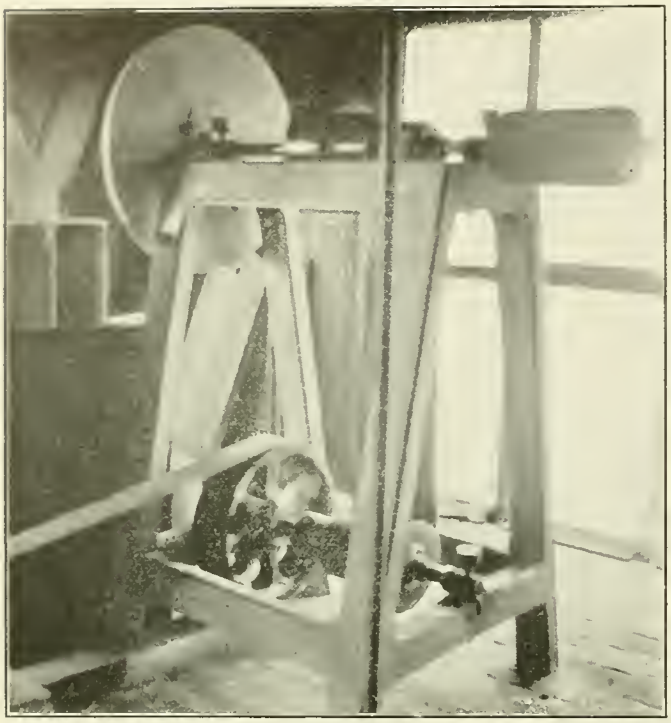


Fig. 3—Home-Made Sanding Machine for Cabinet Shop or Mill Room

Angle-Corner Wood-Boring Attachment. This little machine (Fig. 4) is indispensable for boring wooden center sills. We can bore holes in center sills within an 8 in. space and within 1¾ in. of the flooring. This machine is fool-proof, as not a gear or set screw is exposed on any part of the machine. The machine has an 18-in. shaft extending from it which is attached to a No. 61 Thor wood-boring air motor.

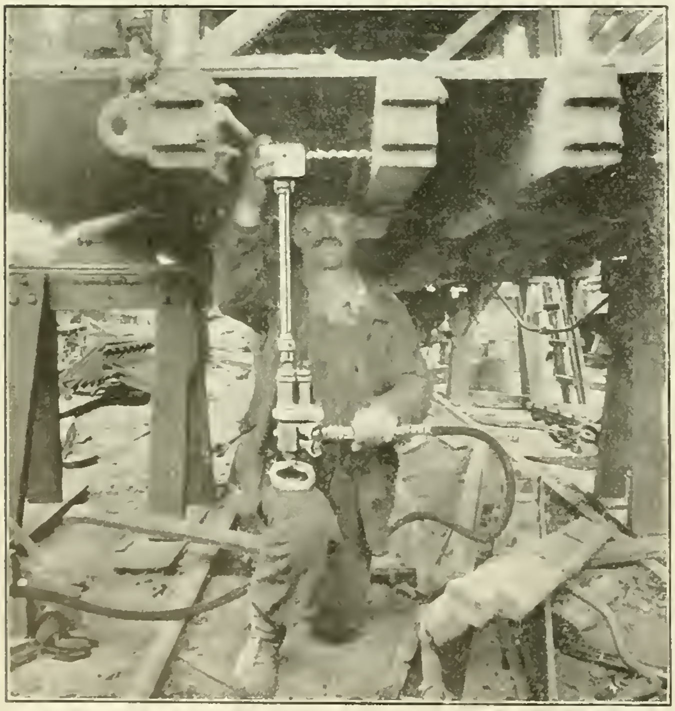


Fig. 4—Close Quarters Boring Attachment for Air Motor

Reclaimed Axle Centering Machine. This machine (Fig. 5) was built to drill and center all reclaimed axles. It consists of a 14-in. channel taken out of the scrap pile with two pair of wrought iron legs arranged to support it. Two sets of jaws are provided, operated by right- and left-hand screws to chuck the axle central at the sand collar. A movable table at each end with two small air motors attached operates the drills for centering. A guide bushing set central with the jaws insures accuracy.

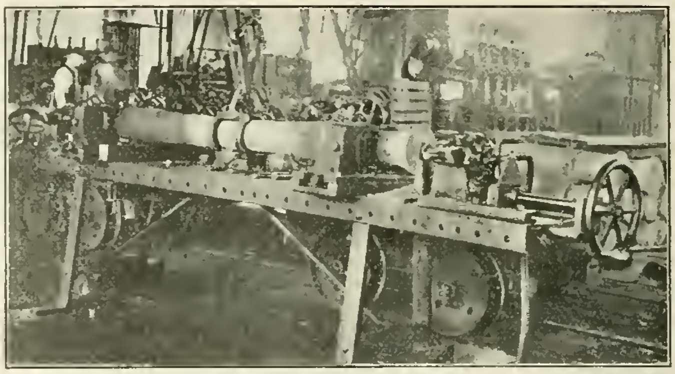


Fig. 5—Centering a Reclaimed Car Axle

This machine saves the company about $35.00 a day. With the old style of centering with a template and drilling, 15 axles a day could be centered with two men on the job. With the new machine as described, 75 axles are centered a day with two men on the job.

Circular Saw. A circular saw, run by an air grinder motor and equipped with a sliding table, has been erected primarily for cutting Blox-on-end flooring to the sizes needed for laying it. This cutting was formerly done by hand. The estimated saving per express car in which Blox-on-end floor is laid is 22 man-hours at 70 cents an hour or $15.40 a car.

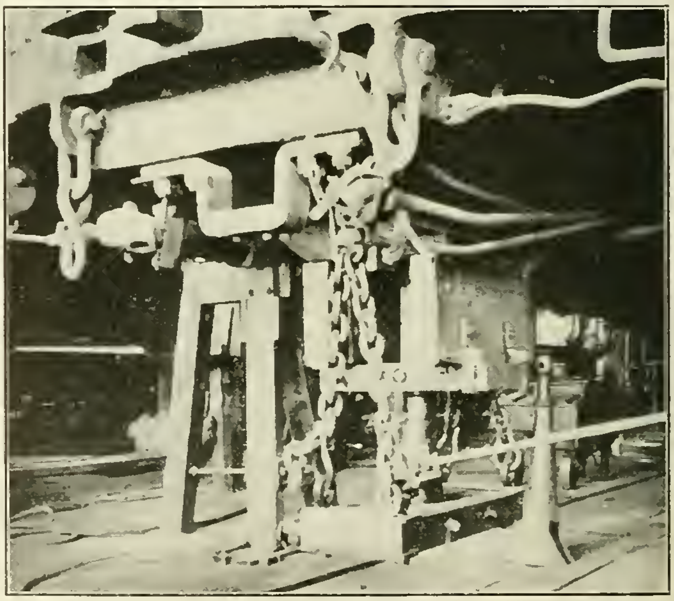


Fig. 6—Convenient and Effective Device for Removing Stuck Draft Gears

Draft Gear Extractors. A draft gear extractor (Fig. 6 and 7) is designed to remove the draft gears on passenger cars having cast steel draw lugs. On many of these cars the draft gears are wedged in so that it requires from 12 to 16 man-hours to remove one. By using the extracting device illustrated a draft gear can be removed in two man-hours at a saving of $7.00 to $9.80.

The principle of the extractor is evident, as a heavily-braced wooden framework straddles the draft gear and resists vertical movement of the jack ram reacting powerfully to push down the bottom block whenever the jack is operated. This tends to pull down the draft gear by means of the chains shown.

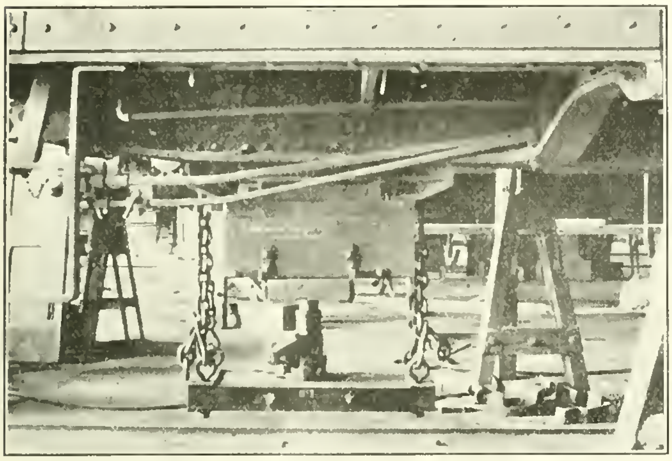


Fig. 7—Another View of the Draft Gear Remover

In conclusion I wish to state we have many home-made machines in the blacksmith shop, air brake shop and other departments that are showing a handsome saving per year, and that is why with the decrease in forces an increase in production is continually going on. Oftentimes our superiors wonder why we are producing more with a smaller force, but it is all due to special tools which decrease the man power required and increase production.

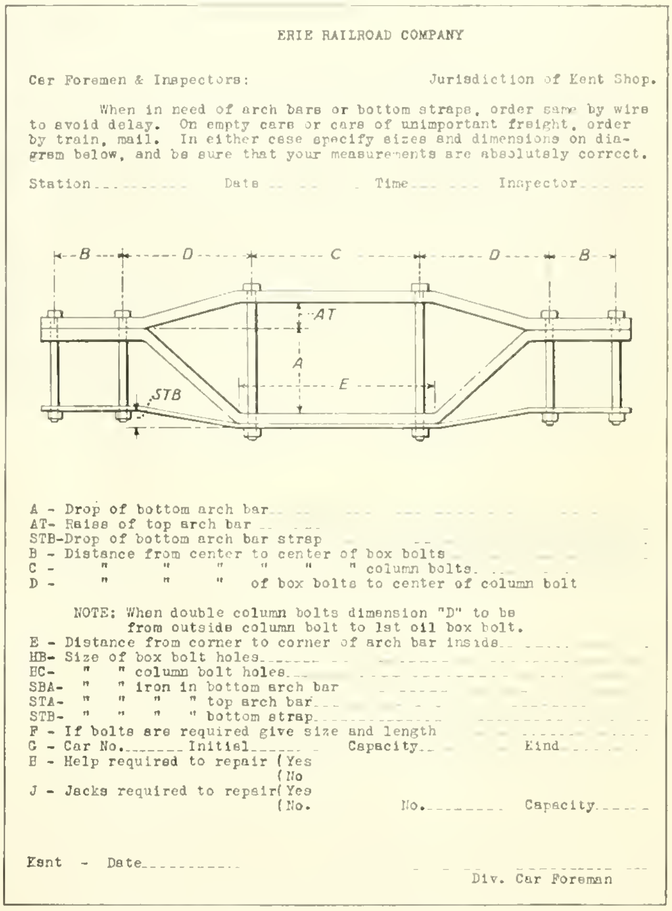
Form for Ordering Arch Bars

By F. C. Watrous
Division Car Foreman, Erie

The illustration shows a form for ordering arch bars that has been used very successfully on the Kent division of the Erie. For some time considerable difficulty had been experienced in educating the car inspectors at outlying stations to a point where they were competent to order an arch bar for any car set out. Some inspectors, who perhaps were better educated than their fellows, were successful, while others experienced a lot of trouble. On innumerable occasions it was necessary to send a second set of arch bars to get the car moving.

Cars that are set out at outlying stations between terminals are often left on the station or team track until repaired. The use of these tracks is essential to the economical operation of any station, and when one of these tracks is blocked with a crippled car that cannot safely be moved, it is of importance that the car be repaired with the least posible delay. To accomplish this, the form was developed, and up to the present time it has met all requirements. These forms are furnished to all inspectors at outlying points, and are promptly filled out when a car is set out at their station, or in their territory, with a broken or cracked arch bar. After the form has been made out, all measurements are carefully checked to avoid mistakes. The car inspector then telephones the nearest terminal and the clerk fills in one of these forms as directed by the car inspector. This form is then turned over to the stores department, which arranges to have the arch bar manufactured and shipped on the first passenger train. In this manner, cars set out at outlying points on account of defective arch bars are repaired without delay.

In the majority of cases, cars are repaired within 16 hours after being set out. This is all the more remarkable when it is considered that a majority of the cars set out of trains on account of defective arch bars are set out at stations remote from supervision and where one car repairer handles the cars set out at two or three points within a radius of 10 miles from his home station.



ERIE RAILROAD COMPANY

Car Foremen & Inspectors: Jurisdiction of Kent Shop.

When in need of arch bars or bottom straps, order same by wire to avoid delay. On empty cars or cars of unimportant freight, order by train, mail. In either case specify sizes and dimensions on diagram below, and be sure that your measurements are absolutely correct.

Station.......... Date.......... Time.......... Inspector..........

B
D
C
D
B
AT
A
E
STB

A - Drop of bottom arch bar..........
AT- Raise of top arch bar..........
STB-Drop of bottom arch bar strap..........
B - Distance from center to center of box bolts..........
C - " " " " " " column bolts..........
D - " " " of box bolts to center of column bolt

NOTE: When double column bolts dimension "D" to be from outside column bolt to 1st oil box bolt.

E - Distance from corner to corner of arch bar inside..........
HB- Size of box bolt holes..........
HC- " " column bolt holes..........
SBA- " " iron in bottom arch bar..........
STA- " " " " top arch bar..........
STB- " " " " bottom strap..........
F - If bolts are required give size and length..........
G - Car No.......... Initial.......... Capacity.......... Kind..........
H - Help required to repair (Yes (No
J - Jacks required to repair (Yes (No. No.......... Capacity..........

Kent - Date.......... ....
Div. Car Foreman

Form Used on the Erie for Ordering Arch Bars

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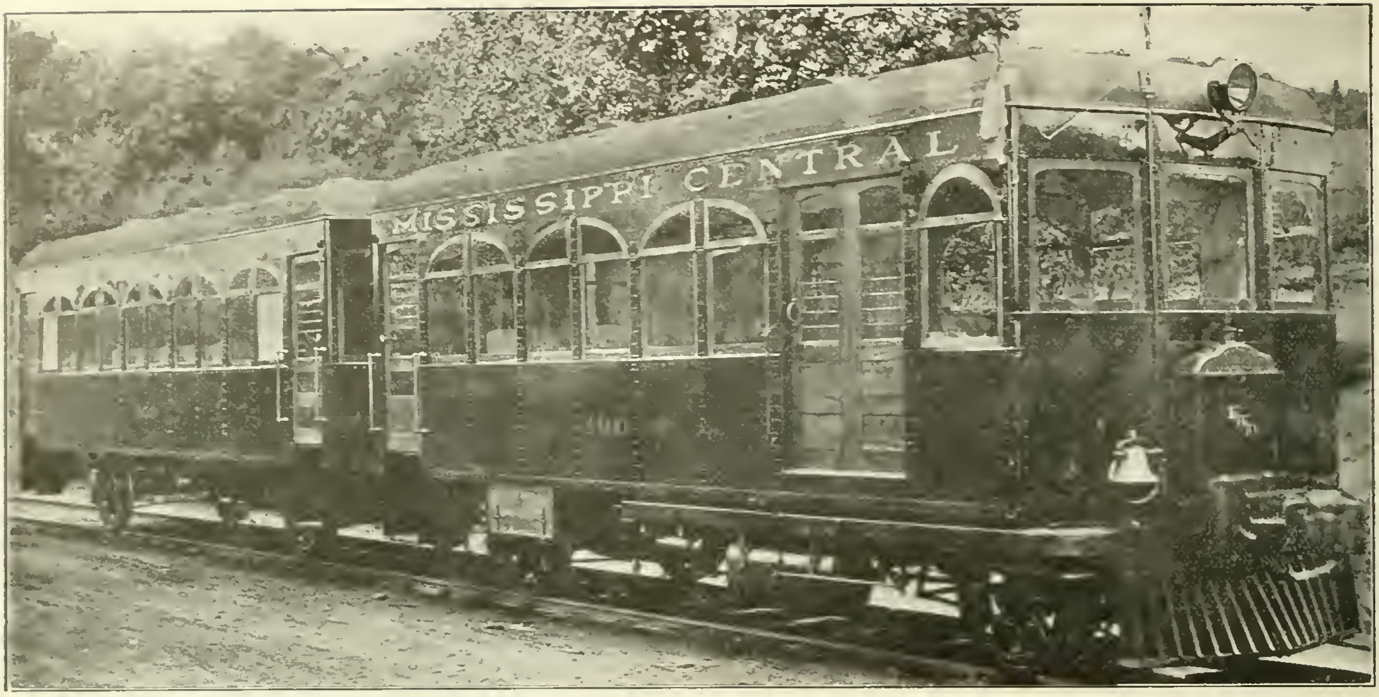
Interior of Pullman Buffet Car on London, Harrogate and Newcastle Train of the London and North Eastern



Motor-Driven Passenger-Baggage Car and Trailer Built by the Four-Wheel Drive Auto Company

Two-Car Motor Train for Mississippi Central

Chassis, of Four-Wheel Drive Type, and Trailer Provide Baggage Space and Seats for 46 Passengers

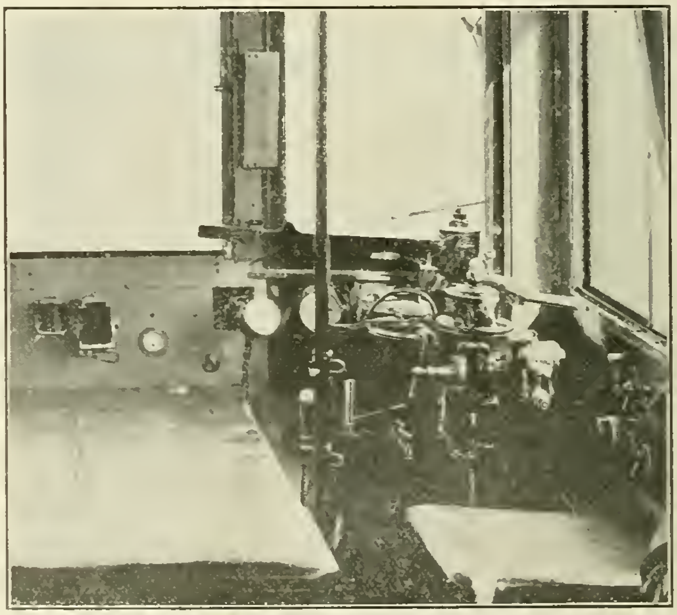
THE two-car, motor-driven train illustrated was recently built by the Four Wheel Drive Auto Company, Clintonville, Wis., for service on the Mississippi Central. It will operate from Hattiesburg to Beaumont, Miss., a distance of 27 miles with a ruling grade of 1 per cent and a maximum curvature of six degrees. The motor unit provides space for baggage and seats for 12 passengers. It weighs, complete, 11,000 lb. and has a wheelbase length of 185 in. The trailer chassis seats 34 passengers, weighs complete 6,300 lb. and also has a wheelbase length of 185 in. The lengths of the motor unit and trailer, center to center of the couplers, respectively, are 25 ft. 5½ in. and 27 ft. 5 in.

The motor chassis is provided with a six-cylinder 62-hp. motor having a bore of 5.1 in. and a stroke of 5.5 in. with a piston displacement of 672 in. While the S. A. E. rating of this motor is 62 hp. it develops 94 hp. under brake test. Force feed lubrication is provided. The cooling system capacity is 15 gal., the water being circulated by the centrifugal pump and cooled in a tubular radiator supported by a 3-point suspension.

Ignition is provided by an Eisemann high tension magneto with impulse starter. The carburetor is of the Stromberg plain tube type. The gasoline system has a capacity of 30 gal. with the tank mounted at the side of the chassis. The gasoline is fed by air pressure, applied through a reducer valve from the air brake system.

The clutch is of the Hele Shaw multiple disc type with a clutch brake. The jaw clutch transmission operates with the gears always in mesh, providing four speeds forward and four speeds in reverse. The reverse gear mechanism is mounted in the sub-transmission. This reverse mechanism contains a differential and permits the power to be transmitted to the car in either forward or backward direction. The mechanism is controlled by a hand lever near the driver similar to the reverse lever of a locomotive and is mounted on ball bearings throughout. It is housed in an oil-tight, dust-tight case and runs in an oil bath.

Power is transmitted from the reverse gear differential to the axles through propellor shafts, each containing universal joints. These have hardened steel bushings and pins and are thoroughly housed in dust-proof, oil-tight casings.



The Convenient Location of Operating Valves and Handles Is Apparent

Both front and rear axles are rigid like the rear axles on a truck and are of the full floating type. Each axle contains a differential through which the power is transmitted to the driving wheels. These axle differentials are also completely enclosed in oil-tight, dust-proof housings and run in an oil bath. The weight of the car is taken on these housings and not on the driving axle. Each trailer axle is made of one piece of cold drawn tubing, of 4 in. outside diameter and ¾-in. walls. This tube is turned at the ends to accommodate the spring seats and the roller bearings on which the wheels are mounted.

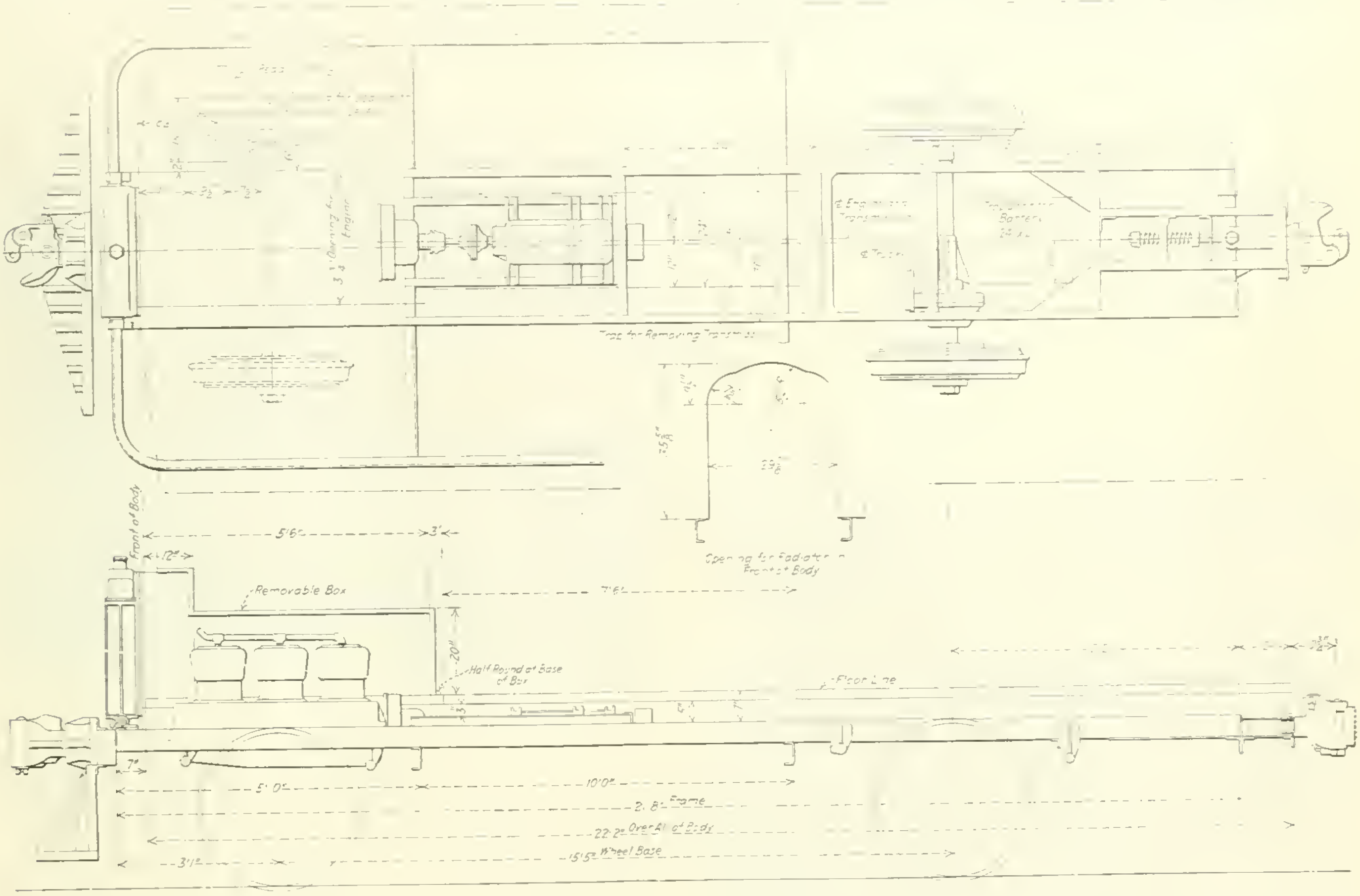
Springs for both the power unit and trailer are 54 in. long, 2½ in. wide and are made of chrome silicon manganese steel, heat treated. These springs are connected to the chassis frame with double-swing shackles which allow the chassis to swing slightly sidewise, thus cushioning the side impacts against the rail and improving the riding qualities of the car. The action of these shackles is very similar to that of the swinging bolster used in railroad cars. The axles are held in place by radius rods, by the adjustment of which the wheels can be brought into accurate alignment.

The wheels for both the power unit and trailer are of the cast-steel, hollow-spoke type. Tires are of rolled steel and have the standard M. C. B. contour. They are 35 in. in diameter and are mounted the same as demountable solid rubber tires. Ball bearings are used throughout the clutch, transmission, reverse gear and axles.

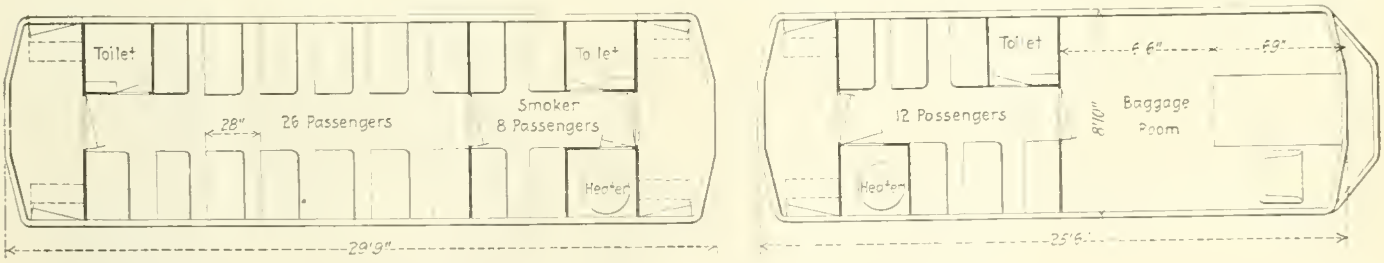
Cast-iron brake shoes are used on all four wheels, there being one brake shoe for each wheel. A Westinghouse air brake system is provided with an air compressor installed at the rear of the transmission. This compressor has a capacity of 10 cu. ft. per min. and is controlled by an automatic governor. An air strainer at the intake prevents dust and dirt reaching the cylinder. This brake system is provided with all necessary safety valves, emergency valves, operator's valves, application valves, etc. It is a two-pipe system similar to that used on street cars, with a direct air system for service applications and an indirect system for emergency.

One sand box, 7 in. by 10 in., is placed at the rear of each rear wheel and at the front of each front wheel. The flow of the sand from these boxes is governed by an air valve at the driver's seat with air supplied from the air brake system.

Standard M. C. B. couplers are used, the front coupler



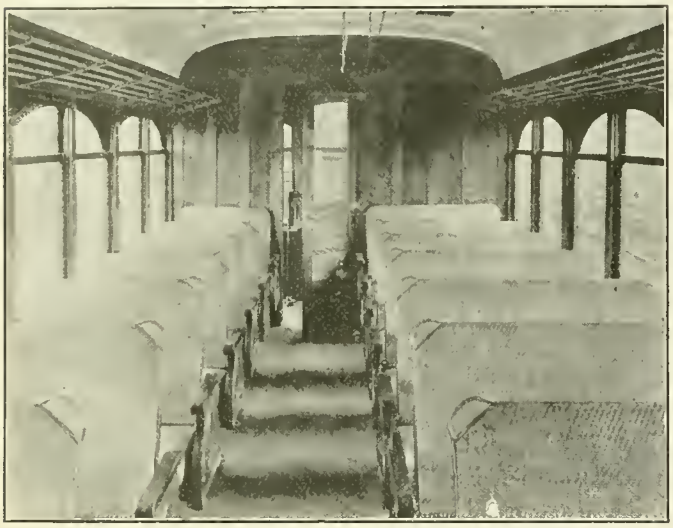
Chassis of the Motor Car



Seating Arrangement of the Mississippi Central Motor Train having a reinforced wooden filler block and being bolted rigidly to the front of the chassis frame. The rear coupler is of the spring type. The front guard is made of white oak, reinforced and braced in a substantial manner.

A two-unit starting and lighting system is furnished, consisting of a starting motor which operates on the fly wheel of the engine through a Bendix drive. A 270-watt generator and 225-amp.-hr. storage battery are used, the system operating on 12 volts. The wiring is of the single wire type with return through the frame of the chassis. All wires are heavily insulated and carried in steel conduits. Connections are provided for the head light, sufficient body lights, the driver's instrument light and rear marker lights. With this lighting system is furnished one head light, one instrument lamp, a lighting switch, an ammeter and a reverse current cut-out. There are also two oil marker lamps and four marker lamp brackets.

With the chassis is provided in the exhaust line a valve by which the exhaust gasses can be shunted through heating pipes in the car body. A series of wrought iron pipes is provided beneath the seats at the left hand side of the body and connected with the heater valve. A hot water heating system can be furnished if desired.


Interior View Showing Walk-Over Seats and Luggage Racks

The maximum drawbar pull, as shown in the accompanying table, is 3,780 lb., obtainable with a gear ratio of 29.40 to 1 in low. The maximum speed with this gear ratio is 5.3 miles an hour and the drawbar pull of 3,780 lb. is obtainable at two-thirds of the maximum speed or about 3.5 miles an hour. With a gear ratio of 15.6 to 1 in low, a drawbar pull of 2,000 lb. is obtainable at about 6.6 miles an hour.

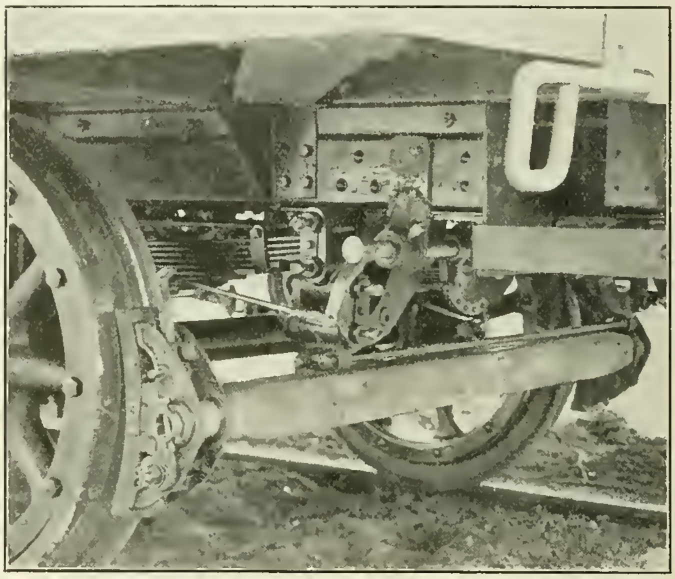
Gear Ratios, Drawbar Pull and Speeds of the Two-Car Motor Train

Gear ratio	Transmission reduction	Drawbar pull at ⅔ max. speed	Max. speed in miles an hour
	Ratio 3.9 to 1 in high		
15.6 to 1	Low	2,000 lb.	10 m.p.h.
7.8 to 1	Second	1,000 lb.	20 m.p.h.
5.4 to 1	Third	680 lb.	29 m.p.h.
3.9 to 1	High	500 lb.	40 m.p.h.
	Ratio 5.0 to 1 in high		
20.0 to 1	Low	2,580 lb.	7.75 m.p.h.
10.0 to 1	Second	1,290 lb.	15.5 m.p.h.
6.86 to 1	Third	784 lb.	22.6 m.p.h.
5.0 to 1	High	645 lb.	31.0 m.p.h.
	Ratio 5.65 to 1 in high		
22.60 to 1	Low	2,930 lb.	6.8 m.p.h.
11.30 to 1	Second	1,460 lb.	13.75 m.p.h.
7.76 to 1	Third	1,000 lb.	20.00 m.p.h.
5.65 to 1	High	730 lb.	27.5 m.p.h.
	Ratio 7.35 to 1 in high		
29.40 to 1	Low	3,780 lb.	5.3 m.p.h.
14.70 to 1	Second	1,880 lb.	10.75 m.p.h.
10.00 to 1	Third	1,275 lb.	15.00 m.p.h.
7.35 to 1	High	940 lb.	21.5 m.p.h.

Note—This drawbar pull is the maximum obtainable. A working safety factor of 20 per cent should be allowed from these figures.

The general dimensions of the passenger-baggage car are as follows: Length overall, 25 ft. 6 in.; width of sheathing, 8 ft. 10 in.; from rail to top of floor, 3 ft. 8 in.; from rail to top of roof, 10 ft. 3½ in.; post spacing, approximately 2 ft. 4 in.; from floor to top of window rest, 2 ft. 4 5/16 in.; from floor to bottom of Gothic sash, 4 ft. 2 7/16 in.; width of door opening in clear, 2 ft.

The following are the general dimensions of the trailer body: Length overall, 29 ft. 9 in.; width of sheathing, 8 ft. 10 in.; from rail to top of floor, 3 ft. 8 in.; from rail to top of roof, 10 ft. 3½ in.; post spacing, 2 ft. 4 in.; from floor to top of window rest, 2 ft. 4 5/16 in.; from floor to bottom of Gothic sash, 4 ft. 2 7/16 in.; width of door opening in clear, 2 ft.


This Illustration Shows the Brake Beam and Brake Shoe Arrangement and the Double Swing Spring Shackle

The inside of the cars are oak grained with the head lining painted white. The sashes are mahogany grained. The outside of the cars are painted in Pullman body color, with black roofs, Pullman truck color platforms and black enameled iron work. They are lettered and striped with imitation gold paint.

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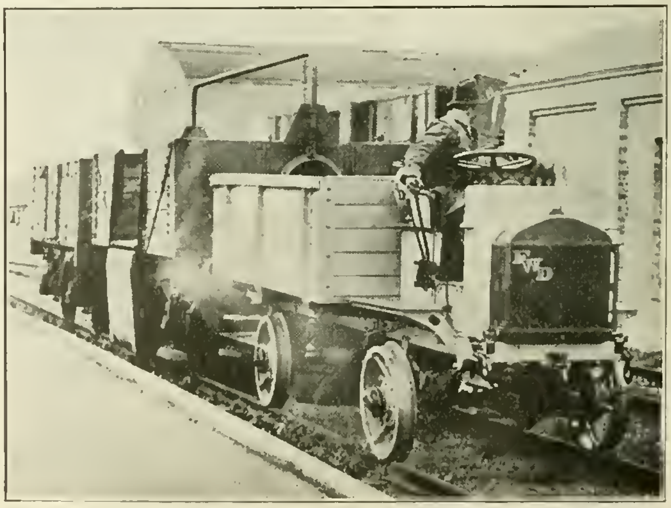
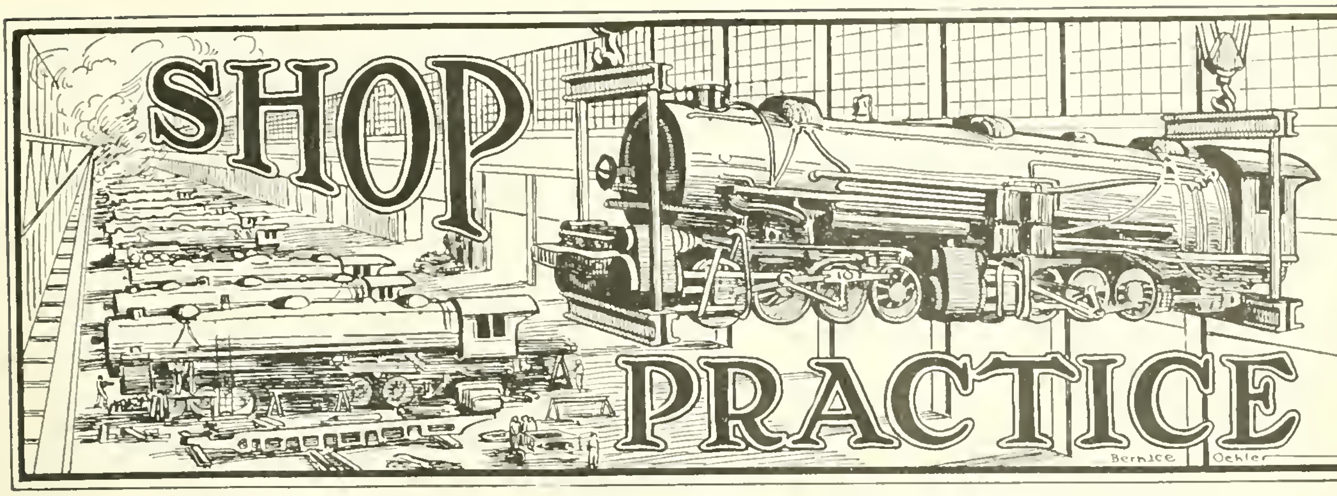


P & A

A Convertible Highway-Railway Motor "Lorry" Used in England



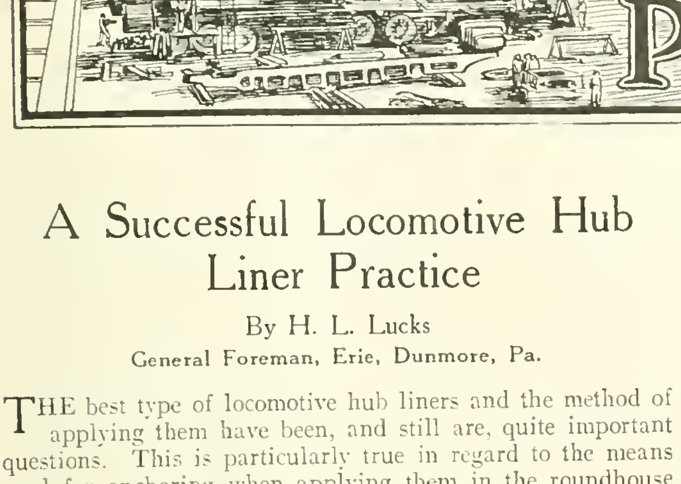
A Successful Locomotive Hub Liner Practice

By H. L. Lucks

General Foreman, Erie, Dunmore, Pa.

THE best type of locomotive hub liners and the method of applying them have been, and still are, quite important questions. This is particularly true in regard to the means used for anchoring when applying them in the roundhouse when the engine is in for boiler washing.

A substantial and lasting liner, which has given excellent service and is applied easily, is shown in the illustration. It is made from ¼-in. steel plate cut out to the size of the recess or the face of the driving wheel hub, and with an inside diameter suitable to go over the axle, as shown in Fig. 1. The liners then are cut in two, beveled at the joint and three 1-in. holes drilled in each half. The first half of the liner is applied by electrically welding it to the hub through the holes and tack welding it on the outer circumference. The engine is then moved, the other half applied in the same manner, and the joints between the halves welded up. The next liner is now taken and similarly applied with its joint overlapping the joint of the first liner, as shown in Fig. 2. This process is repeated until the desired thickness is obtained. The method described is applicable, of course, only to steel driving wheel centers as the electric weld will not tack or fuse to cast iron with sufficient certainty to make the method a reliable one in such cases.



Hub Liners Are Made From ¼-In. Steel Plate Built Up to Desired Thickness

These liners can be carried in stock and then it is a matter only of pulling down the binder and removing the driving box cellar to perform the operation.

Function of the Shop Schedule

By H. V. Styers

HOW does a schedule system apply to repair work on a locomotive? First, you must have a planning department to lay out the work and check up materials, castings, boiler sheets, wheel centers, and various other units that are used in the repair of a locomotive. With a production board properly laid out with the dates of actual working days, the locomotive can be entered, together with the dates when the various operations must be completed in order for the locomotives to go out on time. The operations must be listed in their proper order. For instance, the boiler lagging can not be put on before the boiler is tested, nor is the locomotive painted before all the parts are completely assembled, and all piping in place.

Now the question comes up, what is the erecting shop going to do in case the machine shop does not deliver the rods or pistons and crossheads? There must be a reason why the machine shop foreman did not deliver these parts on schedule time and the man who looks after material reports that bushings of the proper size were not available in the storehouse. The storekeeper is immediately notified and orders placed. In the meantime, the production board shows that the rods were not delivered on time and in the morning when the shop superintendent comes in, he looks at the production report which shows only jobs which are behind. He can then get busy with the responsible foreman and either substitute materials, or get material from some other locomotive of the same class.

With a properly maintained schedule board, *it is possible to put as many locomotives out of the shop the first week of the month as it is the last* when everybody is working to keep the reputation of the shop and the company is paying time and one-half for overtime. Work can be planned just as well in a repair shop as in a manufacturing shop. Work dates should be established by the shop superintendent and changed only by him as he is responsible for the output of the shop. When manufacturing companies pay large salaries to men as production managers and maintain large clerical forces to enter and execute their orders, it surely is advisable for railroads to look after their planning and bring it up to a point of greater efficiency than is now common.

Relation of Stores and Mechanical Departments

Wrong Conditions Are Reflected Upon the Shop Payroll As Well As Upon the Inventory Sheets

By F. M. A'Hearn
Assistant General Foreman, Bessemer & Lake Erie, Greenville, Pa.

VARIOUS tales have been told to illustrate the value of united effort by the different departments of an organization. In no case is unity of effort of more value than between departments of a railroad, this being particularly applicable to the relations of the stores and mechanical departments. Railroads are engaged in selling one thing only—transportation. Were their principal business selling the output of the shops or retailing quantities of materials, then the department which provided the principal reason for the company's existence might well consider its affairs and wants to be of highest importance. We can readily see the folly of the time and effort wasted where each department is inclined to consider only its own interests regardless of its bearing upon the remainder of the organization.

It is not to be implied that railroad officers approve of such actions, nevertheless rules or instructions carried out to the letter must also be carried out in spirit, otherwise the company is not receiving fair treatment. The stockholders, who are our employers, furnish the capital and assume the risks of loss incidental to conducting a business. To them the mechanical and stores departments are equally responsible, and from the common fund earned by their investment, the wages and expenses of each department are paid; likewise from the same fund are paid the losses caused by either department.

Staff Meetings Reveal Lack of Co-operation

Meetings of railway shop supervisory staffs frequently find such subjects as obtaining material and the delays incidental to the failure of the stores department to provide material, topics of importance. In such meetings where stores department representatives are present, the responsibility of such failures is handed back and forth, or "the buck is passed" to considerable extent. The mechanical department endeavors to prove their side by showing the amount of material ordered and the number of days that have elapsed since the orders were forwarded to the stores department. The stores department in turn produces evidence to show that the requirements of the mechanical department have been in excess of all previous requirements for that period of time. They usually contend that they are unable to prepare for unusually heavy demands for certain stock without being given sufficient advance notice. In addition to this, delayed deliveries from manufacturers are frequently the cause of shortage in stock.

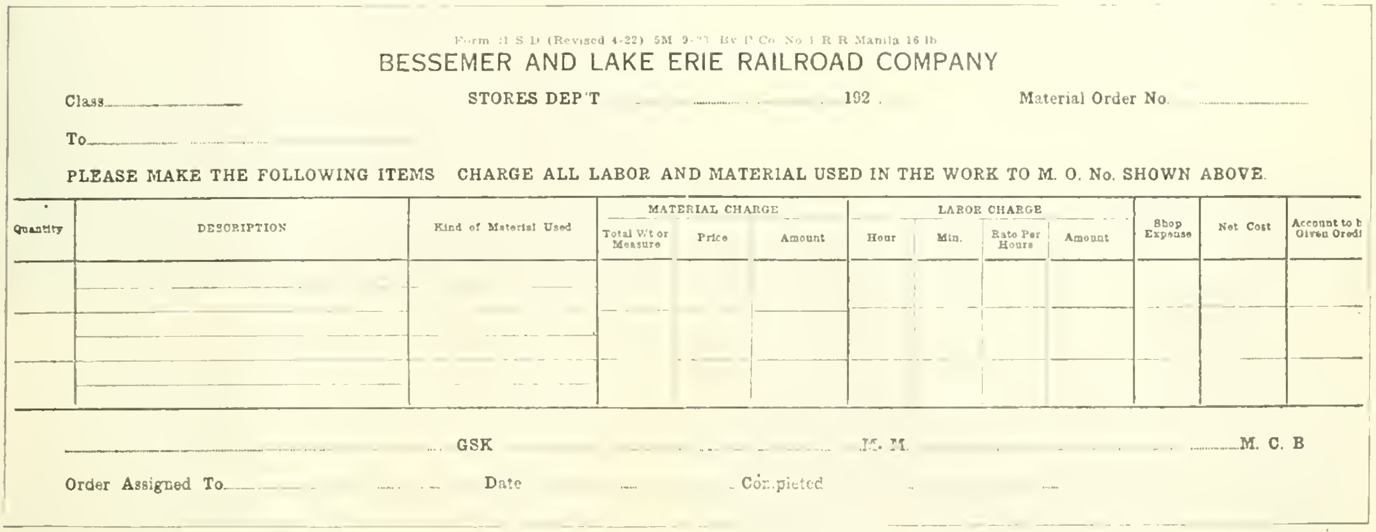
All of this debate, while of interest, does not place the material at the points awaiting it. It is evident that we may

Aeroplane View of the Bessemer Shops at Greenville, Pa.

have two departments not working for the common good. The mechanical department endeavors to show that the stores department is responsible for delays on account of the lack of material. Possibly substitutions could be made but these are not wanted, for shifting the blame to the other department provides a smoke screen for certain omissions or short-comings in its own organization. On the other hand, the stores department in order to show small inventories and low inactive stocks, may pare the requisitions too closely to the detriment of the mechanical department.

Determining Future Requirements

In order that fewer delays occur in the mechanical department and that the minimum amount of stock be carried in the stores department, let us consider the following practice: The mileage that should be obtained from locomotives of a certain class during the interval between classified repairs, is determined by past performances. It is not a difficult matter to make a record of each locomotive at the time of monthly inspection by noting the principal conditions that determine the service period between shoppings, such as fireboxes, flues, tire wear, machinery, etc. From this information we can determine approximately the date when the locomotive will be held from service for classified repairs. Many parts that are not regular stock or are not frequently required, such as cylinders and frames, may be ordered several months in advance for delivery in ample time for application. The smaller parts which can be finished to size, such as eccentrics, main rod bearings, driving boxes, driving box shoes and wedges, driving box saddles, crosshead shoes and gibs, valve gear parts, and innumerable other parts, can be finished in production quantities and carried in stock.



Form 31 S D (Revised 4-22) 5M 9-23 By P Co No 1 R R Manila 16 lb

BESSEMER AND LAKE ERIE RAILROAD COMPANY

Class__________ STORES DEP'T __________ 192 . Material Order No.__________

To__________

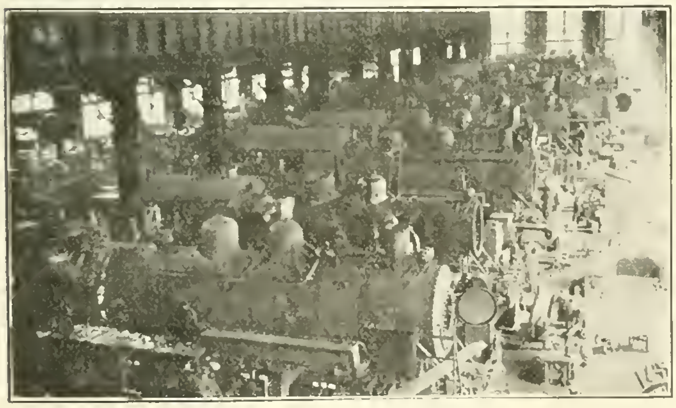
PLEASE MAKE THE FOLLOWING ITEMS CHARGE ALL LABOR AND MATERIAL USED IN THE WORK TO M. O. No. SHOWN ABOVE.

Quantity	DESCRIPTION	Kind of Material Used	MATERIAL CHARGE			LABOR CHARGE				Shop Expense	Net Cost	Account to b Given Credi
			Total Wt or Measure	Price	Amount	Hour	Min.	Rate Per Hours	Amount			

__________ GSK __________ M. M. __________ M. C. B

Order Assigned To__________ Date __________ Completed __________

Form 31 S. D.—Used by Stores Department for Ordering Material from the Shops



Interior View of Erecting Shop

Method of Handling Firebox Renewals

Information concerning the practice of the Bessemer & Lake Erie in handling certain stocks of material was obtained from Guy M. Gray, superintendent of motive power, and R. McAndrew, general storekeeper, both of whom are located at Greenville, Pa. The system by which the stores and mechanical departments of that company co-operate with firebox renewals, as an example, is as follows: A record is made at the monthly inspection of each locomotive, giving in a condensed form the condition of the machinery, driving boxes, rods, flues, fireboxes, and tires. This information is entered on a 3-in. by 5-in. card and filed in the usual manner. At the end of each month a sheet is prepared showing the months of service each locomotive is expected to perform before shopping. During the three months prior to shopping, the class of repairs the locomotive will receive is entered on this sheet.

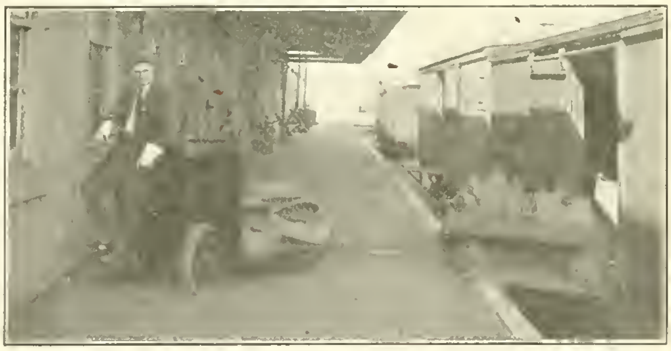


Fig. 1—Type of Trucks Used for Platform and Runway Deliveries

In addition to this information, records are kept giving the date of application of each firebox, and after a certain term of years, an estimated date for firebox renewal is made. With this data available, a fairly accurate program for firebox applications to certain classes of power covering a period of from six to twelve months in advance is developed, and arrangements are made with the stores department for delivery of certain amounts of material at specified times.

A firebox material bill for each class or type of locomotive is furnished the stores department. The bill specifies the numbers and dimensions of the sheets, length, diameter, kind, and number of stays, sizes and amounts of rivets, size and number of arch tubes, and size and number of flue ferrules. Each bill covers sufficient material for one locomotive. In this manner the stores department is enabled to carry sufficient material for current requirements without having a large amount of inactive stock on hand at any time and without having unused stock remaining at the completion of the program of work.

When the material is received, the stores department, upon request of the mechanical department, issues a material order on Form 31 S. D. to the shops to build the required fireboxes. The various departments of the shop that have work to do in connection with the material order are given duplicates of the original. All time and material consumed are reported to the stores department with the return of Form 31 S. D. The completed fireboxes are carried as units on the stores department stock books to be issued together with one bill of miscellaneous parts when a firebox application is made.

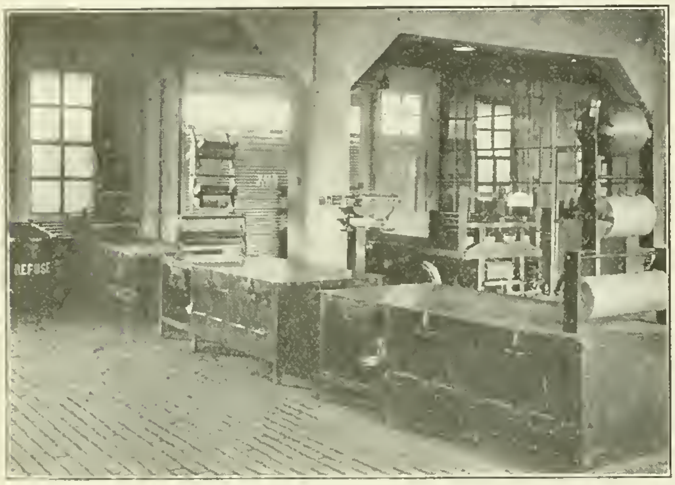


Fig. 2—Interior View of Shipping and Receiving Department

After the completion of the stated program, the items shown on the material bill are not carried in sufficient quantities for firebox renewals, but only in sufficient amounts to cover the regular 30 or 60-day demand if any such demand exists. The material bill referred to is developed from drawings and records of the detailed parts needed for one firebox application. Fig. 5 is a drawing made up by the mechanical department from which the stores department can determine the number, length and style of staybolts required for a firebox on certain classes of engines. The drawing consists of an approximate layout of the crown sheet, door sheet and throat sheet showing the location of the various lengths and styles of staybolts used. The number required can be readily determined by referring from the layout to the table on the same drawing. The shop builds the firebox or fireboxes, which are then carried on the stores department records as units ready for delivery to the shops, the same as if purchased from outside shops.

System for Delivering Material

All material is delivered to the shops by the stores department, and all scrap is removed from the shop by the stores department. The plant is equipped with a private telephone exchange, enabling the placing of all orders for material by telephone. The delivery clerk fills out the order as phoned. The order is signed by the foreman upon receiving the material, who notes thereon the time received. Delivery trucks are operated on a schedule of two hour intervals to all departments. As a further protection against delays, special deliveries are made upon request. The time required between the placing of an order and receiving small materials on special delivery orders is usually from five to ten minutes, delivered to any part of the plant.

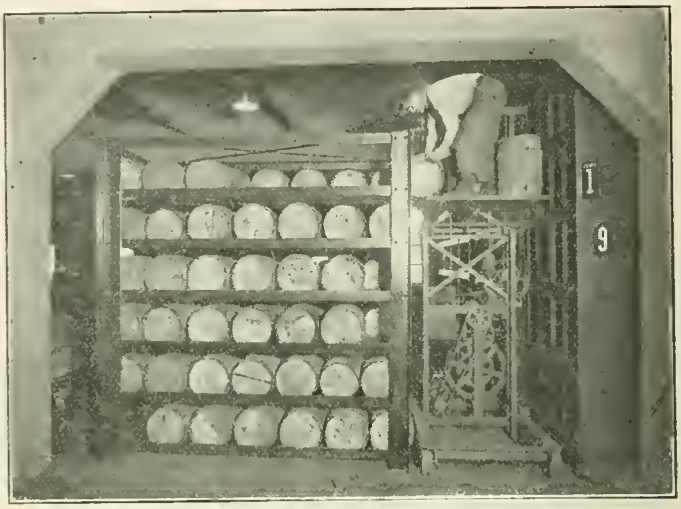


Fig. 3—Storing Kegs of Rivets with a Tiering Machine

Stores Department Provides Excellent Facilities

The storehouse is of reinforced concrete construction, two stories in height, with a one story annex extending beyond the main building. It is centrally located with respect to all departments of the shops, which facilitates the delivery of material. Suitable runways are provided from the storehouse to all points served by the delivery trucks. The type of trucks used for platform and runway deliveries are shown in Fig. 1. The stack bases loaded on the truck have been machined for the stack joints and drilled to fit to the smokebox. Fig. 2 is an interior view of the storehouse at the shipping and receiving department. The work tables or counters are of sheet steel and were constructed in the company shops. Fig. 3 shows a truck man storing kegs of rivets with a tiering machine, built by the Economy Engineering Co., Chicago. The racks are made of standard steel shapes,

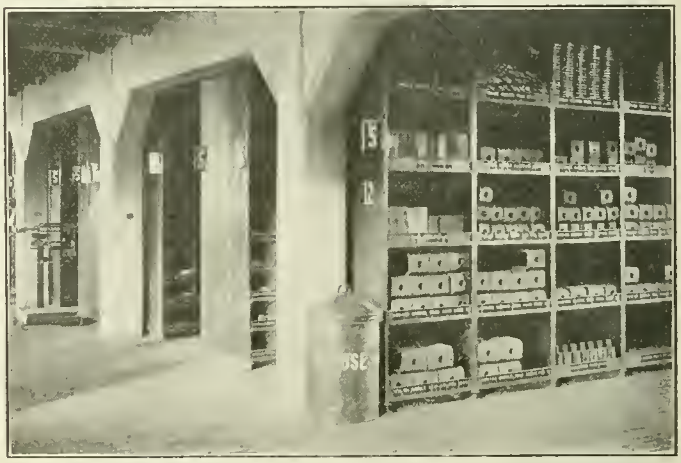


Fig. 4—Style of Stock Bins Used in B. & L. E. Storehouse, Greenville, Pa.

which were also constructed in the shops of the company.

In Fig. 4 we have an illustration of the excellent facilities provided for the handling of material in stock. In the bins in the foreground are various types of locomotive driving box or spring saddles, machined to size and ready for application. The proper identification appears upon each bin, which gives the name of the article, drawing number and line number of the drawing. In the lower row of bins is a stock of crosshead wrist pins rough turned on the body, but threaded and ready for fitting to the crosshead body. In the bins beyond are main rod keys and wedge blocks, wedge bolts, key washers, and various small parts used in rod work. All parts are identified in the same manner as described in the case of spring saddles. There are also in this section spring hangers of various kinds, king bolts, driving spring equalizers, etc.

Amount of Material in Stock Kept Down

The stores department endeavors at all times to keep all stocks of material completed and ready for application as far as possible. At the same time the shops make a special effort to complete promptly and return all orders for the manufacture of material requested by the stores department. It is the practice to keep the amount of stock as small as possible, when by slight alteration a piece can be redesigned to take the place of two or more items that are carried, where one item would be sufficient. Fractional lengths of bolts, both finished and rough sizes, are standardized to simplify the storekeeping. This is typical of innumerable other cases. Any stock of inactive material that may be accumulated is carefully investigated by representatives of the stores and mechanical departments. The inactive material list is kept as low as possible.

In order to avoid carrying any unnecessary material, the stores department will not add any items to its lists to be carried as regular stock unless by written request of the mechanical department. It is not considered necessary to carry a piece requiring an issue of one in six or twelve months as a precaution of what might occur. In order to be protected against a delay at some future time, it has been found to be bad practice to order two pieces of any kind of material when the first failure of the piece occurs. Such a practice will in a short time load the stores department with thousands of dollars' worth of inactive material, which in the course of time becomes obsolete. This is the usual result of such a safeguard against a contingency that never occurs.

Finished Stock on Hand Ready for Application

As an illustration of how the mechanical department functions in having finished material on hand, the writer will cite

NUMBER OF STAYBOLTS REQUIRED																											SYMBOL ON DIAGRAM	LINE	STAYBOLTS
TOTAL		29"	27"	26"	25"	24"	22"	20"	19"	18"	17"	16"	14"	13"	11½"	11"	10½"	10"	9½"	9"	8½"	8"	7½"	7"	6½"	SIZE			
37																						23		14		1"	•	1	Common
358			46	46	46	46	46	46				46		36												1⅛"	○	2	Crown
12											6		6													1⅛"	●	3	Flexible
957														10	8	32	40	62	152	169	166	186	132			1"	×	4	Flexible
6																					4	2				1"	☒	5	Flush Flexible
36								12	6	6		6		6												1"	◉	6	Expansion Stays
36																										1⅛"	◉	7	Expansion Stay Stirrup

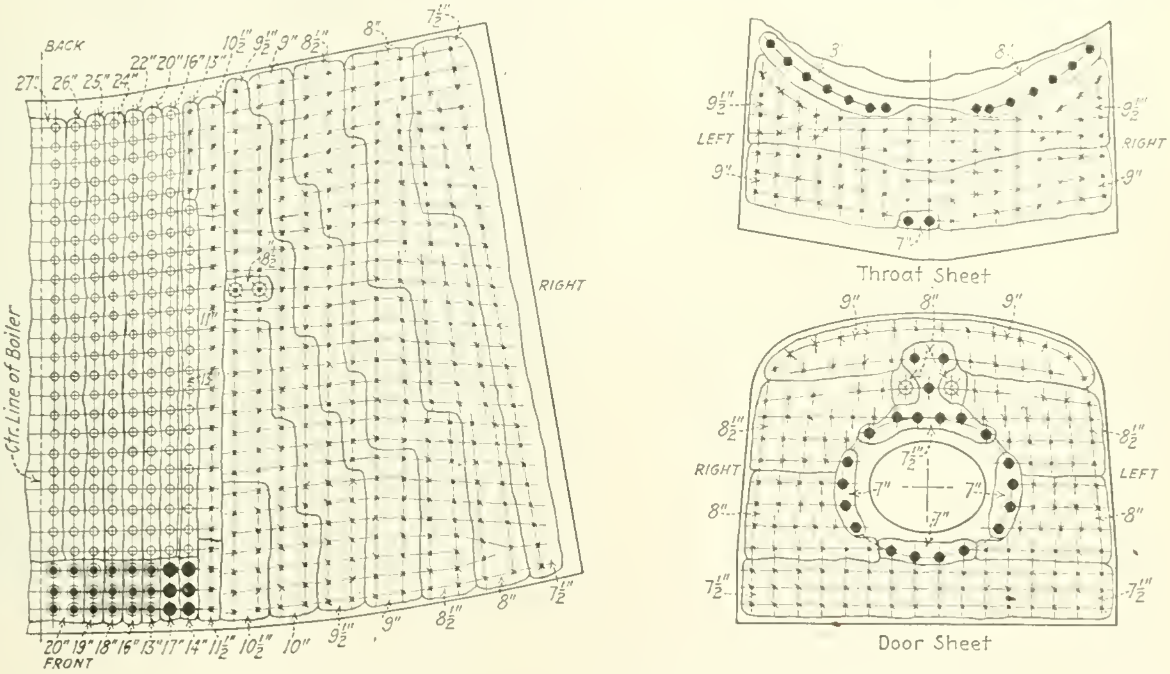
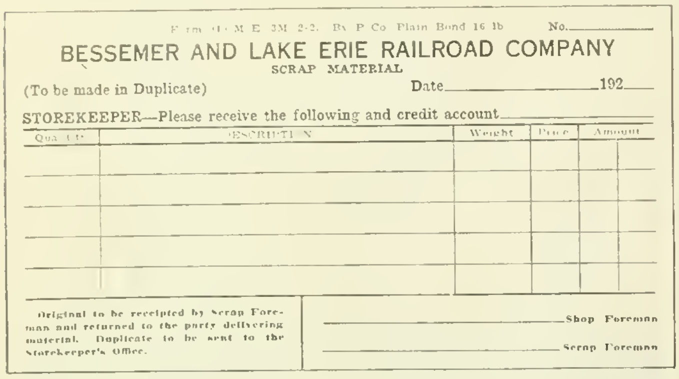


Fig. 5—Drawing from Which the Stores Department Can Make Up Material Bill for Staybolts

a few cases where items are not usually carried as finished stock. All crosshead gibs are machined to standard dimensions. End wear and side wear of the crosshead body is taken up by welding, or by other permissible methods. This is done in order to maintain the standard dimensions necessary to enable the gibs to be carried in stock ready for application without fitting. Guide bars on all types of locomotives are maintained to the original sizes. Side wear is taken care of by planing a recess in each side of the bar and inserting a ½ in. by 2 in. section the entire length of the bar; after this is done the guide bar is finished to the original dimensions. All eccentric blocks for Stephenson type valve gears are held to standard sizes, and all eccentric straps of the same pattern, whether new or used, are interchangeable.



Form 940 M E 3M 2-2. By P Co Plain Bond 16 lb No.________

BESSEMER AND LAKE ERIE RAILROAD COMPANY
SCRAP MATERIAL

(To be made in Duplicate) Date__________192___

STOREKEEPER—Please receive the following and credit account________

Quantity	Description	Weight	Price	Amount

Original to be receipted by Scrap Foreman and returned to the party delivering material. Duplicate to be sent to the Storekeeper's Office.

__________Shop Foreman

__________Scrap Foreman

Form 940 M. E. on Which Scrap Material Is Credited to the Proper Account

This system of standardization is practiced throughout the shops in many details. The taper of every piston rod crosshead key and every valve stem key are the same—½ in. in 12 in. This avoids the delay of waiting for the finishing of rough materials and also illustrates the system whereby the use of numerous pieces of slightly varying types or sizes for the same purpose is eliminated. All driving wheel centers are maintained to standard dimensions, and all driving wheel tires are finish bored ready to apply before being placed in stock.

Disposal of Scrap Material

Scrap material to be credited to any account is recorded on Form 940 M. E. It is made out in duplicate, one copy for the scrap foreman and one for the shops. All scrap is placed at designated stations in the shop and is collected and transferred to the scrap dock by the stores department trucks operated on a regular schedule.

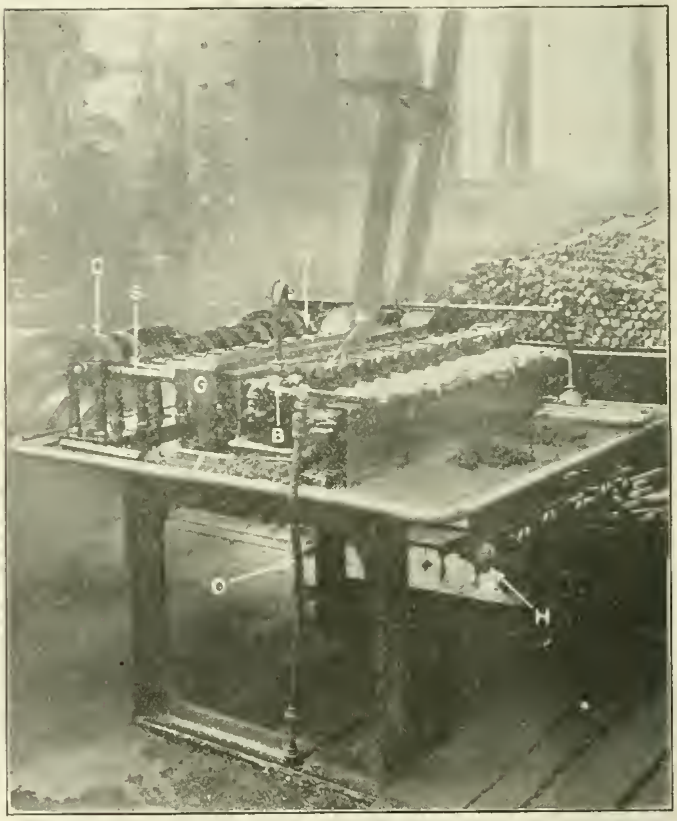
The matter of reclamation of materials has received a great deal of attention from the stores and mechanical departments for many years past and it has been felt that too much material to reclaim is an evidence of bad housekeeping. It also indicates wasteful practice by many who depend upon the reclamation department to salvage good materials carelessly discarded by them. It has been the opinion of the management that there are two places for material after leaving the stores department. One place is in service, the other in scrap, unless it is possible to convert material that would otherwise become scrap to a different use. It is also the practice to anticipate the necessity of renewal of parts by endeavoring to find the cause that brings about the necessity of renewal. We thus tend to avert renewals by avoiding the cause.

Teamwork is practiced as well as preached. The spirit of "putting it over" or shifting the blame is conspicuous by its absence. The lesson is that results are tangible while excuses mean little. Wrong conditions regarding material are reflected upon the shop payroll as well as upon the stores department's inventory sheets.

An Efficient Machine for Drilling Staybolt Telltale Holes

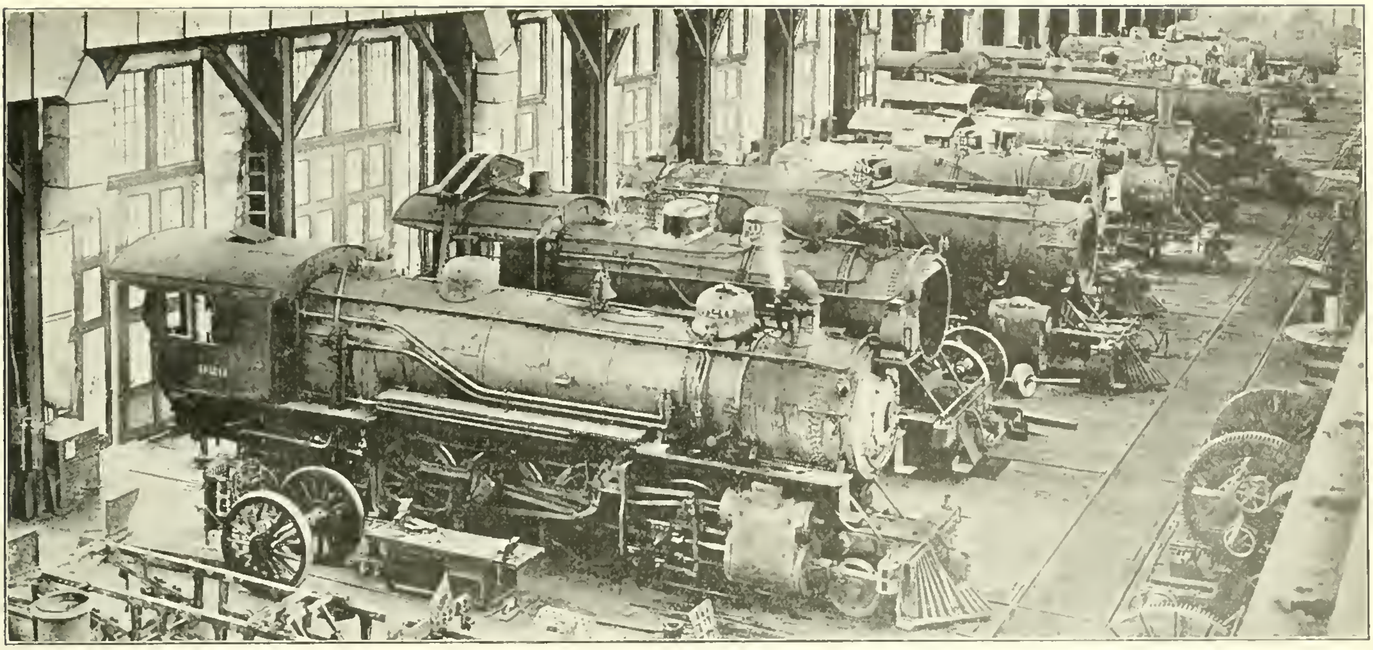
The machine illustrated is installed at the Readville shops of the New York, New Haven & Hartford, being used for drilling telltale holes in rigid staybolts before application to the boilers. While by no means a new machine, it effects an important saving in time and labor for this operation, and may not be familiar to all railroad shopmen.

Referring to the illustration, the machine is seen to consist of a compact and substantial table on which is mounted mechanism for holding the staybolts, driving the drill spindles, and feeding the spindles. Six air chucks, one of which is shown at *A*, are arranged to hold two staybolts each and be operated by six handles as at *H*. Suitable adjusting screws are provided on the chucks and this arrangement enables the staybolts to be put in and released from the machine with a minimum effort. It is evident that 12 staybolts can be accommodated in the machine at one time and 12 drill chucks as at *B* are therefore provided, direct connected to 12 spindles *S* and driven by a train of spur gears from the tight and loose pulley shaft indicated.



Twelve Staybolt Telltale Holes Can Be Drilled at the Same Time on This Compact and Efficient Machine

Drill spindle feed is obtained by the action of six pairs of cams *C*, driven by worm gear *W*. Twelve coil springs which, together with the driving gears, are carefully inclosed under guard plate *G*, provide for the return of the spindles after the holes are drilled. Suitable connections are made from the oil pipe *O* to permit flooding the drills, insuring that they are well lubricated and cooled. The air chucks operate independently so that staybolts can be removed and new ones supplied in one pair of chucks while the others are working. It is obvious that with a suitable arrangement, whereby staybolts are within easy reach of the operator, a very large production of drilled telltale holes can be obtained with this machine.



Erecting Shop Practices—Good and Bad[*]

Facilities and Organization Necessary for Efficiency; How to Extend Mileage Between Shoppings

By Charles Riatt
Assistant Master Mechanic, Atchison, Topeka & Santa Fe, Prescott, Ariz.

THERE is no department of railroad work where organization and systematic methods are so essential to economic production as in the locomotive erecting shop. Given the normal capacity of the shop and the output desired, the labor cost and to a large extent the class of work done depends on the two factors—facilities and organization.

Poor or inadequate shop facilities and poor organization, which means failure to make the best use of force and facilities, spells high labor cost with the added cost which results from holding power out of revenue service, which in turn demands a larger number of engines to handle a given business. The erecting shop is therefore a potent dividend producer or reducer according to its efficiency.

Generally speaking, facilities are increased to keep pace with the output expected, but there are loose ends or practices in organization and methods which materially affect output as well as the quality of the work done in erecting shops, and I wish to mention some of these as I have observed them, rather than dealing with any one or more particular phases of general repair work.

Where Management Counts

Engines should come to the shop in such numbers and sufficiently in advance of the time when shop stalls will be vacant to allow for their being stripped and prepared for their place so that shop space will be fully occupied at all times. Time lost here cannot be recovered. Work reports outlining the class of repairs required should reach the shop sufficiently in advance of the engine so that all new parts required can be ordered and got moving in order to avoid delays for material. The improvements and new appliances called for on nearly all engines coming to the shop make a 90-day advance shopping program the least that can be considered.

Efficiency and Economy

Efficiency and economy should begin in the stripping department. Too much rough stuff is the outstanding sin of stripping gangs and it is too often due to a lack of the proper tools for handling their work. Sledge hammers and chisel bars as stripping tools often send more material to the scrap heap than years of road service.

Shortage of tools in this department is often aggravated by lack of proper toolroom space. The stripping gang should not only have its own tools, but should have a good toolhouse with sufficient room for arrangement of tools so that they can be found readily when wanted. Tool foremen should make a weekly inspection and see that all their tools are kept up to requirements as in this respect stripping gangs are too often left to "a go as you please system."

Engine Stripping

A power device should be available at stripping tracks so that engines can be spotted for removal of rods and other parts without having to resort to pinch bars, and where stripping gangs do not handle sufficient work to justify specialists, the regular shop force should do all stripping of boiler mountings, electrical parts and air appliances as expert handling of these parts will avoid damage to material which will more than offset the added cost.

After all parts are cleaned, all large parts should be stencilled with the engine number or the pit number to which the engine is assigned and a tin tag bearing the same number should be attached to the smaller parts before delivering them to the various sub-departments so that labor and material costs will be correctly charged.

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[*] Awarded honorable mention in Erecting Shop Competition.

Order in Handling Repairs

The date an engine is expected out having been set, all parts delivered to the several sub-departments should be lined up in their order out in relation to other engines and an inspection made by the foreman to determine what new material is required, a list of which should immediately be passed to the material supervisor who should at once see that it is protected by store department stock. A date should then be set for the completion of the various parts in the order they will be wanted for assembling and it is good practice to have a schedule board at each of these sub-departments showing the completion dates of the parts they handle, independent of a general or central board that may be used for such data.

Routing Work Through the Machine Shop

Each sub-department should have the machines required to handle their work located conveniently to save long hauls and so that foremen interested can readily see that it is handled in the order and manner desired. It is also desirable that the sub-foremen should have charge of all the machines so assigned. This is quite practical where general repair schedules are not broken up to meet urgent demands for machine work from the roundhouse—a condition which all of the smaller and many of the larger repair shops have to meet daily. The same trouble arises in shops where system shop order stock is maintained by machines required for general repair work and the machine foremen's morning and evening devotions have very often to be augmented by hiding out periods during the day to escape the wrath of the foreman whose work is delayed. Where possible, therefore, machines should be assigned to roundhouse and stock work exclusively.

Maintaining Standards

All engines getting general repairs should be restored to standard dimensions in all important particulars and to that end standard prints must be available as well as master trammels, gages, etc. This applies particularly to spacing of driving axles, spread of guide bars, length of valve motion parts, piston rods and valve stems, spring hangers and equalizers, etc., as only by this practice can replacement parts be carried to cover breakdowns in service. No condition should excuse a departure from this practice.

Next in importance is the checking of all frictional or wearing parts, such as axle journals, crank pins, piston rods and all carrying gear to see that they are not worn below the safe limit for service. When such parts are approaching the scrapping limit, they should be renewed rather than spend time and labor on them, especially if related parts are renewed, as uniform conditions insure against breakage.

Treatment of Parts to Be Reused

As all revolving and reciprocating parts of a locomotive are subjected to vibration and also to heavy strains which tend to crystallize the metal as well as develop fractures, it is a good practice to anneal all these parts when engines are in for general repairs. Spring hangers and equalizers also should get this treatment. This not only restores the strength of the metal but reveals defects which can be corrected at much less cost than at any other time.

At small shops where furnaces for this treatment are not available, side and main rods and spring rigging parts can be annealed very well by arranging them on old rails set on fire brick supports about 2 ft. above the ground, using scrap wood for a fire.

Valve stem ends and piston rod ends also should be annealed and examined for defects while hot as the draw of keys at sockets and crossheads often ruptures the material at the end of the keyway. This is the surest method of discovering such weakness.

All water, air and oil pipes that are to be used again should be cleaned of all rust and sediment before reapplying them. This usually can be done by hammering and then blowing them out with air pressure or, better still, washing them out with water pressure. All copper pipes should, of course, be annealed and tested before they are covered.

Where Experience Counts

In spite of the best intentions in the world, there are things that escape correction for lack of thought. It should not be taken for granted that driving journals do not need turning because they are smooth and parallel, nor that crank pins do not need attention because they have the same good appearance. These parts bear the whole thrust of the engine and if they have been in service two or three years, there is a flat or worn side that will start the driving box pounding or the rod bearings cutting before they run a thousand miles and the roundhouse force will be fighting them at big expense of material and labor until the engine comes back to the general shop and has these parts turned.

If an engine has a record of repeated trouble from side rods breaking or unequal wear of tires, crank pins should be tested for throw and quarter and this test should always be made when new crank pins are applied. Locomotive builders sometimes make mistakes that run for years before they are discovered, therefore nothing should be taken for granted that can be tested.

When new cylinders are applied, it is good practice to check steam ways for area and see that they are thoroughly clear.

Too much hurry when boring old cylinders and valve chambers costs money for lubrication and valve and cylinder packing. A smooth finish and a uniform size can be made much cheaper with the boring machine than by the action of valves and pistons.

Taper fits in crossheads and valve stems should have a perfect bearing and the taper of keyways and keys should correspond as a sure preventive against the pistons breaking in the crossheads. Proper fitting tapers between piston spider and rod are of equal importance and should not be slighted with the idea that the shrinkage will take care of a poor fit. It is a good guess that many of the unaccountable cases of spiders and piston heads breaking up in cylinders are due to the unequal stresses arising from these poorly fitted parts when under shrinkage strains.

Driving boxes should be tested for parallel with the cellars removed and after the brasses have been bored as the pressure at which brasses are pressed into boxes relaxes somewhat with boring and allows the box to close in at the bottom, thus causing a pound between shoe and wedge.

The application of driving tires is too often handled without a proper regard to the rules governing the size and shrinkage allowance. Loose tires are dangerous and in an effort to avoid them and be on the safe side an equally dangerous condition results from tires bursting or, what is still more common, the cracking of wheel spokes. When the pressure of tires is sufficient to bend steel spokes or to show the impress of the spokes on the axle through the hub—both of which conditions I have seen a good many times—cracked spokes is the inevitable result.

These scattered observations make no pretense of introducing anything new, nor of dealing with the most important phases of erecting shop work. Their object is rather to direct attention to certain rather common practices that creep into otherwise good organizations and seriously affect the maintenance cost of engines after they have been turned out for service, which cost is really the best and only criterion of erecting shop practices and efficiency.

Turning and Rolling Mounted Crank Pins

THE following description and illustrations of a device used in the Billerica Shops of the Boston & Maine for turning and rolling crank-pins while mounted in their respective driving wheels are made available for readers of the *Railway Mechanical Engineer* through the courtesy of T. Jennings, superintendent of shops.

Owing to the heavy weight of modern locomotive reciprocating parts and the tremendous pressures exerted on crank-pins in service, the latter are subject to more or less rapid wear, and the problem of maintaining the bearing surfaces of pins in true cylindrical form is a difficult one. Pins which are badly worn can be improved by filing, but it is difficult and in fact practically impossible to get an accurate cylindrical surface by this method. As a result the pins are usually either pulled and trued by grinding or in an engine lathe, or else put back into service in imperfect condition. In the latter case, rod bushings must be bored to the largest diameter of the worn pin in order to be applied and consequently have undue play at other points on the pin. Excessive bushing wear results, so that bushings fitted to worn pins frequently show as much wear after one week as they should after several months' service.

In view of the above facts, the importance of maintaining accurate, smooth crank-pins can be appreciated, and railroad men have long been on the lookout for some device for quickly and accurately truing the worn pins without removing them from the driving wheels. Portable machines for this purpose are available and greatly to be preferred to hand filing, but in general they are far lighter and less rigid than the device illustrated. In addition, portable crank-pin turning machines afford no provision for rolling after turning. Quartering machines are also sometimes adapted to turning mounted crank-pins, but in this case it is sometimes difficult to eliminate chatter and there is also no provision for rolling. The device shown in Figs. 1 and 2, however, can be used satisfactorily for both turning and rolling mounted crank-pins. It is powerful, accurate, easily adjusted and rapid in operation.

The device consists of a heavy, right-angle steel arm *A* (Fig. 1) of large proportions keyed to the outboard end of the boring bar *B* of a standard horizontal boring machine. This bar is counterweighted by means of weight *W* to compensate for the unbalancing affect of arm *A*, allowing a uniform turning moment to be transmitted to the boring bar. The driving wheel journals rest on a pair of *V*-blocks (one of which is shown at *V*) bolted to a rigid frame work *FF*, built up of 1-in. by 4-in. steel bars firmly riveted together. This framework is supported at a fixed distance from the boring mill on a substantial concrete foundation 3 ft. deep. The V-blocks are adjusted to be parallel with the boring bar, and the driving wheel axle is accurately leveled to take account of different journal diameters by means of suitable shims. Handle *H* extends to the standard operating handle of the horizontal boring machine, enabling the boring bar to be started and stopped while the operator remains close to the work.

Referring to Fig. 2, which gives a close-up view, the arrangement of the round-nose cutting tool *T*, tool block *M* and head *N* of the tool block adjusting screw will be evident. Tool block *M* slides in suitable ways in arm *A*, the radial position of the cutting tool being adjusted by turning head *N* of the feed screw.

In truing a worn crank-pin the first operation is to set the driving wheels on the V-blocks with shims to level the axle. The wheels are then removed until the crank-pin is in approximately the upper position, when two clamps *C* and *D* (Fig. 2) are applied over the spokes of the wheel as shown, the lower ends of these clamps being bolted to the built up framework with nuts providing for adjustment. In other words by loosening the adjusting nut which holds clamp *D* and tightening the nut which holds clamp *C* the crank-pin will be revolved away from the operator as he stands in Fig. 2. The driving wheel is therefore adjusted by this means until the crank-pin is in the same vertical plane as the boring bar. The boring bar is then adjusted vertically until its center line is at the same elevation as the crank-pin center line. Both of these determinations are made by means of a lathe center in the end of the boring bar which also fits in the crank-pin center hole when adjustments are correct. This setting of the boring bar and crank-

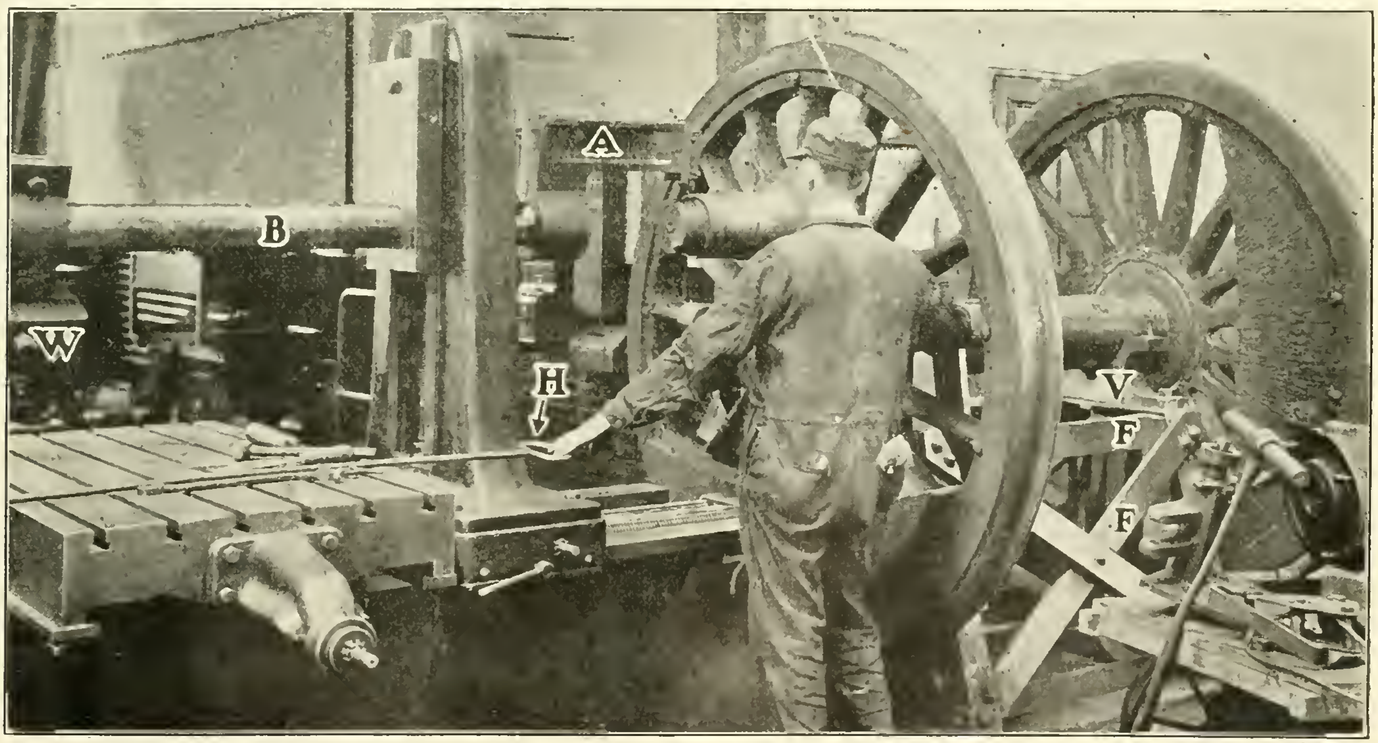


Fig. 1—Front View of Boring Mill Attachment for Turning and Rolling Mounted Crank-Pins at the Billerica Shops of the Boston & Maine

pin is checked, however, by revolving the boring bar and making sure that the cutting point of the tool moves in a circle concentric with the crank arm bearing surface. This surface has not been subject to wear or distortion like the crank-pin center and therefore gives a more accurate measure of the original center line of the crank-pin. It is essential to take these precautions in lining up the crank-pin and boring bar in order that the distance between the center of the pin and center of the axle may remain standard and not change the stroke of the piston.

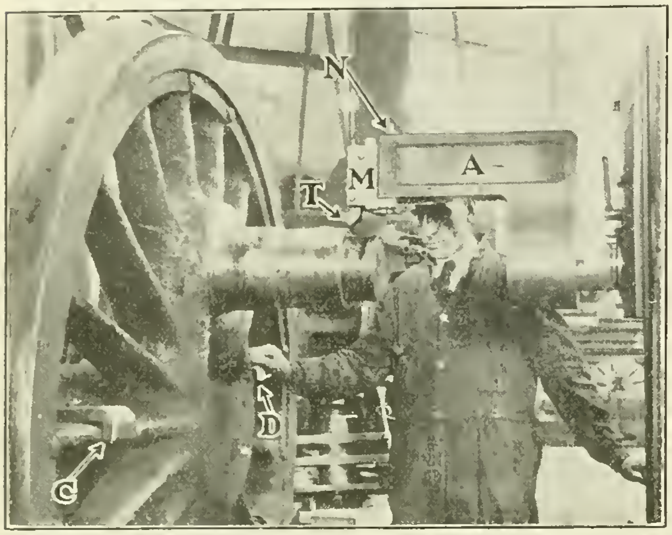


Fig. 2—Close-up View Showing Tool-holder and Adjusting Clamps

Crank-pins must be renewed after being reduced through wear and machining to a limiting diameter and it is important therefore to remove as little metal as possible in truing the pins. The cutting tool is adjusted with this in mind. After the turning operation has been completed on both bearing surfaces of a pin, the cutting tool is replaced by a hardened steel roll and the pin rolled in accordance with customary engine lathe practice. The crank-pins on the pair of wheels illustrated, 9 in. in diameter, were turned and rolled in 2½ hr., floor to floor.

Making Round Head Bolts From Bar Stock

By L. K. Silcox,

General Superintendent Motive Power, C. M. & St. P.

QUITE a saving is effected at the Milwaukee shops of the Chicago, Milwaukee & St. Paul by the use of round head bolts made direct from bar stock instead of the usual hexagon head forged bolts for locomotive frames and cylinders. An analysis of the operations required to make and fit a frame bolt by the usual method is as follows:

No.	Description of Operation
1.	Bar iron taken from stock pile to shear.
2.	Cut to required length for forging.
3.	Taken to forging machine.
4.	Heated and headed.
5.	Placed in store stock.
6.	Sheared to length if exact length is not available.
7.	Ends faced and centered on centering machine.
8.	Moved to lathe.
9.	Turned to size and length.
10.	Moved to bolt cutter.
11.	Threaded.
12.	Returned to engine lathe.
13.	Turned and fitted as required.

The same results are accomplished in the round head bolt system in two operations, thus:—

No.	Description of Operation
1.	Bar iron from stock to bolt lathe.
2.	Bolts completely turned and fitted on turret lathe.

It is self-evident that there is a direct saving in labor of eleven distinct operations and of the use of three machines and one furnace.

Straight bolts are used for all frame and cylinder work except very long bolts in frame splices where extended taper bolts are used. Straight holes are reamed in groups to exactly the same diameter which permits the turret lathe operator to adjust turning tools for finishing the entire group without change in setup. It has been found that the advantage in time consumed in fitting bolts is at least 35 per cent in favor of the bar stock system, and that the efficiency of bolting is equal to, if not better than, the forged end engine lathe turned bolt.

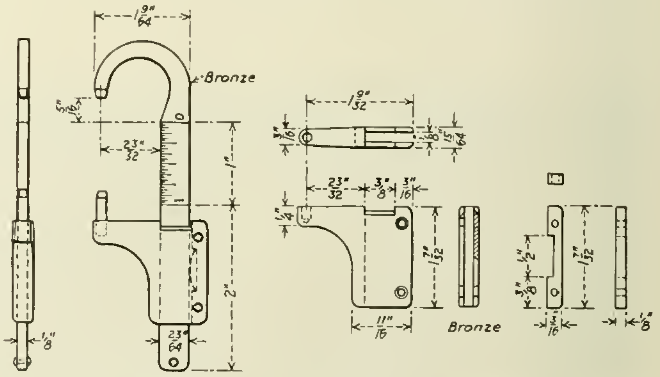
A greater advantage is also found in the simplification of the store stock, because bar iron only needs to be carried in stock as compared with the multiplicity of sizes and lengths of bolts that must be stocked when forged bolts are used. We have also found that there is a great possibility of wastage in not having the proper length of bolt in stock and cutting down longer lengths than necessary when odd sizes are required for immediate use.

There seems to be no good reason for the use of a hexagon headed bolt where the value of the bolt depends largely on the efficiency of the driving fit and the principal stresses are shearing. There is no occasion to turn or hold such bolts with a wrench. In some cases, it seems to be advisable to continue the use of the hexagon headed bolt, for example, engine truck and binder bolts which may be frequently removed in the course of roundhouse maintenance or where it may be desirable to be able to hold the bolt with a wrench to facilitate quick running repairs.

Boiler Plate Gage

By E. A. Miller

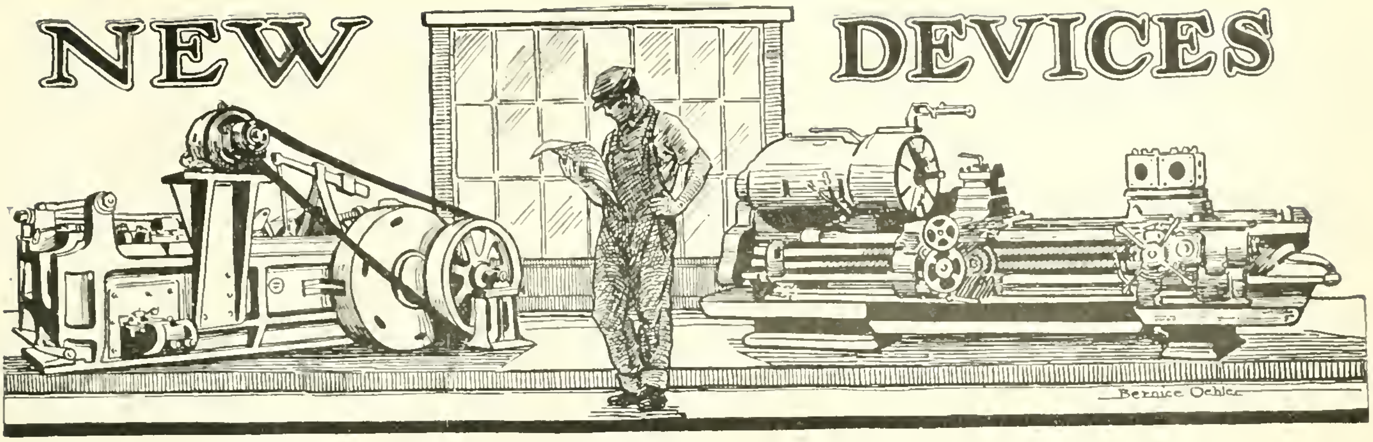
A CONVENIENT boiler plate gage for the use of inspectors and foremen is shown in the illustration, the goose neck effect being provided so that sheets having a rolled edge can be readily gaged. For plates thicker than 5/16 in. and having a rolled edge all around, a larger goose neck gage will be necessary of the same type as illustrated.



Simple but Convenient Boiler Plate Gage for Boiler Inspectors

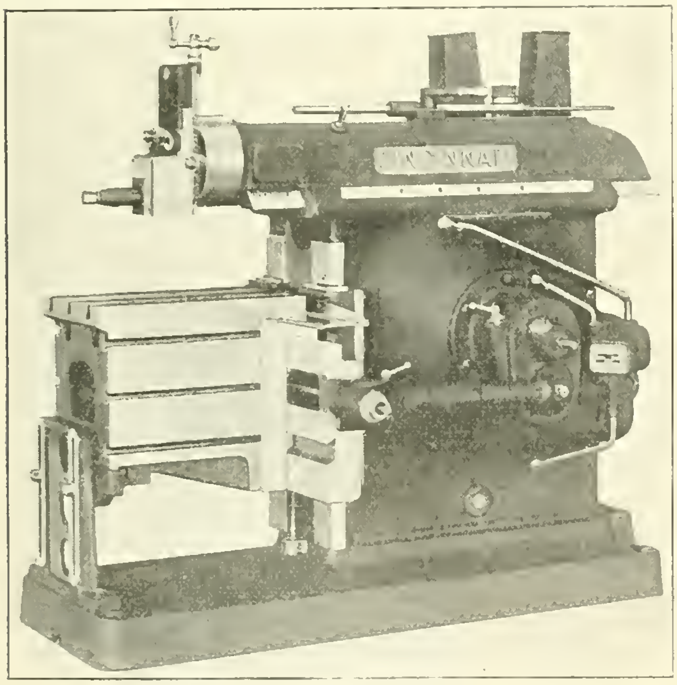
Referring to the illustration, the body of the tool is made of bronze, finished all over and graduated as shown. The slide likewise is made of bronze, slotted on one side to receive the filling piece after the small spring has been put in place. The filling piece is riveted using ⅛ in. rivets in countersunk holes, the slide then being capable of movement on the body with just the required spring tension. A ⅛ in. bronze stud or anvil ½ in. long is sweated in the hole in the slide as shown in the assembly view. This anvil projects 5/16 in. beyond the slide so that when the calipering points touch, the slide is at zero on the scale.

This gage can be easily constructed and will prove a reliable and valuable tool for boilermakers and inspectors.



A Shaper With Several Unique Features

A NEW line of shapers, to be known as the Cincinnati Climax, is now being manufactured by the Cincinnati Shaper Company, Cincinnati, Ohio. These machines are built in seven sizes; namely, 16 in., 20 in., 24 in., 28 in., and 32 in. heavy duty type, and in two sizes, 20 in. and 24 in. of the standard type. These machines contain a number of unique features, one of which is the feeding motion that is actuated by cams and not by an eccentric and ratchet. This provides for a gradual, rather than for an abrupt feed, and it confines the entire feed under any condition wholly within the return stroke. Eleven feeds, ranging from .010 in. to .170 in., are provided. The feed variation is accomplished by means of a lever, mounted on a direct reading dial, indicating the feed in thousandths.

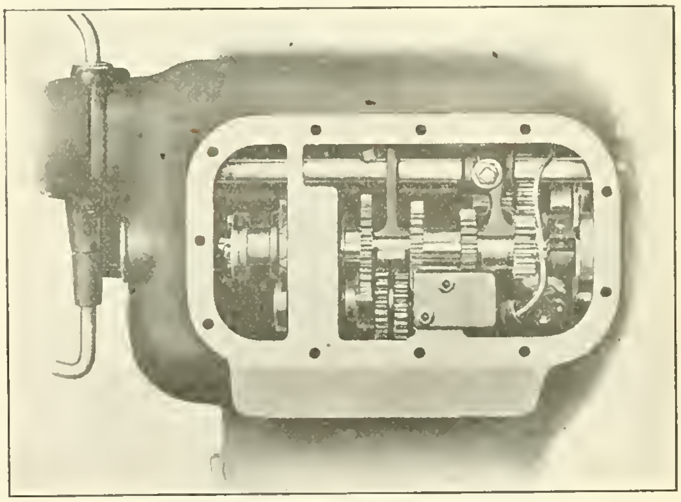


Cincinnati Climax Shaper

Another feature of the general feed arrangement is the omission of the usual feed box on the end of the cross rail. This mechanism has been placed on the side of the column in a position where it will not encroach upon the operator's working space. All speed and driving gears run in oil, slide on integral multiple key shafts and are placed within the column. The lubricating system is of the automatic visible type which supplies oil to the bearing surfaces of the machine.

Eight selective changes of speed are provided, from 11 to 138 cutting strokes per minute on the 16-in. to 9 to 102 cutting strokes per minute on the 32-in. shapers. The levers for starting, speed control, feed engagement and variation, and ram and stroke adjustment are all easily reached by the operator without leaving his working position. Direct reading indicators for speed, feed and length of stroke are provided. The main crank gear is of the helical type and is made in one piece of semi-steel. All the other gears are made from chrome nickel steel and are heat treated. The gear chamber forms the reservoir for the oil used for lubricating both the drive gears and the balance of the machine. The machine is completely guarded both for the operator's protection against danger from moving parts and belts, and also for the protection of the sliding surfaces against chips.

The drive is of the single-pulley type with friction clutch and brake. The pulley shaft is mounted on roller bearings. The machine may be driven by a motor mounted directly on pads provided on the back of the tool. The construction permits the addition of the motor at any time without difficulty. On account of being able to have both sides of the ram ways in the column cast solid with it and to provide for complete adjustment to the ram ways by means of a single screw, thereby taking care of any play in either a sidewise or a vertical direction, the V-type ram was adopted



View of the Gear Box with Lid Removed

by this company. A guard that forms part of the ram prevents dirt from working its way into the bearings.

The length of stroke is maintained without the usual clamping nut on the stroke adjusting shaft, the purpose of the nut being fulfilled automatically. The indicator shows the setting for the length of stroke irrespective of whether the machine is running or not. The separate crank gear bearing permits a solid crank gear and makes possible a replaceable bushing as in other bearings. The tooth proportions adopted eliminate undercut in the pinion, provides full contact in action, and at the same time give equal strength in the teeth of the gear and pinion, which are of different materials. The crank gear journal is especially long and of two diameters. The purpose of the enlarged portion is to provide additional strength and bearing surface at the point of greatest strain, while the length of the smaller portion maintains the alinement.

A special feature is the close proximity of the crank gear bearing to the rocker arm. In addition, the gear portion of the wheel is made to overhang the bearing, thus bringing the driving load further within the bearing.

The crank pin, of drop forged steel, hardened and ground, is held in the dovetailed slide of the crank gear by a taper gib. The rocker arm is of a closed type, made of semi-steel. It is fulcrumed at the bottom, and connected to the ram by a link. The fulcrum and link pins are hardened and ground.

The sliding block is of gray iron, having a hardened and ground steel taper gib on its driving side to compensate for wear. Thus there is a hardened steel crank pin bearing in the gray iron sliding block, and a hardened steel crank block gib which bears against the semi-steel rocker arm.

The cross rail is square locked to the column, a type of clamping best suited to resist the direct thrust of the cut. Side alinement is maintained by a taper gib. Felt wipers remove any dust from the face of the column while adjustment is being made. The vertical screw is stationary and made in one piece. The thrust of the revolving nut is taken by a ball bearing. The screw does not project below the floor level.

A heavy steel guard protects the rail bearing from chips. This guard does not in any way decrease the working surface of the table, nor interfere with the operator. The apron is provided with T slots for holding the work when necessary. These T slots do not run across the entire width, but leave reinforcing ribs at the center and sides, thus providing a much stiffer member than would otherwise be the case. A slot is placed across the face of the apron for alinement of fixtures. The apron is secured to the long narrow guide of the cross rail by taper gibs at the top and bottom.

The table is practically a complete box section, having but small openings in the front and bottom. It is secured to the apron by six bolts. The spacing of the T slots is such that the vise will fit either the top or the sides. The table support is of improved design, the sliding action taking place at the bottom of the table instead of at the shaper base. With this type of support, parallel action is not dependent upon the exact alinement of the base. Protection against chips and dirt is complete. The base is made of box section closed at the top and serves to catch oil dripping inside of the column.

New Three-Way Open-Side Planer

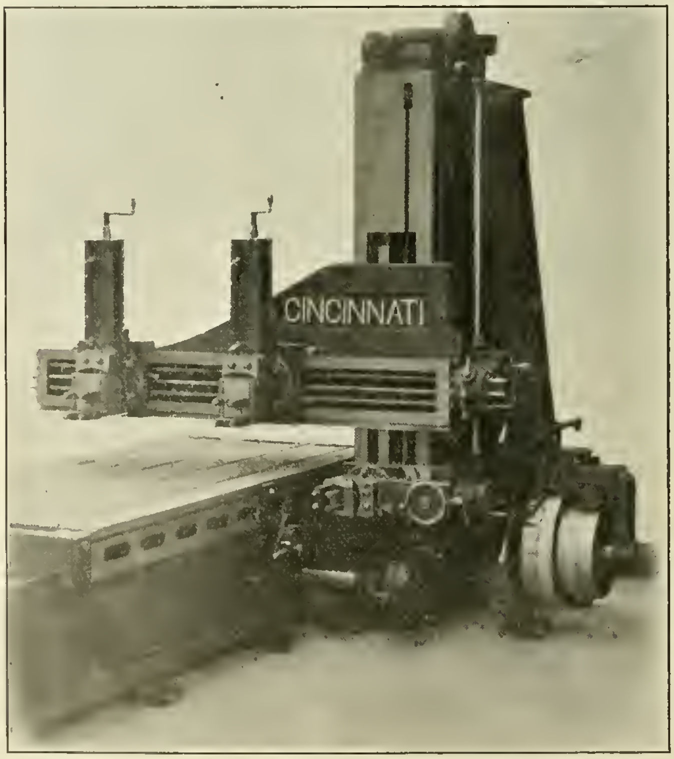
The Cincinnati Planer Company, Cincinnati, Ohio, has just built a special planer which has a bed with two vees and one flat. The box table has five T slots for clamping purposes. The table is also equipped with a table clamp and inner guides to avoid any possible chance for it to lift or tilt out of the track. All ways are provided with forced lubrication which is accomplished by means of a reversible pump that forces the oil into the ways directly under the tool. The oil, before reusing, is settled and strained to avoid dirt from getting into the ways.

The rail is of the extended type and is so constructed as to take care of the strains when cutting at the extreme end. The knee carries the same outline as the rail and is securely bolted and dowelled. Large T-slot blocks, made the full length of the knee bearing, are used for clamping the rail against the column. This insures both a stiff knee and a stiff rail.

The heads are equipped with rapid power traverse in both directions. They have been made exceptionally long so that they can plane some distance below the rail. With this type of head construction the slide can have full bearing on the harp at all times and the down feed screw is always in tension. The rail is equipped with a power elevating device for raising and lowering. A limit stop prevents the rail from being raised beyond its maximum height.

The column is braced and ribbed on the inside in a manner intended to prevent distortion and, in addition to being bolted and dowelled to the bed, a large tongue cast integral with the bed fits a groove in the column, which further provides against moving.

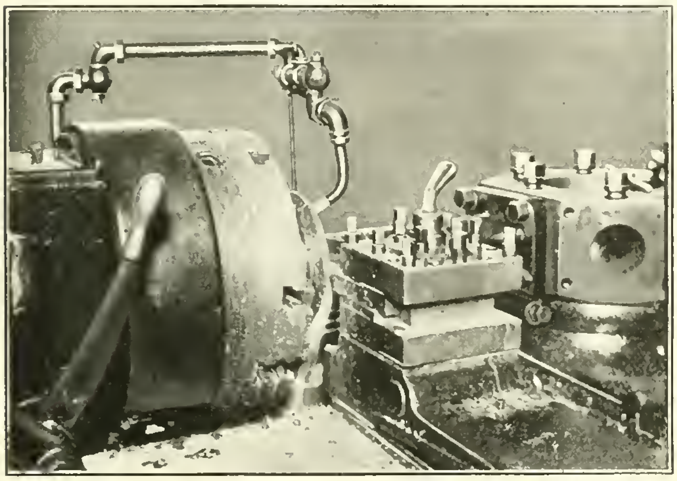
This machine is equipped with a rapid power traverse to the side heads which allows the operator to raise and lower the rail heads by pulling the rapid traverse lever in the direction which he wants it to go. The slide is equipped with a hand wheel for feeding, which eliminates the old method of a crank handle which was a source of trouble when reaching to the extreme limit with the slide.



Special Open Side Planer—Cincinnati Planer Company

New Development in Cutting Metal

An important development in cutting metal has recently been brought out by the Chesterfield Metal Company, Detroit, Mich. This metal is known as Chesterfield cutting metal. It is described as being a non-corrosive, non-ferrous, non-magnetic cast alloy of semi-rare metals. Its composition is such that it cannot be annealed, tempered or heat treated in any way that will improve its cutting qualities. The elasticity of the metal is very low. This feature can be more readily appreciated when one considers that its scleroscope hardness is approximately 70, yet it is decidedly harder to file or grind than high speed steel that scleroscopes considerably above this figure. Although the metal is considerably harder than high speed steel, it maintains its cutting edge under the most severe conditions.


Facing Outside of Side Rod Collar With Cutting Tool of Chesterfield Metal—Speed, 96 R. P. M.; 32 Thread Feed; Depth of Cut, 1/8 Inch

Extensive tests run on railroad shop work show that the metal has ample strength to support the tool combined with a degree of toughness which eliminates the breaking and chipping heretofore encountered with cutting alloys. Chesterfield cutting metal can be ground either on a dry or flooded wheel. However, it is not deemed advisable to quench it in water when hot as the surface may be fractured. In manufacturing, it is cast to shape and, being already hard, it merely requires grinding to be ready for the machine.

A number of tests were made recently in a railroad shop to determine the suitability of this cutting metal for railroad work. There was a saving of 1 min. 50 sec. in facing the back of front side rod collars. From ten to twelve pieces were completed in this operation with Chesterfield metal before it was necessary to grind the tool. Comparative tests using high speed steel showed that it was necessary to grind the tool after performing this operation on from two to three pieces. The time required to make the cut with high speed steel was 3 min. 10 sec., and with Chesterfield metal, 1 min. 20 sec. The depth of the cut varied from 1/16 in. to 3/32 in. From the outside diameter to the center the cutting speed decreased from 188 ft. per min. to 91 ft. per min.

Operation on Piston Rings
Machine -- 36 in. Bullard Boring Mill
Material -- Hunt-Spiller Iron
Length of cut, boring and turning 14 in.

Test No.	Operation	Tool Used	R.P.M.	Cut ft.	Feed	Cut Depth	Time Min.	Floor to Floor Time High Speed Steel	Floor to Floor Time Chesterfield Metal	Floor to Floor Time Saving
	Boring and turning	C.M.*	18	95.4 103.7	5/64	3/16 - 1/4	10	142 min.	75 min.	67 min.
	Boring and turning	H.S.S.*	11	58.3 63.4	"	"	18			
	Cut 21 R.	C.M.	25	143.9	.009	3/16 in.wide	35			
	Cut 21 R.	H.S.S.	11	63.4	"	"	112			
2	Boring and turning	C.M.	18	89.5 103.7	5/64	1/4	10	168 min.	95 min.	73 min.
	Boring and turning	H.S.S.	11	54.7 63.4	"	"	18			
	Turn 20¼ diameter	C.M.	25	143.9	.009	1/2 in.wide	25			
	Turn 20¼ diameter	H.S.S.	11	63.4	"	"	90			

* Chesterfield Metal
High Speed Steel

Results of Two Tests on Boring, Turning and Cutting Piston Rings

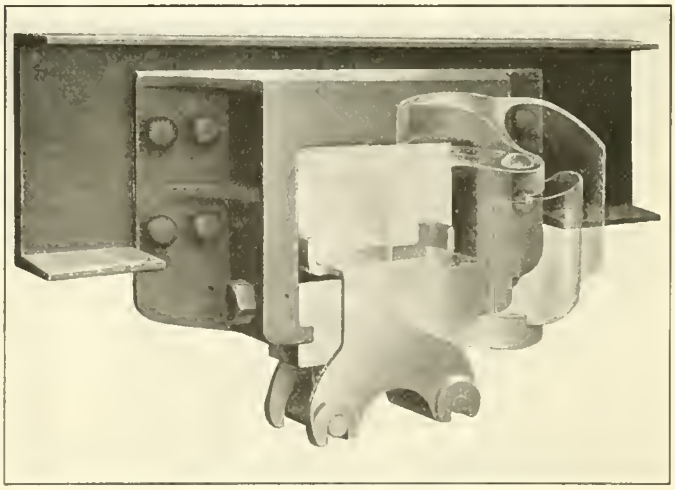
The results of two tests run on a 36-in. boring mill are shown in the table. In the first test a saving of 67 min. was brought about by the increased speed and depth of cut the Chesterfield metal was able to withstand. This saving was considerably bettered in the second test although it was run at practically the same speed and feed as the first test.

A Swing Carry Iron and Centering Device

The Tuttle Railway Supply Company, Inc., New York, has placed on the market a combination carry iron and centering device that contains several novel features in its construction.

The coupler shank rests on a movable casting supported by swing links from the carry iron. The swing of the links permits the coupler to move to either side of center with little friction. It is always in center position when free on account of the weight of the coupler being supported entirely on the links and swing carry iron.

Aside from the usual results obtained by the use of centering devices, the manner in which the coupler is supported prevents wear on the bottom wall of the coupler shank and the top of the carry iron. The principal wearing points are the bearing surfaces of the swing carry iron and links. No bolts, rivets, pins or cotters are required in its construction. This device is known as the Economy swing carry iron and centering device. The illustration shows its application to the striking plate of a freight car.


Economy Swing Carry Iron and Centering Device

The Master Radial Drilling Machine

THE present development of American-made machine tools in automatic features, power, durability, easy manipulation, wide range of cutting speeds, etc., is a high tribute to the machine tool industry. Its ingenuity in solving problems and persistence in overcoming obstacles have made this development possible.

One of the basic machine tools is the drill, and from a very crude beginning this machine has been improved until it can perform feats undreamed of in former days. The new Master radial drill (Fig. 1), recently placed on the market by the Cincinnati Bickford Tool Company, Cincinnati, Ohio, can drive a 3-in. high speed drill through 55 point carbon steel at 101 r. p. m. and .025 in. feed, or at the remarkable rate of 2.53 in. per min. Besides power this machine has other valuable features which will be referred to later.

The Master radial drill, with a 20-hp. driving motor and a 22-in. column, can be furnished in arm lengths from 6 to 10 ft. It is particularly suited for railroad shop and engine-house drilling operations because of its power and ready adaptability to handle all kinds of drilling jobs commonly encountered in locomotive and car repair work.

The radial arm is made in box section, including the ribbing, which gives it great strength. The arm swings with surprising ease considering its weight, and lowers at double its elevating speed. Each of the arm lugs is provided with a limit screw to prevent undue sagging when the binder levers are unclamped. The elevating screw is fitted with a ball thrust bearing and patented safety nut, and is so designed that it can neither be set in motion by accident nor remain in motion after the arm reaches its limits of movement. The arm binder and interlock is a recently patented feature which prevents the elevating screw from being set in motion while the arm is clamped.

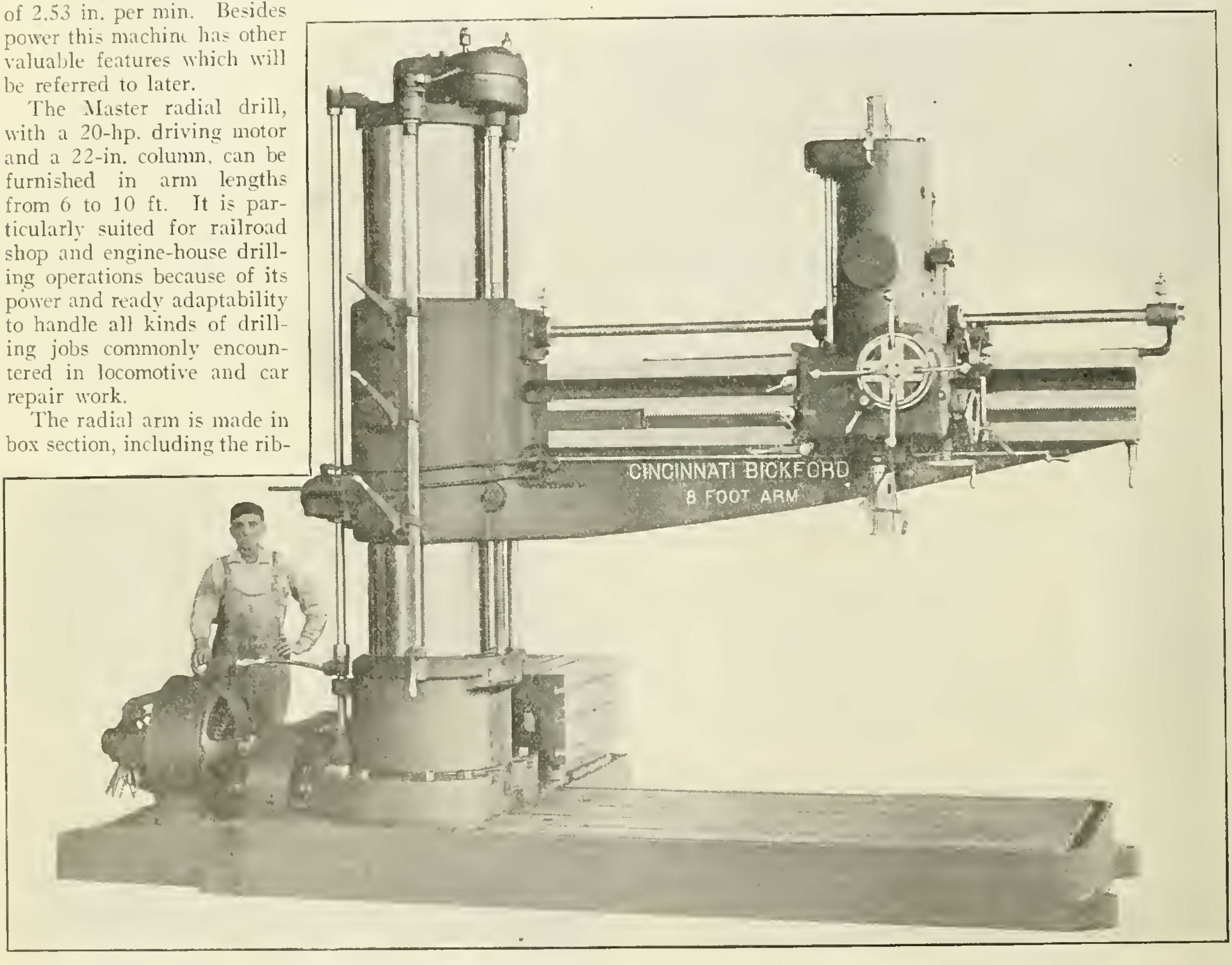


Fig. 1—Cincinnati Bickford "Master" Radial Drill Equipped with Air Column Binder, Cutting Lubricant Outfit and Driven by a 20 Hp. Variable Speed Motor

An automatic trip is incorporated in the design of the dial depth gage and quick return mechanisms. It is entirely encased, reading direct from zero, and is always within convenient reach for positioning. It may be set in an instant to disengage the feed at any predetermined depth, thus guarding against the spindle being advanced beyond its intended range of movement.

The back gears, consisting of six gears and two positive clutches, are incorporated in the head and furnish four changes of speed, each of which transmits more than twice the pulling power of the next faster one. They engage instantly while running and, although fully encased, are readily accessible.

The base is provided with an extension for the table and contains a reservoir and channels for the use of a cutting fluid. Being enclosed at the bottom, the base possesses an unusual degree of strength. The bearings are bronze bushed throughout the machine, including those in both the driving and feed mechanisms, and all the more important ones are provided with sight feed oilers of approved design to insure a thorough distribution of oil.

The column consists of two members, an inner trunk made fast to the base, and an outer sleeve which revolves thereon and clamps directly to its enlarged portion. By this means the two become practically one piece when the sleeve is tightened, a construction which not only adds stiffness to the frame as a whole but greatly enhances the binding facilities. The trunk extends up to and has a bearing at the top of the sleeve. It is internally ribbed in the planes of greatest stress, and is provided with ball bearings to carry the thrust and radial load. The column binder is furnished in three styles, operated by a lever on its cuff, a lever at the end of the arm, or by air from the head. The superior strength of the outer sleeve is used to augment the resistance against spring.

The cutting lubricant outfit not only permits driving drills in steel at a much higher speed than is otherwise possible, but contributes materially to the smoothness of the holes. Its nozzle is attached to the head and consists of a double-jointed pipe connection fitted with a valve which enables the operator to control the stream of fluid from his position at the head.

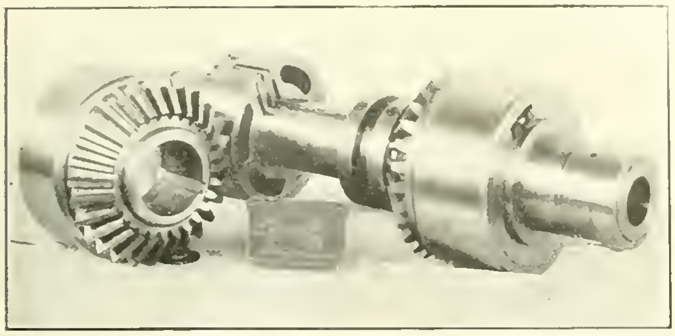


Fig. 2—Driving and Reversing Clutches, Showing Large Friction Rings and Toggle Arrangement for Expansion

The drive is furnished in four styles, and may consist of a direct-connected speed box, a constant speed motor and speed box, a variable speed motor mounted on the base as illustrated, or a variable speed motor placed on the arm. The machine is capable of absorbing 28 hp. without overloading the belt.

The feed mechanism advances the spindle at the rates of 8, 10, 12, 14, 16, 20, 25, 30, 35 and 40 thousandths, or .20, .25, .30, .35, .40, .52, .64, .76, .88 and 1.00 millimeters per rev., each of which is instantly available by means of lever-operated drive-keys. The mechanism is entirely encased. It contains two ball bearings to receive the thrust of the worm and is constructed throughout with particular regard to strength. All the operator has to do to obtain any desired feed is to turn the levers to the proper number.

The gearing throughout the driving mechanism is made of nickel steel, hardened and ground, while that in the feed mechanism is proportionately durable. The thrust of the reversing gears is received on ball bearings. No gear exceeds a periphery speed of 960 ft. per min. and each is completely encased.

The head is of exceedingly stiff construction, supports the feed worm gear on either side of its teeth, and is gibbed to an intermediate guide-way, on the principle of a boring machine saddle. On account of its accurate balance, the head can be positioned with great ease. Working parts of the head are few and simple, and, although entirely encased, are readily accessible.

The quick return levers engage the feed the instant they are pulled, thereby eliminating the loss of time incident to having to perform by hand the further operation of engaging a trip-clutch on the worm-shaft before the power-feed becomes effective.

The speed box is provided with a friction clutch and gives, with the quadruple back gears, 24 changes of speed. When driven by a variable speed motor, as many as 60 speed changes are obtainable. The changes are made without shock, and each is positive and instantly obtainable. The speeds are graded to drive ¾-in. to 3-in. drills at approximately 35, 40, 45, 50, 60, 70, 80, 90 and 100 ft., and to bore a 10-in. hole at 60 ft. per minute. Although the speed plate (Fig. 3) contains but two columns of figures, it enables the operator to determine at a glance how to position the levers for any of the 144 settings shown.

The spindle is made of high carbon stock, double splined, with a ball thrust bearing both above and below its sleeve. It is provided wtih a safety stop which trips the feed just prior to the spindle reaching the limit of its movement. The table is furnished in two styles, plain and universal, each of which is made to fit the extension on the base, where it is always ready for instant use.

The tapping mechanism drives through friction clutches and hence permits the operator to start, stop and reverse the spindle without shock while the rest of the machine is running. It is operated from the front of the head and its advantageous position between the arm shaft and back gears, which minimizes the duty required of the frictions, enables it to transmit at its lowest speed power far in excess of requirements.

For purposes of comparison the Cincinnati Bickford Company has made a complete test of the power absorbed by Master radials in driving drills at various feeds in medium hard steel. Selected test results, one for each size of drill, are shown in the accompanying table. The large drills are operated at a lower peripheral speed than the small ones because they cannot be kept cool under a fixed size stream of cutting lubricant.

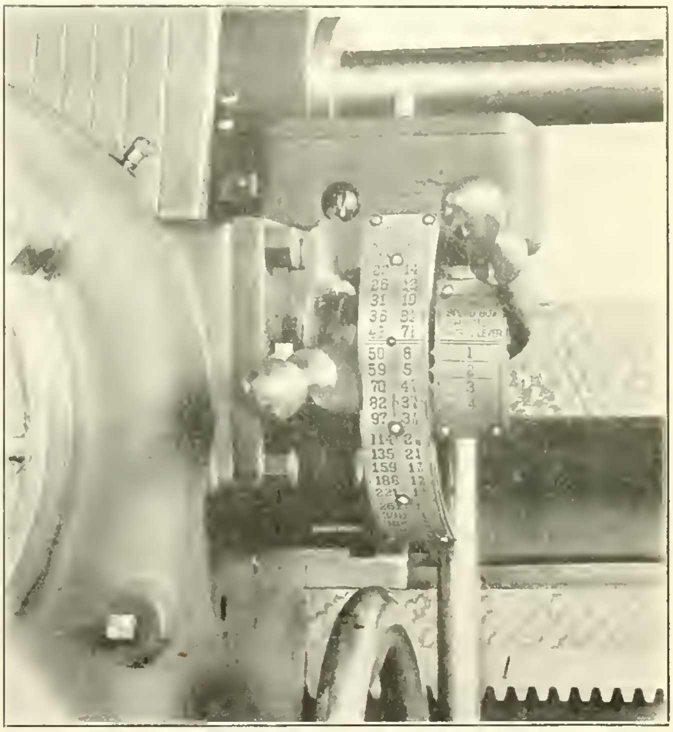


Fig. 3—View Showing Back Gear Levers and the Direct Reading Speed Plates

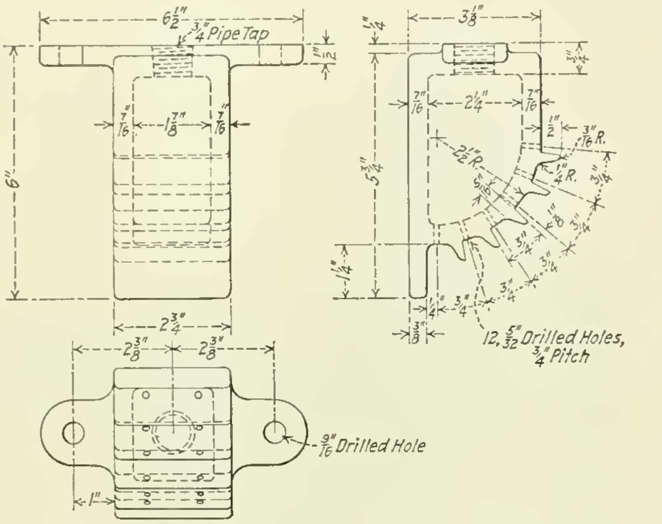
Power Absorbed by Master Radials in Drilling Medium Hard Steel
(When Fitted with a Variable Speed Motor Mounted on the Base)

Dia. of Drill	Speed		.012 Feed		.016 Feed		.020 Feed	
	Rev.	Feet	Depth	Power	Depth	Power	Depth	Power
¾	510 0	100.2	6.12	5.40	8.16	6.69	10.20	7.88
1	373.0	97.6	4.48	5.61	5.97	6.94	7.46	8.18
1¼	294.5	96.4	3.54	5.80	4.72	7.18	5.89	8.48
1½	251.7	98.9	3.02	6.22	4.03	7.70	5.03	9.09
1¾	207.2	95.0	2.49	8.07	3.32	9.99	4.15	11.78
2	177.0	92.7	2.12	8.09	2.83	10.01	3.54	11.81
2¼	151.2	89.0	1.82	7.88	2.42	9.76	3.03	11.50
2½	129.8	91.5	1.68	8.32	2.24	10.30	2.80	12.15
2¾	119.5	86.1	1.43	7.83	1.91	9.69	2.39	11.43
3	110.5	86.8	1.33	8.04	1.77	9.95	2.21	11.74

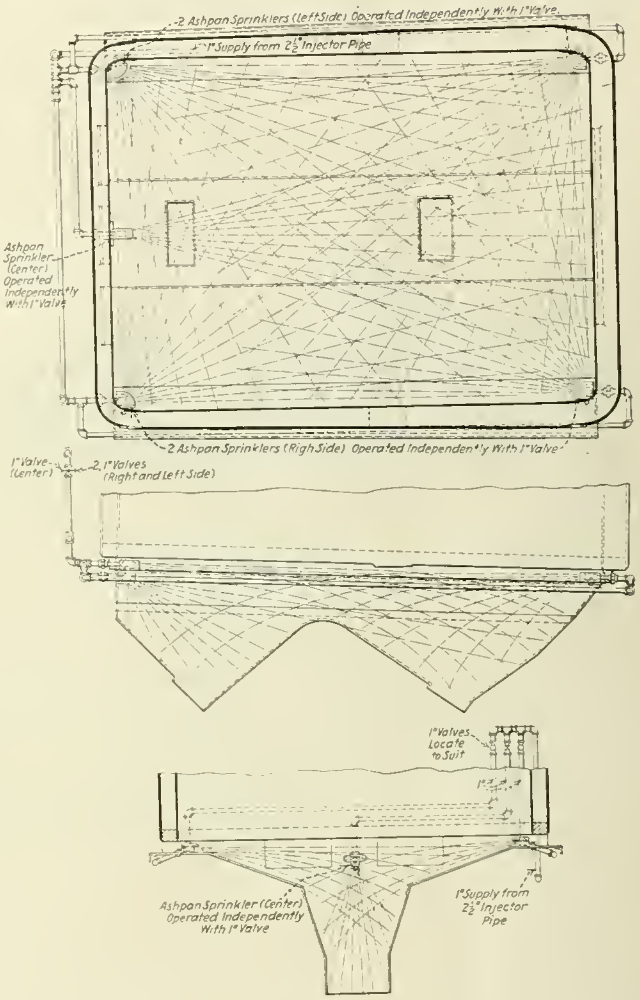
Ash Pan Sprinkler and Cleaner

THE Pratte Vacuum Air Sander Company, Denver, Col., has on the market an ash pan sprinkler and cleaner of unique design. Water is piped through a 1-in. pipe from the injector pipe to a number of sprinklers located at strategic points at the center and sides of the ash pan. The water is turned into the supply pipes by a valve in the cab. As shown in the illustration, the sprinkler is designed to spray the water over a large area. The number of sprinklers required depends upon the size of the ash pan. On a pan of 11 ft. or more it is recommended that a sprinkler be placed at each corner.

With boiler pressure behind the stream, any fire shaken through the grates can readily be put out and the ash pan given a thorough cleaning. It is claimed that where this device is installed on locomotives, cleaning the ash pans with a hose at terminals is practically eliminated. A better draft through the grates is obtained with a clean ash pan and considerable saving is accomplished as the pan will not warp when this device is used.



Drawing of Sprinkler Nozzle for Side of Ashpan


2 Ashpan Sprinklers (Left Side) Operated Independently With 1" Valve.
1" Supply from 2½" Injector Pipe
Ashpan Sprinkler (Center) Operated Independently With 1" Valve
2 Ashpan Sprinklers (Righ Side) Operated Independently With 1" Valve
1" Valve (Center)
2, 1" Valves (Right and Left Side)
1" Valves Locate to Suit
Ashpan Sprinkler (Center) Operated Independently With 1" Valve
1" Supply from 2½" Injector Pipe

Arrangement of Sprinkler on an Ashpan of Large Size

Oil-Burning Rivet Forges and Torches

A LINE of modern rivet forges with non-clogging vacuum oil burners, oil-burning torches, and pressure blowers has been developed and recently placed on the market by the Johnston Manufacturing Company, Minneapolis, Minn. The rivet forge, shown in one of the illustrations, is made in three styles, No. 1 for car repair yards, No. 2 for structural steel shops and No. 3 for boiler shops. The only difference in these forges is in the capacity of the burners, the No. 3 forge having about one-fourth the capacity of the burner on the No. 1. All the burners are adjustable through the usual range of about one to three, but best results are obtained by having the burner on each forge adapted to its specific use.

Aside from strength and easy portability by means of the large-diameter, ball-bearing wheels with wide tires, the principal feature of this rivet forge is the non-clogging vacuum oil burner, shown separately in one of the illustrations.. In order to avoid the formation of scale on rivets a uniform flame is necessary, obtainable only by maintaining the oil feed in proper proportion to the air. To accomplish this result the Johnston oil burner was developed with an air inlet valve by which the oil feed is regulated indirectly. This air valve does not clog since only air passes through it and as the air passages in the burner are larger and direct, the oil flow tends to remain uniform, and the character of the gases in the heating chamber consequently remains as first adjusted.

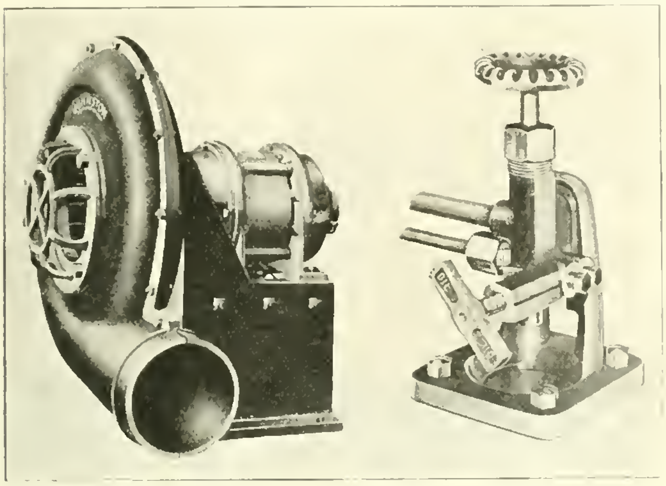
To overcome difficulty from variable air pressure in shops, and especially in car repair yards, this burner was so designed that the vacuum by which the oil is drawn up varies directly as the air pressure. The relation between the air and oil supply are, therefore, automatically maintained as first adjusted regardless of changes in air pressure. As a result of the non-clogging feature and provision to offset variable air pressure the character of the flame remains constant; scaling and smoking are reduced to a minimum and the forge operates at high combustion efficiency. The burner has a high vacuum and large oil connections, enabling heavy oil to be used.

The frame of this forge is in the form of a triangle, providing maximum strength and rigidity in proportion to weight. This is a valuable feature, in view of the use and abuse to which rivet forges are put in the course of everyday service.

Forge linings often fail by burning through at the top where the flame strikes and by cracking and spalling around the charging opening. In the Johnston forge the linings are not less than 4½ in. thick where the flames strike and with a charging opening 6 in. wide there is little tendency for this opening to become enlarged by cracking. Additional features are the pivoted tongue which acts as a guard for the burner, the filling funnel and strainer, the air curtain pipe to deflect the hot gases upward and the welded oil tank which has a capacity to hold 20 gallons of fuel oil.

Oil Burning Torches

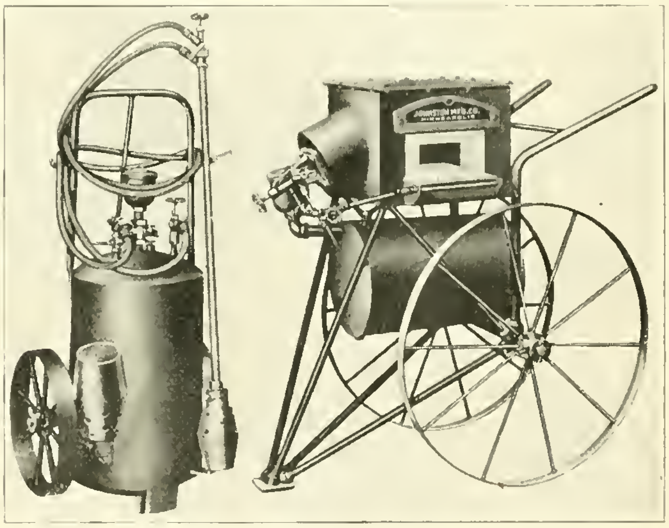
The oil-burning torch illustrated is made in two styles, No. 20 for car repair work and No. 21 for firing locomotives for steam test or for starting coal fires in locomotives. The difference between the two styles is in the capacity of the atomizer, the first using 15 gals. of oil an hour and the second 35. This torch, known as the "one man portable," is featured by high capacity and light weight combined with rugged design. This is accomplished by using light, practically unbreakable cast steel nozzles and one large pipe from the torch head to the hose connection. This single pipe is strong and easy to hold. Instantaneous ignition and steady operation are accomplished by a new and unique atomizer which breaks the oil up into a fine fog close to the torch head and permits the use of a short, and therefore light, single chamber nozzle. Pressure in the oil tank is blown down through the air connection, and this operation does not spray oil over the operator. The filling funnel has a strainer in which the dirt collects and is effectually prevented from entering the tank. Plug cocks are used on air and filling connections for quick and easy operation. The oil hose is protected by an automatic valve which closes in case of failure of the oil hose.


Pressure Blower for Furnaces and Forges—Vacuum Oil Burner

This torch has an unusual range of capacity with either nozzle. The large nozzle operates from a small flame 12 in. long up to the big flame required for firing a locomotive boiler for the steam test. Another feature is the tubular handle for the tank, providing a light, convenient grip. The length of hose furnished is 12½ ft. As in the case of the rivet forge the oil tank is welded. It has a capacity of 20 gallons. An extra nozzle for the torch is carried on a bracket as shown in the illustration, being always available. The nozzles run at moderate temperatures, giving long life.

Pressure Blowers for Furnaces and Forges

An ample supply of air at the full rated air pressure is imperative for the satisfactory operation of oil burners. To provide this air pressure when not otherwise available, the Johnston Manufacturing Company has developed the special pressure blower for oil-burning furnaces and large coal forges illustrated. This blower is designed to maintain a practically constant pressure from no load to full load of 10 oz. per sq. in. There are no moving parts except the blower wheel and the rotor of the motor and no bearings except the motor bearings, which are lightly loaded. These considerations and the fact that the blowers are especially designed for use at the standard speed of the 60-cycle alternating current motors by which they are driven tends to give high efficiency. The rigid construction of the motor base and direct connection between motor and lower casing assure permanent alinement. The power input is about 20 per cent of full load at no discharge and increases uniformly to full load at full discharge. This gives economical operation when only a small amount of air is required. The blowers may be equipped with direct current motors of the same speed as the corresponding alternating current motors.


Oil-Burning Torch and Rivet Forge for Car Repair and Boiler Shops

This blower is made in four sizes with the following motor rating and output: two horsepower, 500 cu. ft. per min.; three horsepower, 800 cu. ft. per minute; five horsepower, 1,250 cu. ft. per minute; seven and one-half horsepower, 1,800 cu. ft. per minute.

Developments In Aluminothermic Welding

CONSIDERABLE advancement has lately taken place in aluminothermic welding, due to the fact that the design of the mold, the class of molding material used, and proper venting of the mold have been the subjects of study and improvement. It was at one time claimed that ordinary cast steel foundry practice could not be followed because of the excessive temperature at which aluminothermic steel was handled. It is now recognized that the best aluminothermic steel can be injured by pouring in a mold where no precaution has been taken to prevent the generation of gases from unsuitable molding material or organic binders when subjected to the intense heat. The gases, under pressure, are absorbed by the metal. This results in a poor weld due to blow holes and spongy metal. Even with suitable molding material, care should be taken to thoroughly vent the mold as is the practice in steel foundries.

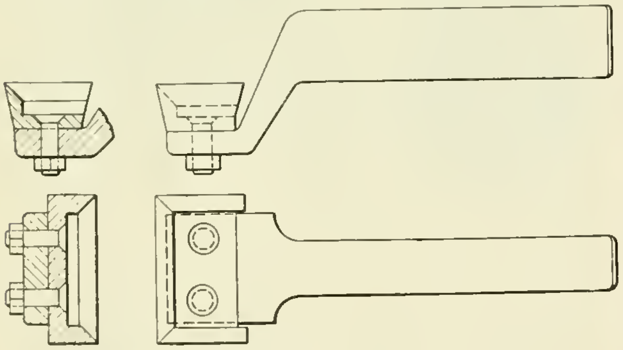
The preparation of the parts to be welded is extremely important in all classes of welding. If precautions are not taken to relieve strains, the members are apt to fracture in service outside the welded area, although the weld itself may be good. In heavy welding where the aluminothermic process is used, it is claimed that metal of exacting specifications can be introduced in bulk in a reducing condition between the parts to be welded with better results than by the drop by drop production of metal used in both electric and autogenous welding. Oxidation is unavoidable and slag inclusions as well as internal strains set up as each successive layer of metal is added. There is only one strain where bulk metal is available, and this can be taken care of in a definite manner. In smaller sections the strains do not have so much effect as they are relieved by warping of the parts. It is said that the aluminothermic process does not depend to a great extent on the skill of the operator and there is small chance of failure if instructions are followed.

Until recently, the drawback to a more extensive application of the aluminothermic process was its high cost and lack of uniform metal. The inventor of the process, the late Dr. Hans Goldschmidt, developed a method of producing an aluminothermic mixture that produces metal of uniform character. His researches resulted in the mixture marketed under the trade name Feralite, by the Alumino-Thermic Corporation, Roselle Park, N. J., being produced at a considerably lower cost. No metallurgist endeavors to produce steel without a thorough understanding and control of the slag. Until Dr. Goldschmidt's recent investigations and discoveries, this angle of the aluminothermic generation of steel, it is said, had apparently not been investigated.

In Feralite, the ingredients are treated and then compounded in such a manner as to obtain proper fluidity of slag to prevent absorption by the metal of the gases and impurities. This is claimed to insure metal of uniform analysis and physical characteristics.

Planer Tool for Removing Babbitt

A TOOL to be used on metal planing machines for the purpose of removing babbitt or soft metal from a locomotive crosshead shoe has been patented by H. H. Henson, machine shop foreman of the Southern, Chattanooga, Tenn. The object in designing this device was to save time and to insure the thorough removal of all loose babbitt or soft metal. This is essential in order to prevent the loosening of the replaced metal after the shoe has been relined. A further purpose of the invention is to provide a planer tool which will obviate digging or hanging in the metal, eliminate chatter and the formation of marks presenting an unfinished appearance which, in operation, rolls or bunches the metal. It will be noted in the illustration that the soft metal is removed in long shavings, which can readily be kept separate from other metal cuttings and chips. This simplifies the reclamation of the soft metal for further use.



Drawing Showing Detail Construction of Planer Tool

The tool is comprised of a holder and a cutter. The holder is a forging or piece of machine steel heavy enough to support the cutter without chatter, or to give it a tendency to dig or hang in the babbitt metal. It is comprised of a shank, a seat and an offset whereby the seat is disposed laterally from the line of the shank and at such a distance as to bring the cutting edge of the cutter in line with the center line of the fulcrum of the tool.

The cutter consists of a base, and end bit and side bits. The bits are preferably formed separately and electrically welded to the base and to one another. They have a rake of about 45 deg. and a clearance approximating 90 deg. It is best made of carbon tool steel and is tempered to a degree to permit the bit being sharpened by a fine mill file. The cutter is secured to the holder by means of two countersunk bolts as shown in the drawing.

It is claimed that this tool is rapid and effective in operation and insures the thorough removal of all this metal from the crosshead shoe, and is free from chatter or any tendency to produce marks which would give an unfinished appearance. This tool is to be placed on the market by the Adams-Fisher Manufacturing Company, St. Louis, Mo.

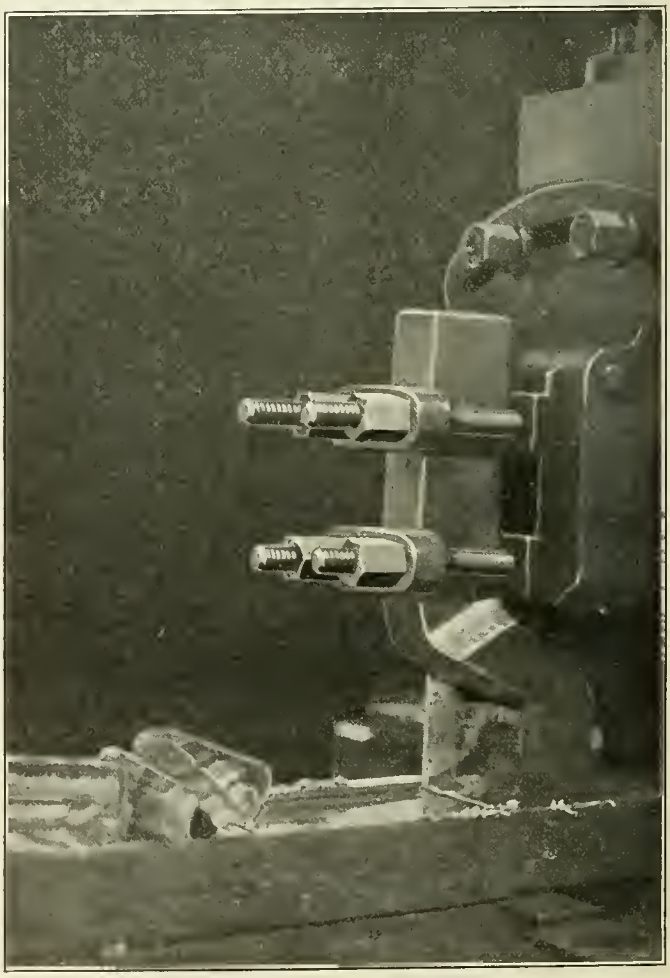


Illustration Showing the Manner in Which Planer Tool Removes Babbitt

GENERAL NEWS

The Japanese Department of Railways reports that 380 passenger cars were lost in Tokio alone, together with 33 locomotives and 31 electric cars. Only a few of locomotives can be reconditioned for service.

The Pere Marquette has extended its group insurance plan entered into with the Equitable Life Insurance Society on July 1, 1922, to cover all employees of the mechanical department. The employees will pay one-half of the premium and the company will pay the balance.

The Interstate Commerce Commission has reopened its investigation into the cost of construction and repair of railway equipment in so far as it pertains to locomotives on the Erie. This is the proceeding in which the commission criticised certain railroads for the amount of the expenditures for repairs to locomotives in outside shops during 1920.

Following closely on the announcement of the Mechanical division of the American Railway Association that it will hold its annual convention at Atlantic City on June 11-18, 1924, the Pennsylvania System has announced that it will operate a special train in two sections from Chicago to Atlantic City, leaving Chicago at 1 p. m., Monday, June 9, and arriving at Atlantic City at 10:30 the following morning, making intermediate stops at Englewood (Chicago), Fort Wayne, Ind.; Lima, Ohio; Crestline, Alliance and Pittsburgh, Pa. These trains, each of which will consist of ten cars, will contain the same equipment as the Broadway Limited.

Employees of the Altoona shops of the Pennsylvania numbering 15,000, through elected representatives, have passed a resolution addressed to the Interstate Commerce Commission protesting against any attempt on the part of the officials of the state of Pennsylvania or any other state in recommending any reduction in freight or passenger rates at this time to increase the miners' wages. This resolution was occasioned by the suggestion of a decrease in freight rates in order to absorb the 10 per cent increase in wages granted the anthracite miners under Gov. Pinchot's settlement plan. The railroad men fear that a loss in railroad income would ultimately be met by reduction in their wages.

The Railroad Labor Board announces that notice has been received from the New York Central and from the road's shopmen withdrawing from the Board their controversy as to wages; indicating that an agreement has been reached between the company and its employees for the use of the piece-work system of payment. The classes of workers affected are the machinists, boilermakers, blacksmiths, sheet metal workers, electrical workers, carmen, helpers and apprentices and car cleaners. It is understood that for the present the piece-work system will not apply to wrecking service, road service, power-house employees, millwright gangs, or car inspecting and repairing in train yards. Piece-work prices are to be increased or reduced corresponding with changes in the hourly rates.

Rolling-Stock Construction Increases in Poland

A total of 140 passenger and 1,910 freight cars were built in Poland in 1922, compared with 20 passenger and 400 freight cars built in 1921, according to the acting commercial attaché at Warsaw. Of the locomotives constructed during 1922, 10 were built at the locomotive works at Chrzanow. Polish locomotive and car building companies have on hand orders for 2,600 locomotives, 7,800 passenger, and 70,400 freight cars.

Fuel Association Competition Prize Awarded

The prize of $100 offered by Eugene McAuliffe through the International Railway Fuel Association for the best paper on fuel conservation by an engineman, fireman, conductor, brakeman or switchman has been awarded by the judges to W. L. Richards, locomotive engineman employed by the Union Pacific at North Platte, Neb. The competition, which closed August 31, aroused wide interest and 2,028 papers were received by the association. The volume of work entailed in classifying and reading these papers was so great that a prompt announcement of the result was impossible.

In addition to the association prize of $100, Mr. Richards also receives the Railway Age prize of $50 for the best paper submitted in the contest, the Union Pacific prize or $100 for the best local paper and one of the Railway Review prizes of $10 for the winner of each local contest.

Safety Appliance Act—Defective Couplers

The Texas Court of Civil Appeals holds that a railroad cannot, by a rule relieving switchmen of going between the cars, when, because of its failure to comply with the Safety Appliance Act, the switchmen could not uncouple the cars without going between them, exempt itself from liability under Section 2 of the act, requiring automatic couplers.—St. Louis Southwestern v. Hosey (Tex. Civ. App.), 247 S. W. 327.

Inspection Bureau Finds Defective 55 Per Cent of Locomotives Examined

The Interstate Commerce Commission's monthly report to the President on condition of railroad equipment shows that during October 6,507 locomotives were inspected by the Bureau of Locomotive Inspection and 55 per cent were found defective, while 525 were ordered out of service; also, 103,827 freight cars were inspected, of which 4.7 per cent were found defective, and 2,300 passenger cars, of which 1½ per cent were found defective.

Anthracite Shipments in October

Shipments of anthracite for the month of October, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 6,564,526 gross tons. These figures are not comparable with the previous month of September on account of the suspension of mining during negotiations between operators and miners. The average daily shipment in September after operation was resumed amounted to 219,490 gross tons, while the average daily shipment during the month of October amounted to 262,581 tons, an increase of about 43,000 tons.

Slack Work in Railroad Shops

The Pennsylvania Railroad furloughed several thousand shopmen on November 26; and according to newspaper accounts, this general suspension of work will continue until December 3. A memorandum was issued by the company stating that the readjustment of forces was coincident with the usual normal slackening of freight traffic at this season and that the company's supply of serviceable freight cars and locomotives was now ample for all needs.

The Baltimore & Ohio on November 26 closed its principal shops for one week, laying off several thousand men.

The New York, New Haven & Hartford has laid off about 1,000 shopmen, furloughs being ordered at Readville, New Haven, East Hartford, Providence, Norwood and Van Nest.

Motor Trains Increasing in France

The use of internal-combustion motors for trains appears to be developing rapidly in France. The State Railway, it is announced, has recently placed an order for 10 units on the model of the one tried out successfully between Mortagne and St. Gauberge, the motor being applied to an ordinary passenger coach. The Renault firm is also actively engaged in perfecting a new type of motor train called the Scemia-Renault, which was run on trial recently over the lines of a local Rheims company. This car carries 40 passengers and is equipped with double-end controls, whereby the necessity of a turntable is avoided. On the 350-mile stretch between Rheims and Asfled, with 2.5 to 2.8 per cent grades, the average gasoline consumption was 108 gallons per 1,000 miles and the average speed 25 miles per hour. With a trailer, the consumption would be 138 gallons. It is stated that orders for six cars have been received and that the Societe des Transports en Commun de la Région Parisienne, which controls all the surface traffic in and around Paris, intends to place one of them in regular service on the Versailles-Les Mureaux line.

October Locomotive Shipments

The Department of Commerce has prepared the following table showing shipments of locomotives in October from the principal manufacturing plants, based on reports received from the individual establishments:

Locomotives

	October 1923	September 1923	October 1922	Ten months' total, January to October 1923	1922
Shipments—					
Domestic	295	313	133	2,410	718
Foreign	15	22	12	151	187
Total	310	335	145	2,561	905
Unfilled Orders— (End of month)					
Domestic	915	1,102	1,420	....	....
Foreign	62	76	118	....	....
Total	977	1,178	1,538	....	....

Labor Board Decisions

In a dispute between the maintenance of way employees of the Norfolk & Western and the management in regard to the application of the overtime rule when the meal period is worked, the Labor Board has ordered that the payment of time and one-half starts at the expiration of the tenth continuous hour on duty, computed from the employees' regular starting time. It further ordered that where this continued service includes meal period, no deduction shall be made therefor, and the employee shall, at the first opportunity, be allowed 20 minutes in which to eat.—*Decision No.* 2015.

The Labor Board, in reconsidering Decision No. 1726 in which it ordered that supervisors of mechanics on the Denver & Rio Grande Western, who had been considered out of service on account of their refusal to exercise their seniority as mechanics, be reinstated, has decided that evidence introduced in the rehearing was such that the request for reinstatement of the supervisors of mechanics should be refused, upholding the contention of the road.—*Decision No.* 2006.

Wage Increases

The Missouri-Kansas-Texas has increased the wages of shopmen 2 cents an hour, effective October 14. The increase will aggregate $226,000 annually and affects workers in all mechanical crafts.

Shop crafts employees on the Atlantic Coast Line have been granted wage increases, effective October 15, which will aggregate $400,000 a year. Mechanics receive an increase of 3 cents an hour, apprentices, 2 cents an hour, and helpers, 1 cent.

Stationary engineers and firemen and shop laborers on the Northern Pacific have been granted wage increases of about 1 cent an hour. Clerks, freight handlers, express and station employees on the Staten Island rapid transit have received wage increases of from 1 to 2½ cents an hour.

Shopcrafts employees of the Chicago, Burlington & Quincy have been granted an increase in wages of 2 cents an hour, following a series of conferences between officers of the road and representatives of the shop workers. The increase will affect some 18,000 men of all classes in the shops and will add approximately $1,000,000 per year to the payroll of the road.

Rock Island Stock for Employees

The Chicago, Rock Island & Pacific has put into effect a plan whereby employees may secure preferred stock on a monthly payment basis. Any employee of the company of more than six months' service may invest in the preferred stock of the railway under this plan. Both 7 per cent and 6 per cent preferred stock may be bought but the total which may be ordered or carried at any one time must not exceed one share for each $300 of annual salary or pension of the employee and shall not exceed ten shares altogether.

The amount to be paid for the stock will be governed by the market price at the time it is purchased. Active employees of six months' service or more will be required to make an initial payment of $5 a share and a monthly payment thereafter of not less than $3 a share. Pensioned employees are permitted to buy, and they are not required to make the initial payment of $5 a share. Ten per cent of the purchase price will be deducted from each monthly pension check.

The company will hold the stock purchased as security for the payments of the balance of the purchase price, which balance will be paid through payroll deductions as authorized by the employee. Interest at the rate of six per cent per annum will be assessed on the unpaid balance, and dividends received on the stock will be applied to the unpaid balance. The employee may make full payment at any time but contracts of purchase are not transferable. An employee may terminate the contract at any time, when the stock will be sold at the current market price.

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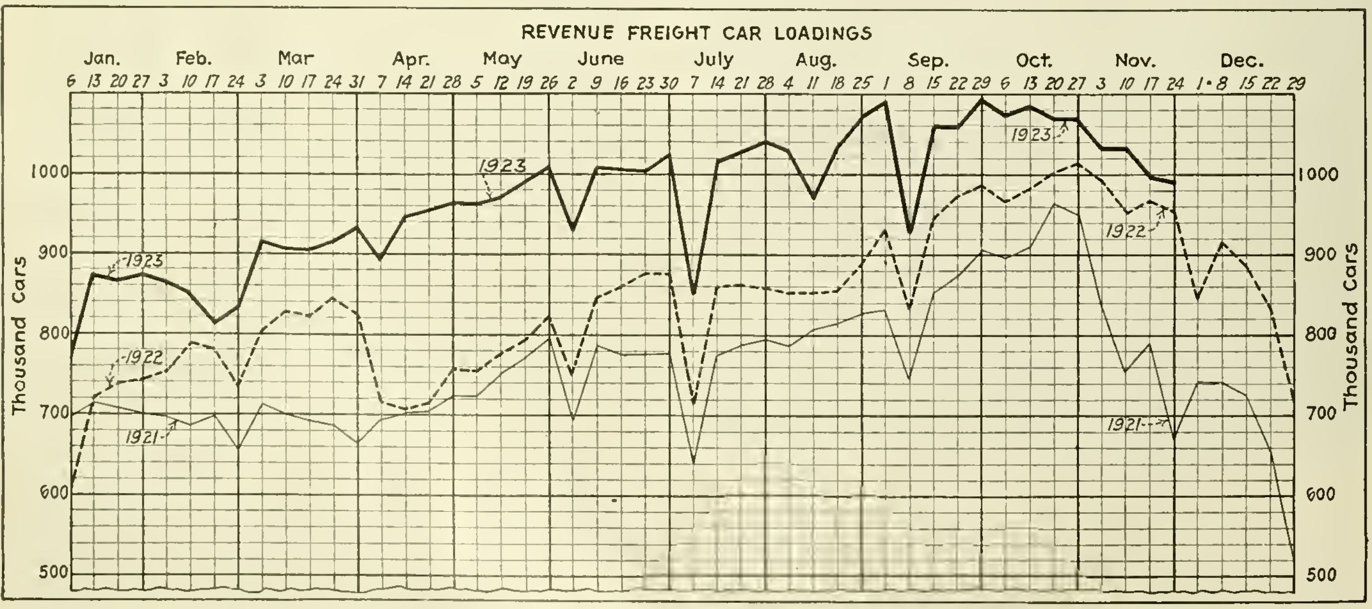


Comparison of Revenue Freight Car Loadings for 1923 with 1922 and 1921

Oklahoma Commission Approves Railways' Physical Condition

Efforts of shopcrafts employees on several lines in Oklahoma to secure the appointment of inspectors to investigate and report on the physical condition of the roads in the southwest territory proved unsuccessful when the Oklahoma Corporation Commission declared that no necessity exists for such appointments and that the complaint was obviously based on misinformation. The submission which was brought against the roads by the defeated shopcrafts strikers was presented to the Oklahoma commission on August 6 by O. E. Heath, an officer of the railway employees' department of the American Federation of Labor. The Chicago, Rock Island & Pacific and the Arkansas Western were particularly charged with "employing in the transportation of passengers and freight, engines and cars with such defects as to imperil the safety of passengers and employees." The Oklahoma commission found "that the motive power and rolling stock of the railroads in Oklahoma are at this time in as good if not better condition than at any period in the history of the railroads." The report of the commission also pointed out that freight traffic had been expedited in 1923, that the cars furnished had been in excellent condition, that claims for loss, damage and delay had been much decreased and that shippers in Oklahoma had not suffered from any car shortage.

Hal S. Ray Addresses Chicago Car Foremen

The Car Foremen's Association of Chicago held its regular monthly meeting Monday evening, November 13, at the Great Northern Hotel, Chicago, the principal address, which was in the nature of an inspirational talk, being by Hal S. Ray, director of public and personnel relations of the Chicago, Rock Island & Pacific. Mr. Ray, after commenting briefly on railroad public relations work, devoted his attention to the railroad foreman and his responsibility in interpreting management ideals and policies to his men. Regarding this subject, Mr. Ray said in substance: "Railroad officers are honest in advocating the square deal to their employees. They are honest, if for no other reason, because it is the best policy. The day of 'bunk' and 'bluff' in railroading has long since passed, experience having repeatedly demonstrated that the only way to secure results with men is by treating them fairly. It is the duty of foremen to overcome the suspicion with which employees from long habit regard all improvement and betterment plans emanating from the management.

"The rank and file of railroad foremen do not realize the importance of their jobs and the big opportunity which they have to be of inestimable service by creating a better understanding between the managements and the men. Foremen are the channels through which right can be made wrong, and wrong can be made right. The best plans developed by the managements can be made non-effective by the way in which they are interpreted to the workmen, and on the other hand, workmen will be slow to think ill of any railroad which is fortunate in employing able, conscientious foremen. Most railroad foremen are always on the job, efficient, dependable, but entirely too modest and unassuming, with the result that the importance of their work is not always appreciated. It is the foreman's duty to be consistently hopeful and helpful in dealing with his men, always endeavoring as far as may be possible to give each man work to which he is fitted and which he can enjoy. No part of the foreman's work is more important than to encourage and help the men who work under him. When questions are asked regarding various phases of the work, courteous, brief and informative answers should be given. Don't answer a question with a lot of conversation which doesn't mean anything. Another essential is to convey to workmen an understanding of the importance of their work and an appreciation of the vital link which they form in the railroad chain."

271 Swedish Locomotives Received in Russia

Of the 500 railroad locomotives of the 0-10-0 type ordered by Russia from the Swedish firm Nydquist & Holm in 1921, 271 have been passed by the Russian inspecting commission up to September 1, and 55 more were expected to arrive before the close of the present navigation season, according to an abstract from Economic Life (Moscow) appearing in Commerce Reports.

The new locomotives have already been placed in operation on the Northern, the Murmansk, the Moscow-Kazan, the Kiev-Voronezh, the Southern, the Syzran-Viazma, and the Transcaucasian Railways.

B. & M. Contemplating Group Insurance

Group insurance for employees of the Boston & Maine is being planned for, with the expectation of giving the benefits of the scheme to about 6,500 employees. This action has been taken at the request of the Mechanical Employees' Association. It is proposed to provide policies of $1,000 life insurance each, with certain weekly payments for sick or accident disability. As in other movements of this kind, at least 75 per cent of the employees in each class must accept the scheme before it can be made effective. The railroad company will, it is understood, contribute to the insurance the minimum proportion required under the insurance company's terms.

MEETINGS AND CONVENTIONS

Mechanical Convention at Atlantic City

The General Committee of Division V, Mechanical, of the American Railway Association, at its meeting in New York on Thursday, November 8, decided to hold a convention, with exhibits, at Atlantic City on June 11-18, 1924. The Executive Committee of the Railway Supply Manufacturers' Association also voted on the same day in New York to hold an exhibit on the same dates, viz., June 11-18, 1924.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical. V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 W. Forty-third St., New York. Annual meeting December 3 to 6.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting December 11. Paper on Handling of Mail by Railways will be presented by R. L. Laprairie, inspector railway mail service, Montreal Stereopticon views.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 605 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting November 13, annual dinner and election of officers.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting December 11, Copley-Plaza Hotel, Boston. Paper on Air Brake will be presented by George Terwilliger, general air brake inspector, N. Y., N. H. & H.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Annual dinner December 6, Hotel Commodore, New York, N. Y.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting December 13. Seventh annual holiday entertainment for families of members.

Railway Club of Greenville.—G. Charles Hoey, Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting December 14. Paper will be presented by N. D. Ballentine, assistant to president, Seaboard Air Line.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

[illegible] has been elected vice-president and director of the [illegible] Corporation, New York.

[illegible] foundry, 100 by [illegible] South [illegible] avenue, Chicago.

[illegible] Stearns & [illegible] Car Truck Corporation, Lawton, [illegible] Justus S. Stearns has been [illegible].

[illegible] Company has ordered the structural steel [illegible] Madison, Ill., from the Kenwood [illegible].

[illegible], western sales manager of the Hale & Kilburn [illegible] at Chicago, died October 28 at [illegible].

The [illegible] sales office of the Jones & Laughlin Steel Corporation [illegible] moved from 1314 Rockefeller building to 1407-11 [illegible] Trust building.

[illegible] of the Talmadge Manufacturing Company, Cleveland, Ohio, was on November 23 elected vice-president of the company.

C. A. [illegible], formerly sales manager of The Weldless Tube Company, has been appointed manager of the Delaware Seamless Tube Company, Auburn, Pa.

The [illegible] Shop & Foundry Company has ordered the [illegible] steel for a foundry building at Kansas City, Mo., from the Kansas City Structural Steel Company.

[illegible] Lathrop, representative of the Conveyors Corporation of America, Chicago, Ill., in the Cincinnati district, has removed [illegible] 503 Neave building, Cincinnati, Ohio.

The [illegible] & Risman Company, Buffalo, N. Y., dealer in railway equipment, has opened a district sales office in the Ulmer building, Cleveland, Ohio, in charge of R. B. Morrison.

The Philadelphia division of the B. F. Sturtevant Company, Boston, Mass., is now located at Thorne & Copewood streets (near White Horse pike and Haddon avenue), Camden, N. J.

J. A. Cece has been appointed assistant to the manager of purchases of the Consolidated Purchasing Agency for the American Short Line Railroad Association, with headquarters at Chicago.

J. T. Stephenson, formerly chief material inspector of the Southern Railway, has been appointed Washington sales agent for railroad supplies of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

Edmund H. Jahnz has been appointed agent of the Mercury Manufacturing Company, Chicago, for its tractors and trailers in Philadelphia, Pa., and surrounding territory. Mr. Jahnz's office is at 2009 Market street, Philadelphia.

R. P. McCormick will have supervision of the sales activities of the Eastern district for the Pawling & Harnischfeger Company, Milwaukee. He will have offices at 30 Church street, New York, and 605 Stephen Girard building, Philadelphia, Pa.

D. P. Bennett, vice-president of the Pittsburgh Steel Company, Pittsburgh, Pa., has been elected president, and F. H. Bindley, a director, has been elected vice-president. Henry J. Miller was elected a director to succeed the late Willis T. McCook.

Henry [illegible], president of the Wason Manufacturing Company, Springfield, Mass., from 1906 to 1910, and vice-president since that time, died on November 27 at the age of 71. The company is a subsidiary of the J. G. Brill Company, Philadelphia, Pa.

H. N. Winner has been appointed general manager of the Garlock Packing Company, Palmyra, N. Y. Mr. Winner was formerly manager of the Philadelphia, Pa., branch of the Garlock Packing Company and later served as president and also as general manager of the Crandall Packing Company.

The Mahr Manufacturing Company, of Minneapolis, Minn., manufacturers of rivet forges, torches, furnaces and kindred oil-burning equipment, has moved its New York office from 56 Murray street to larger quarters at 42 Murray street. Ray G. White is the district representative of the company at New York.

[illegible] Pica, sales manager of the Mahr Manufacturing Company, with office located at 527 Commercial Trust building, Philadelphia, Pa., has had his territory extended so that it now comprises the state of Pennsylvania, with the exception of the northeastern portion, the states of Maryland and Delaware and the southern part of New Jersey.

David Newhall, of Philadelphia, Pa., has been appointed a sales representative in the steel car department of the Bethlehem Steel Company, with headquarters at Bethlehem. Mr. Newhall, before the war, was vice-president in charge of sales of the Geo. M. Newhall Engineering Company; this firm did an extensive railroad business in the East.

The Independent Equipment Corporation, with offices in the McCormick building, Chicago, has been organized for the purpose of repairing freight car equipment, leasing and repairing tank cars and manufacturing miscellaneous car parts. This company has bought the plant of the Goodwin Car & Manufacturing Company, located at Clearing, Ill.

The Linde Air Products Company, New York, recently started continuous operations in its new plant at Tulsa, Okla. Oxygen will be extracted from the air by the liquefaction process. The plant is also able to reclaim the nitrogen and separate the rare gases, argon and neon. C. A. Kennedy is operating superintendent. A Prest-O-Lite plant, for the manufacture of welding and cutting gas, is also planned for the same locality.

The Link-Belt Company, Chicago, has secured by purchase the Meese & Gottfried Company, of San Francisco, Los Angeles, Seattle and Portland. Meese & Gottfried Company, and its predecessors, have been manufacturers of power transmission machinery and distributors of conveying and transmission machinery on the Coast for many years. The new organization will be known as Link-Belt Meese & Gottfried Company, with headquarters at San Francisco and officers as follows: Charles Piez, chairman of the board; B. A. Gayman, president; Harold H. Clark, vice-president and sales manager; Leslie W. Shirley, treasurer, and Richard W. Yerkes, secretary.

The Electric Heating Apparatus Company, manufacturers of Multiple Unit and Heavy Duty electric furnaces, with general offices and works at Newark, N. J., has recently terminated an agreement with the Westinghouse Electric & Manufacturing Company for the exclusive sale of their special furnaces. The Electric Heating Apparatus Company has enlarged its sales and service department and has established a district office in Chicago. F. A. Hansen, formerly in charge of sales of electric furnaces in the Chicago territory for the Westinghouse Electric & Manufacturing Company, has been appointed district manager for the Electric Heating Apparatus Company in the Chicago territory, with office in the Marquette building, Chicago.

The Chain Belt Company, Milwaukee, Wis., manufacturers of Rex chain, transmission machinery and conveying equipment, formerly represented on the Pacific Coast by the Meese & Gottfried Company, San Francisco, Cal., has established direct factory branches and warehouses in Portland, Ore., and Seattle, Wash. The Northwest territory, with headquarters at Portland, will be in charge of Allen C. Sullivan. Don B. Catton will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by Wm. F. Nichols, of the Seattle office. The Portland office of the Chain Belt Company is located at 67-69 First street and the Seattle office at 1040 Sixth avenue, south. Large stocks are maintained at both Portland and Seattle.

The Industrial Works, Bay City, Mich., which was established in 1873, celebrated its fiftieth anniversary on October 13 at Bay City. The celebration included a sales conference of all representatives of the Industrial Works from all principal points of the United States, Canada, Cuba and South America. Another feature was a test of a 200-ton wrecking crane which had been built for the Norfolk & Western. At the banquet addresses were made by William L. Clements, president; C. R. Wells, secretary and treasurer, and Ernest B. Perry, general manager. The Industrial Works was started in 1873 with a working force of 30 men in a factory building 75 by 100 ft. The plant today covers an area of 29 acres of ground, and includes 59 buildings with 440,000 sq. ft. of floor area, 5 miles of railroad track and employs 1,800 men. The 59 buildings include a foundry and pattern, blacksmith, boiler, bucket, car, canopy, electrical, paint, pipe and machine shops, each of which is a complete unit. Besides, there is a pattern storage building, an employees' restaurant, a garage, and an office.

Dana R. Bullen, manager of the supply department of the General Electric Company, Schenectady, N. Y., has been appointed assistant vice-president on the staff of the vice-president in charge of sales of general apparatus and supplies. The lighting department has been changed to the central station department and the name of the power and mining department changed to the industrial department. C. W. Stone, manager of the former lighting department, continues as manager of the central station department. M. O. Troy, who was manager of the transformer sales department, has been appointed executive assistant manager of the central station department, with headquarters at Schenectady, and W. M. Stearns, formerly one of the assistant managers of the supply department, has been appointed assistant manager of the central station department. R. D. Mure, assistant manager of the former lighting department, has been appointed assistant manager of the central station department in charge of apparatus sales. F. G. Vaughen and present staff have been transferred to the central station department and continues in charge of the meter business of the company, Mr. Vaughen retaining the title of sales manager. W. S. Clark and present staff in charge of the company's wire and cable business, have been transferred to the central station department, and the railway supply section and present staff conducting the company's business on railway motor and control parts, railway line material and rail bonds, have been transferred from the supply department of which E. P. Waller is manager. Industrial heating devices, industrial control, mine locomotive and stationary motor repair parts, and fabroil, textoil and textolite gears sections of the supply department, have been transferred to the industrial department of which A. R. Bush, manager of the department under its former name of power and mining department, continues in charge. N. R. Birge, formerly one of the two assistant managers of the supply department, has been assigned to the staff of the president and will assist in supervision of associated manufacturing companies, being asociated with D. C. Durland in this work.

H. E. Graham

H. E. Graham, manager of traffic and sales of the Pressed Steel Car Company and its subsidiary, the Western Steel Car & Foundry Company, with headquarters at New York, has resigned to become vice-president in charge of sales of the Illinois Car & Manufacturing Company, with headquarters at Chicago. Mr. Graham was born on June 21, 1880, at Alliance, Ohio. He entered railway service in 1896 as a call boy in the operating department of the Pennsylvania at Pittsburgh, Pa. He was later a time clerk in the division superintendent's office and a bill clerk in the traffic department until 1898, when, upon the organization of the Pressed Steel Car Company, he entered its employ as chief clerk in the traffic department at Pittsburgh, Pa. He held this position until 1905, when he was promoted to traffic manager, with the same headquarters, which position he held until 1920, when he was promoted to manager of traffic and sales, with headquarters at New York. He has held the latter position until his resignation to become vice-president in charge of sales of the Illinois Car & Manufacturing Company. Mr. Graham will take over the duties with the Illinois Car & Manufacturing Company on January 1.

The J. G. Brill Company, Philadelphia, on November 1 purchased the railroad motor coach division of the Service Motors, Inc., Wabash, Ind., with exclusive rights for the production and sale of the type of gasoline-driven rail car heretofore known as the Service Model 55 Railroad Motor Coach. Cars of this type now in operation have completed one million and a half miles of service. While the Brill company has heretofore furnished only the bodies for these cars, it will now furnish the complete units without change in design. This type car will now be known as the Brill Model 55 Gasoline Car and will be handled by the automotive car division of the J. G. Brill Company, Philadelphia, with C. O. Guernsey, designer of this unit and formerly vice-president of Service Motors, Inc., as chief engineer; C. J. McPherson, sales manager; A. H. Hudson, formerly of Service Motors, Inc., as Eastern representative, and A. F. McCormick, formerly of Service Motors, Inc., as Southwestern representative. All renewal part business for cars of this type now in service and guarantees given by Service Motors, Inc., have also been taken over by the Brill company.

William F. Wendt

William F. Wendt, founder and former president of the Buffalo Forge Company, Buffalo, N. Y., and prominent for many years in local business and political affairs, died at his home in Buffalo on Tuesday morning, October 30, at the age of 65. He was a brother of Henry Wendt, now president of the Buffalo Forge Company. Mr. Wendt was born in Buffalo. He continued as president of the company, which he was instrumental in starting, until 1916, when he retired. He was also president of the George L. Squire Manufacturing Company, the Buffalo Steam Pump Company and the W. F. Wendt Publishing Company, which published the American Blacksmith and La Hacienda, a magazine printed in Spanish and circulated in South America. He retired from the latter company two years ago. Mr. Wendt was for some years prominently connected with Republican politics in his native city and was keenly interested in the betterment and advancement of civic and national affairs. While a keen student of political affairs, he never sought office for himself, although several times prominently mentioned and urged to become the candidate of the Republican party for mayor of Buffalo.

The Bradford Corporation

The Bradford Corporation has acquired all the capital stock and assets, and will assume all the obligations of the Bradford Draft Gear Company, the Republic Railway Equipment Company, Inc., and the Joliet Railway Supply Company. These properties will be operated as one unit after December 31, 1923.

The officers of the Bradford Corporation will be Horace Parker, president, New York; Burton Mudge, executive vice-president, Chicago; W. W. Rosser, vice-president, Chicago; Floyd K. Mays, vice-president, New York; A. F. Stuebing, chief engineer, New York; E. H. Barnes, secretary, New York; James H. Slawson, general manager, Chicago; Charles A. Carscadin, general sales manager, Chicago; William F. Hoffman, treasurer, New York; Arthur L. Pearson, assistant vice-president, Chicago. The executive committee will be Fred A. Poor, chairman; Horace Parker and Burton Mudge.

The Bradford Corporation will maintain executive offices at 25 West Forty-third street, New York City, and Railway Exchange building, Chicago, and sales offices in Washington, D. C., in charge of Harry F. Lowman; St. Louis, Mo., in charge of Walter C. Doering; San Francisco, Cal., in charge of E. F. Boyle; Mexico City, in charge of Joseph H. Cooper. The company will be represented in Canada by the Holden Company, Limited, of Montreal.

The company will sell and manufacture Bradford Draft Gears, Bradford Draft Arms, Chambers Throttle Valves, Huntoon Truck Bolsters and Huntoon and Joliet Brake Beams.

EQUIPMENT AND SHOPS

Locomotive Orders

The Chicago & North Western has ordered a snow plow from the American Locomotive Company.

The Southern Pacific has ordered 20, 0-6-0 switching type locomotives from the Lima Locomotive Works.

The Louisville, Henderson & St. Louis has ordered 1, 4-6-2 type locomotive from the American Locomotive Company.

The Temiskaming & Northern Ontario has ordered 3, 2-8-2 type locomotives from the Canadian Locomotive Company, Ltd.

The Long Bell Lumber Company has ordered 3, 70-ton geared locomotives from the Willamette Iron & Steel Works, Portland, Ore.

Passenger Car Orders

The Canadian Pacific has ordered from the National Steel Car Corporation 15 steel frames for colonist cars.

The Washington & Lincolnton has ordered a gasoline motor car from the Edwards Railway Motor Car Company.

The Laurinburg & Southern has ordered a gasoline motor car from the Edwards Railway Motor Car Company.

The Toronto, Hamilton & Buffalo has ordered 16 coaches and 6 smoking cars from the Canadian Car & Foundry Company.

The Minnesota, Dakota & Western has ordered one gasoline motor coach from the Oneida Manufacturing Company, Greenbay, Wis.

The Birmingham & South Eastern has ordered a gasoline motor car and trailer from the Edwards Railway Motor Car Company.

The St. Louis, Kennett & Southeastern has ordered a gasoline motor car and a trailer for this car from the Edwards Railway Motor Car Company.

The Tennessee, Kentucky & Northern has ordered from the Edwards Railway Motor Car Company, Sanford, N. C., a 32-ft. completely equipped motor car.

Freight Car Orders

The Great Northern will build 500 stock cars in its own shops.

The Southern Railway has placed an order for 1,000 steel underframes.

The New York, Chicago & St. Louis will build 15 caboose cars in its own shops.

The Lehigh & New England has ordered 7 caboose cars from the Magor Car Corporation.

The Great Northern has ordered 100 underframes from the St. Paul Foundry Company.

The Ulster & Delaware has ordered 10 caboose cars from the Pressed Steel Car Company.

The Southern Railway has ordered 1,000 box cars from the American Car & Foundry Company.

The Anaconda Copper Mining Company has ordered 24 Ingoldsby type dump cars from the Koppel Industrial Car & Equipment Company.

Freight Car Repairs

The Missouri Pacific will repair 100 gondola cars and 200 general service cars in its own shops.

The Carnegie Steel Company will have repairs made to 200 steel hopper cars at the shops of the Greenville Steel Car Company; repairs made to 50 at the shops of the Federal Shipbuilding Company, and repairs made to 248 at the shops of the Koppel Car Repair Company.

Machinery and Tools

The New York Central has placed an order for a 30-ton gantry crane.

The Pennsylvania Railroad has placed an order for a 6-ft. radial drill.

Shops and Terminals

Wabash.—This company has prepared plans for an addition to its enginehouse and shops at Moberly, Mo., to cost $65,000.

Southern Pacific.—This company contemplates constructing new shop buildings and roundhouse facilities at Valentine, Tex.

Chicago & North Western.—This company will construct a storehouse at Casper, Wyo., at a cost of approximately $14,000.

Gulf Coast Lines.—This company plans the construction of a new enginehouse and repair shop at Brownsville, Tex., to cost $100,000.

Pennsylvania.—This company will construct a coal dock with unloading machinery and 60,000 ft. of storage track at Sandusky, Ohio, at a cost of $342,000.

Chicago, Milwaukee & St. Paul.—This company plans the construction of a new enginehouse and shop at Monticello, Iowa, to cost approximately $60,000.

St. Paul Union Depot.—This company plans the construction of a roundhouse, adjoining the Union Depot yards, at St. Paul, Minn., to cost approximately $75,000.

Erie.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 200-ton steel automatic electric coaling station at Brier Hill, Ohio.

Missouri-Kansas-Texas.—This company has awarded a contract to H. B. McCoy, Cleburne, Texas, for the construction of additions to its car shops at Denison, Texas, to cost approximately $200,000.

New York, Chicago & St. Louis.—This company will construct a new enginehouse and locomotive repair shop at Fort Wayne, Ind., on land recently purchased as a site for a new freight terminal and yard.

Union Pacific.—This company has awarded a contract to the Unit Construction Co., San Francisco, Cal., for the construction of an enginehouse with a repair department, 75 ft. by 175 ft., at San Pedro Harbor, Los Angeles, Cal.

Denver & Rio Grande Western.—This company has placed an order with the Roberts & Schaefer Company, Chicago, for two standard N. & W. type electric locomotive cinder handling plants for installation at Soldier Summit, Utah.

The Toledo, St. Louis & Western.—This company has awarded a contract to Bierd, Lydon & Grand Pre, Chicago, for the construction of a 27-stall engine house and other engine terminal facilities at Frankfort, Ind., to cost approximately $300,000.

Lake Terminal.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 200-ton reinforced concrete automatic electric coaling station and gravity sand plant with mechanical cinder handling plant at Lorain, Ohio.

Michigan Central.—This company has awarded a contract to the Ellington-Miller Company, Chicago, for the construction of an 8-stall roundhouse, cinder pits, water and sewer lines and a number of small buildings in connection at Lansing, Mich., to cost $125,000.

Chesapeake & Ohio.—This company has awarded contracts to the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., for the construction of water treating plants at Russell, Ky., Huntington, W. Va., Wheeler and Robbins, Ohio, and Whitesville, Taplin and Brushton, W. Va.

South Australian Railways.—A contract has been awarded to the Roberts & Schaefer Company, Chicago, for the construction of nine reinforced concrete and steel coaling stations, the largest to be of 300 tons' capacity including sand handling facilities. The Roberts & Schaefer Company will supervise the construction of each plant in Australia. The coaling stations will be located at Mile End, Peterborough, Adelaide, Karwonda, Port Adelaide, Port Erie, Wolseley, Cockburn and Port Lincoln.

PERSONAL MENTION

General

E. G. Sanders has been appointed fuel supervisor of the Panhandle & Santa Fe, with headquarters at Amarillo, Tex.

C. R. Brunelle has been appointed fuel supervisor of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters in Emporia, Kan.

William O. Hawkins and Warren W. Saxton have been appointed traveling firemen on the Lehigh & Susquehanna division of the Central of New Jersey.

J. L. Smith has been appointed superintendent of motive power of the Pittsburgh & West Virginia and the West Side Belt with headquarters at Pittsburgh, Pa., succeeding H. P. Anderson.

R. A. Greene, supervisor of fuel and lubrication of the Chicago & Alton, with headquarters at Bloomington, Ill., has resigned to enter the service of the Galena Signal Oil Company as a special representative at Chicago.

Don Nott, roundhouse foreman of the Chicago, Burlington & Quincy with headquarters at Galesburg, Ill., has been promoted to assistant master mechanic, with the same headquarters, succeeding H. H. Urbach, promoted.

Edward B. Whitman has been appointed superintendent of the Pennsylvania, with headquarters at Buffalo, N. Y. Mr. Whitman was born on November 6, 1888, at Washington, D. C., and attended St. Paul's School, Concord, N. H., and was graduated from Princeton University in 1910. He entered railway service on June 21 of the same year as a special apprentice at the Altoona shops of the Pennsylvania. In 1915 he was appointed motive power inspector and a year later was appointed assistant road foreman of engines. In 1917 he entered the army and served as a major and a commanding officer of the Fifty-ninth railway engineers of the American Expeditionary Force. Returning from military service, in 1919, he was appointed assistant master mechanic in the office of assistant to the general manager and then as master mechanic of the Wilmington shops, which position he was holding at the time of his recent promotion to division superintendent.

E. B. Whitman

Fred A. Klein has been appointed fuel supervisor of the Illinois division of the Atchison, Topeka & Santa Fe, with headquarters at Shopton, Iowa, and Leo W. Powell has been appointed fuel supervisor of the Missouri division.

John H. Daley, master mechanic of the Boston division of the New York, New Haven & Hartford, has been appointed mechanical superintendent, Lines West and Central New England Railway, succeeding A. A. Harris, assigned to other duties.

J. E. Brown, mechanical engineer of the St. Louis Southwestern, with headquarters at Pine Bluff, Ark., has been promoted to assistant superintendent of motive power, with the same headquarters, a newly created position. Mr. Miller will take over the duties formerly discharged by W. C. Stone, master car builder, who has resigned. E. J. Kueck has been appointed mechanical engineer, with headquarters at Pine Bluff, succeeding Mr. Brown.

Silas Zwight, acting general mechanical superintendent of the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to general mechanical superintendent, with the same headquarters, succeeding H. M. Curry, who has retired. E. L. Grimm, mechanical engineer, with headquarters at St. Paul, has been promoted to assistant to the general mechanical superintendent, with the same headquarters, a newly created position. T. J. Cutler, acting mechanical superintendent, with headquarters at St. Paul, has been promoted to mechanical superintendent of the lines east of Paradise, Mont., with the same headquarters. G. F. Endicott, assistant master car builder, with headquarters at St. Paul, has been promoted to mechanical engineer, with the same headquarters, succeeding Mr. Grimm.

F. P. Howell has been appointed superintendent of motive power of the Atlantic Coast Line, with headquarters at Waycross, Ga. Mr. Howell was born on October 1, 1876, at Tarboro, N. C. He entered railway service on April 11, 1896, as a machinist's apprentice on the Atlantic Coast Line. In April, 1902, he was appointed night roundhouse foreman at Rocky Mount, N. C., and in May, 1903, was promoted to gang foreman, holding that position until March, 1908, when he was appointed erecting shop foreman, with the same headquarters. In January, 1909, he was transferred to the Waycross shops in the same capacity and in July, 1917, was promoted to general foreman with the same headquarters. A year later he was transferred to Savannah, Ga., as master mechanic of the Savannah and Charleston districts, serving in that capacity until October 15, 1920, when he was appointed shop superintendent at Waycross, which position he was holding at the time of his recent promotion to superintendent of motive power of the Second and Third divisions.

F. P. Howell

H. M. Curry, general mechanical superintendent of the Northern Pacific, with headquarters at St. Paul, Minn., has retired from active duty after 43 years of continuous service with the company. Mr. Curry was born on January 6, 1861, in Ogle county, Ill., and entered railway service in April, 1880, as a shop man and locomotive fireman on the Northern Pacific, being promoted to locomotive engineer in July, 1882. He was promoted to assistant road foreman of engines of the lines east of the Missouri river on December 1, 1891, and in December, 1898, was promoted to road foreman of engines. Mr. Curry was promoted to division master mechanic at Fargo, N. D., in November, 1901, and was transferred to Staples, Minn., in December of the following year. He was promoted to general master mechanic of the lines east of Billings, Mont., in February, 1905, and in January, 1908, was given extended duties as general master mechanic to include the lines east of Paradise, Mont. In January, 1910, he was appointed general master mechanic of the lines east of the Missouri river. Mr. Curry was promoted to mechanical superintendent in May, 1911, and in August, 1920, was promoted to general mechanical superintendent.

H. M. Curry

William J. Bohan, assistant general mechanical superintendent of the Northern Pacific with headquarters at St. Paul, Minn., died in that city on October 27. Mr. Bohan was born on November 3, 1873, at Waukesha, Wis., and graduated from the College of Engineering of the University of Wisconsin in 1895. He entered railway service in September of that year as an inspector of electric signals on the Chicago, Milwaukee & St. Paul, three years later being promoted to electrician in charge of electric train lighting at the Western avenue yards in Chicago. In May, 1900, he was appointed electrician in charge of electric train lighting on the Northern Pacific at Portland, Ore., and in February, 1903, was promoted to electrician in the mechanical department. Mr. Bohan was promoted to chief draftsman in the mechanical department on May 1, 1905, and on January 1, 1909, was again promoted to electrical engineer. On January 1, 1910, he was promoted to mechanical engineer with headquarters at St. Paul, Minn., and was promoted to assistant mechanical superintendent in October, 1918. He was promoted to assistant general mechanical superintendent with headquarters at St. Paul in August, 1920, and was holding this position at the time of his death.

Master Mechanics and Road Foremen

A. C. Rider has been appointed road foreman of engines of the Missouri-Kansas-Texas, with headquarters at Denison, Tex., succeeding J. H. Bush.

E. C. Gordon has been appointed assistant road foreman of engines of the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio, succeeding E. A. Burchiel, promoted.

M. King has been appointed road foreman of engines of the Coast division of the Southern Pacific, with headquarters at San Francisco, Cal., succeeding H. L. Moore, who has been assigned to other duties.

B. P. Johnson, acting general master mechanic of the lines from Mandan, Mont., to Paradise, of the Northern Pacific, with headquarters at Livingston, Mont., has been promoted to general master mechanic, with the same headquarters. James Matheson, acting master mechanic of the Seattle division, with headquarters at Seattle, Wash., has been promoted to master mechanic, with the same headquarters.

J. P. Egan has been appointed master mechanic on the Boston division of the New York, New Haven & Hartford, succeeding J. H. Daley. D. P. Carey has been appointed master mechanic of the Midland division. J. B. Wyler has been appointed to a similar position on the Hartford division, as have L. G. Marette on the Old Colony division and O. H. Ritter on the New Haven division. Mr. Marette succeeds C. U. Joy, assigned to other duties.

J. H. Painter, shop superintendent of the Atlantic Coast Line, with headquarters at Rocky Mount, N. C., has been appointed master mechanic of the Richmond, Norfolk and Fayetteville districts, with the same headquarters. P. J. Meade, master mechanic, with headquarters at Rocky Mount, has been transferred to the Wilmington district, with headquarters at Wilmington, N. C. S. E. Porter, general foreman, with headquarters at Port Tampa, Fla., has been appointed master mechanic, with headquarters at Waycross, Ga., succeeding C. A. White.

C. K. Vaught has been appointed assistant master mechanic of the Middle division of the Pennsylvania, succeeding J. G. Shaeffer, promoted. H. H. Haupt has been appointed master mechanic at Wilmington, Del., succeeding E. B. Whitman, promoted. W. B. Porter has been appointed assistant engineer of motive power in the office of the general superintendent of motive power of the Eastern region, succeeding Mr. Haupt. G. S. West has been appointed to a similar position on the Central Pennsylvania division, succeeding Mr. Porter. D. K. Chase has been appointed assistant master mechanic of the Meadows shops, succeeding Mr. West. C. A. Wilson has been appointed assistant master mechanic of the Trenton division, succeeding E. R. Buck, who has been transferred to a similar position.

Car Department

J. P. Ellis has been promoted to general car foreman of the Missouri-Kansas-Texas, with headquarters at Waco, Tex.

O. D. Carey has been appointed assistant foreman of the car shops of the Atchison, Topeka & Santa Fe at Argentine, Kan.

L. H. Conley has been transferred from Gallup, N. Mex., to Richmond, Cal., as car inspector foreman of the Atchison, Topeka & Santa Fe.

W. F. Crowder has been appointed general car inspector of the Pere Marquette, with headquarters at Grand Rapids, Mich., succeeding J. McKenzie, deceased.

J. H. Douglas, master car builder of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, has been transferred to Toledo, Ohio, with office in the Iron street shop yards.

Frank Roehr has been appointed master car repairer of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Cal., succeeding M. H. Warren, who has retired.

W. C. Stone, master car builder of the St. Louis-Southwestern, with headquarters at Pine Bluff, Ark., has resigned to become mechanical superintendent of the American Refrigerator Transit Company, with headquarters at St. Louis, Mo., succeeding T. E. Parker, resigned.

Shop and Enginehouse

E. D. Colon has been appointed shop efficiency engineer of the Pere Marquette, with headquarters at Detroit, Mich.

W. P. Isabel has been promoted to material inspector in the machine shop of the Norfolk & Western at Roanoke, Va.

George Whitmore has been appointed foreman of the old roundhouse of the Norfolk & Western at Williamson, W. Va.

C. E. Kimmerling, machinist, has been promoted to assistant night foreman of the Norfolk & Western at Roanoke, Va.

W. A. Brule has been appointed assistant roundhouse foreman of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan.

Jess Campbell has been appointed roundhouse and boiler foreman of the Missouri-Kansas-Texas, with headquarters at Wichita Falls, Tex.

E. C. Ralph has been promoted to night roundhouse foreman of the Missouri-Kansas-Texas, with headquarters at Muskogee, Okla., succeeding George Hays.

J. W. Chapman, general roundhouse foreman of the Missouri-Kansas-Texas at Franklin, Mo., has been transferred to Parsons, Kan., succeeding J. Malsed.

J. Malsed, general roundhouse foreman of the Missouri-Kansas-Texas at Parsons, Kan., has been appointed mechanical inspector of the back shop at that point.

C. J. Bauman has been appointed supervisor of boiler inspection and maintenance of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

Arthur Smith, assistant foreman of the locomotive paint shop of the Missouri-Kansas-Texas at Parsons, Kan., has been appointed general foreman of the paint shop at Waco, Tex.

E. B. Wood, a graduate machinist from the San Bernardino, Cal., shops of the Atchison, Topeka & Santa Fe, has been appointed instructor of the Santa Fe apprentice school at Las Vegas, N. Mex.

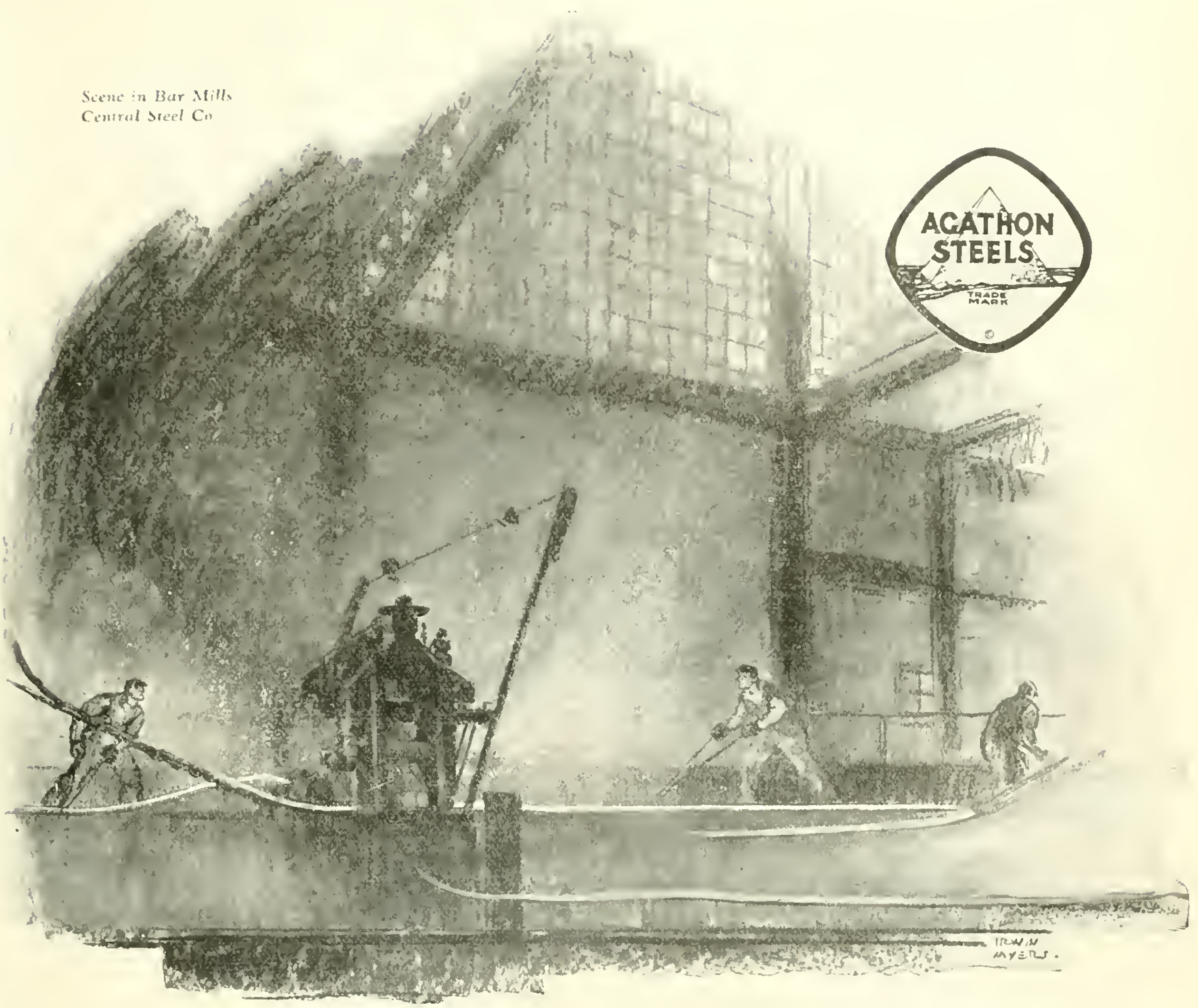
Purchasing and Stores

W. R. Culver has been appointed general storekeeper of the Pere Marquette, with headquarters at Grand Rapids, Mich., succeeding D. W. Roberts, who has resigned.

J. H. Lauderdale, assistant manager of the department of materials and supplies of the Railroad Administration, has succeeded M. J. Wise, manager, who has resigned to accept service elsewhere.

W. C. Bower, assistant manager of purchases and stores of the New York Central Lines, with headquarters at New York, has been appointed manager of purchases and stores, with the same headquarters, succeeding S. B. Wight, promoted.

H. A. Smith, general storekeeper of the Terminal Railroad Association of St. Louis, with headquarters at St. Louis, Mo., has been promoted to purchasing agent and general storekeeper, with the same headquarters, succeeding W. G. O'Fallon, who has resigned to engage in private business.



Scene in Bar Mills Central Steel Co

We Can Solve Your Problem—If It's IN the Steel

We have a daily production in all kinds of Agathon Alloy Steels such as—

Nickel, Chrome-Nickel, Uma, Molybdenum, Chrome-Molybdenum, Nickel - Molybdenum, Vanadium, Chrome-Vanadium, Chromium, etc.

Deliveries in Blooms, Billets, Slabs, Bars, Hot Rolled Strips, etc.

Perhaps you require a steel of greater hardness, strength, density or adaptability to heat treatment than you are now using for locomotive parts such as piston rods, main and side rods, axles, crank pins, etc.

Our expert metallurgists and practical steel men, working in one of the best equipped chemical and physical laboratories in America, will gladly solve your problem in steel—without charge. Write us. Ask for interesting booklet.

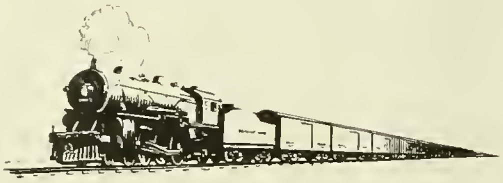
The Central Steel Company, Massillon, Ohio

AGATHON ALLOY STEELS
FOR LOCOMOTIVE PARTS

Here's a Quick Answer

When you are asked about the Security Sectional Arch these facts will help you to answer.

① Over 48,000 engines have been equipped.

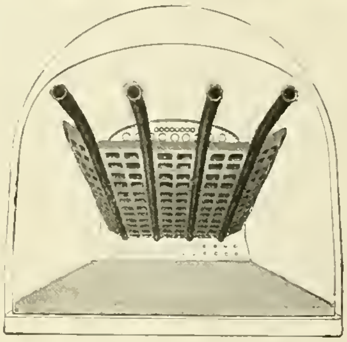


② Over 1,000 old engines have had Arches installed so far this year.

③ An Arch saves $1,000 (10%) of the fuel cost per locomotive per year—an average figure.

④ The cost of the Arch is returned in fuel saving before the brick has to be paid for.

⑤ The Arch is the quickest, least expensive way to increase the steaming power of any locomotive.

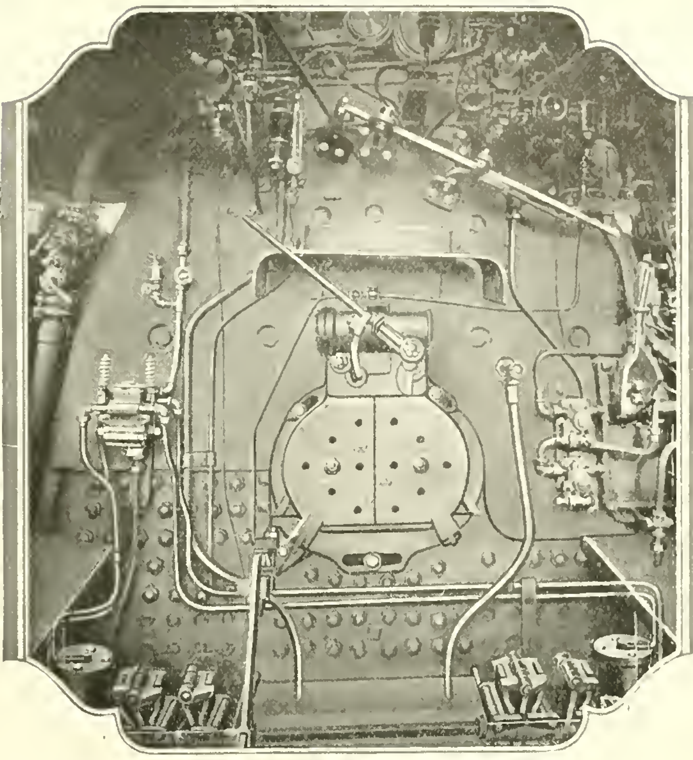


If this is clear to you, clip it and keep it. If it is not clear to you, write us.

AMERICAN ARCH COMPANY, Inc.
Locomotive Combustion Engineers

17 East 42nd Street
NEW YORK

McCormick Building
CHICAGO



Franklin Automatic Firedoor
Butterfly Type

Not a Cent in Seven Years

"In seven years of service not a single cent was spent for maintenance on the Franklin No. 8 Firedoor."—Master Mechanic.

Franklin Firedoors are designed for just such a result.

They are built to save fuel, reduce boiler maintenance and protect lives—not to decorate a repair shop.

Hardened pins and bushings protect all points that wear. This is a refinement peculiar to Franklin.

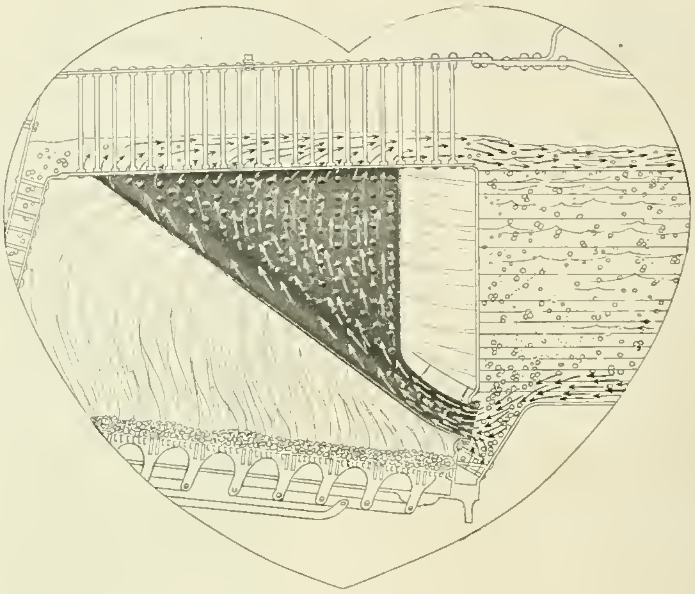
It is expressive of the Franklin policy to build a fire door that the repair man rarely sees.

Franklin Railway Supply Company, Inc.
17 East 42nd Street, New York

332 So. Michigan Avenue, Chicago, Ill.
1209-12 Praetorian Bldg., Dallas, Texas.
774 Monadnock Bldg., San Francisco, Cal.

Franklin Railway Supply Company of Canada, Limited, Montreal
Export Department—International Railway Supply Co.—30 Church St., New York

The FRANKLIN *Automatic* FIRE DOOR



Syphons Stimulate Steam Generation

THINK of the number of locomotives on your road that need more steaming power.

That is all they now lack to enable them to haul more tons.

How can more steaming power be secured without sacrifice of fuel economy?

1. By increasing the heating surface.
2. By stimulating boiler water circulation, thus speeding the steam-making process.

Nicholson Thermic Syphons do both. Additional area is provided at the hottest part of the firebox. The entire contents of the boiler is kept constantly in motion, stimulating steam generation.

Syphons can be quickly installed at the next shopping. Fuel savings will pay for them in a few months.

Bulletin No. 5 explains how Nicholson Thermic Syphons increase capacity without adding to the maintenance burden. Write for your copy.

LOCOMOTIVE FIREBOX COMPANY

140 *South Dearborn Street, Chicago, Illinois*

THE HOLDEN COMPANY, LIMITED

Montreal *Toronto* *Winnipeg* *Vancouver*

NICHOLSON THERMIC SYPHONS

—the Heart of the Locomotive

This Parkesburg Tube is in good condition today, after 33 years of service; sound and free from pitting or other signs of corrosion.

IF
The Price Per Foot *Seems* High—

When comparing the price per foot of charcoal iron boiler tubes, please bear in mind:

> Parkesburg Tubes are *very carefully* made.
>
> None but the best grade of charcoal and the finest basic materials are used.
>
> Manufacturing precautions exclusive with Parkesburg add to our costs and send many tubes to our scrap pile—but keep them out of yours.
>
> Operating the only mill devoted exclusively to the production of charcoal iron tubes, and with fifty-one years of manufacturing experience, we have been able to reduce purchasing and operating costs to the minimum consistent with Parkesburg Quality.

When you place an order for Parkesburg Charcoal Iron Boiler Tubes you are buying at the lowest price at which it is possible to obtain genuine charcoal iron boiler tubes of the Parkesburg standard and you are assuring yourself of the longest-lived, most economical tubes you can put in a boiler.

Look beyond the price per foot. Consider the service life—which really determines the cost—and specify Parkesburgs.

How Parkesburg Charcoal Iron Boiler Tubes are made, why they last longer than tubes of other material, and a number of actual instances of long and economical tube service are interestingly told in "Parkesburg Tubes". Send for a copy.

The Parkesburg Iron Company

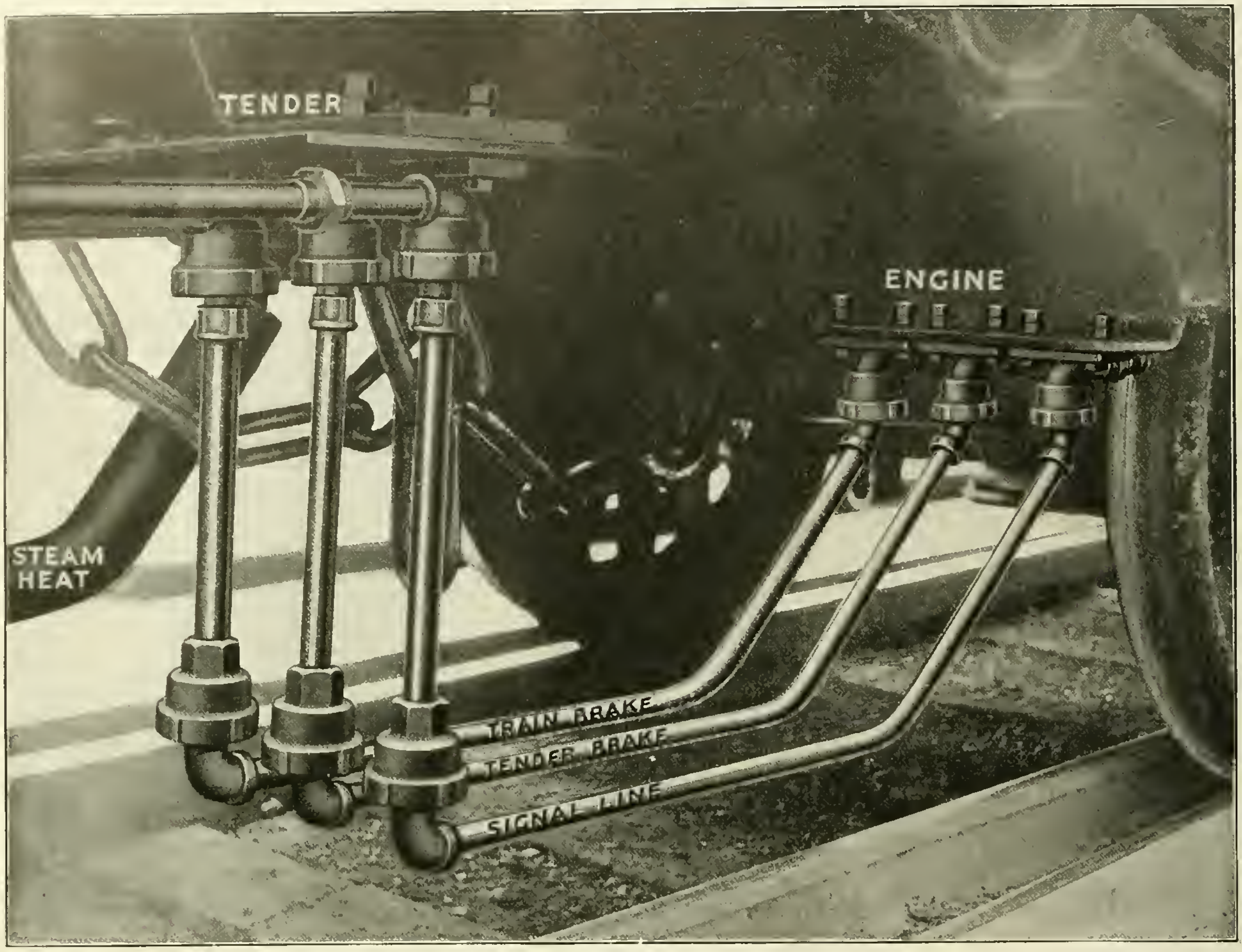
Parkesburg, Pa.

BRANCH OFFICES

New York, 30 Church Street—Boston, Oliver Building—Chicago, Fisher Building
Philadelphia, Commercial Trust Building — St. Louis, Security Building
San Francisco, Rialto Building — Montreal, New Birks Building
St. Paul, 906 Merchants Bank Building

EXPORT AGENTS

Wonham, Bates & Goode Trading Corporation, New York



Connections That Do Not Fail

LOOK at this illustration—study these engine tender connections. You know the troubles you have always had in the past, caused by alternate freezing and thawing when non-metallic equipment was used—the frequent renewals, heavy maintenance costs, engine failures and delays.

Get away from all these connection worries by starting right now to equip your locomotives with—

BARCO 3V CONNECTIONS

the connections which do not fail. Intense cold, high steam or air pressures, the gruelling service to which they are subjected in their exposed position—none of these factors can affect them—because of their durable, all metal construction. Perfectly flexible, too—they take all curves and switches without strain and without restricting the flow.

For detailed description
— see —
LOCOMOTIVE CYCLOPEDIA
1922 Edition

There is a Barco Representative in your vicinity who will gladly furnish facts and figures—when may he call? Write today.

Barco Manufacturing Company

1801 WINNEMAC AVE., CHICAGO, ILL.

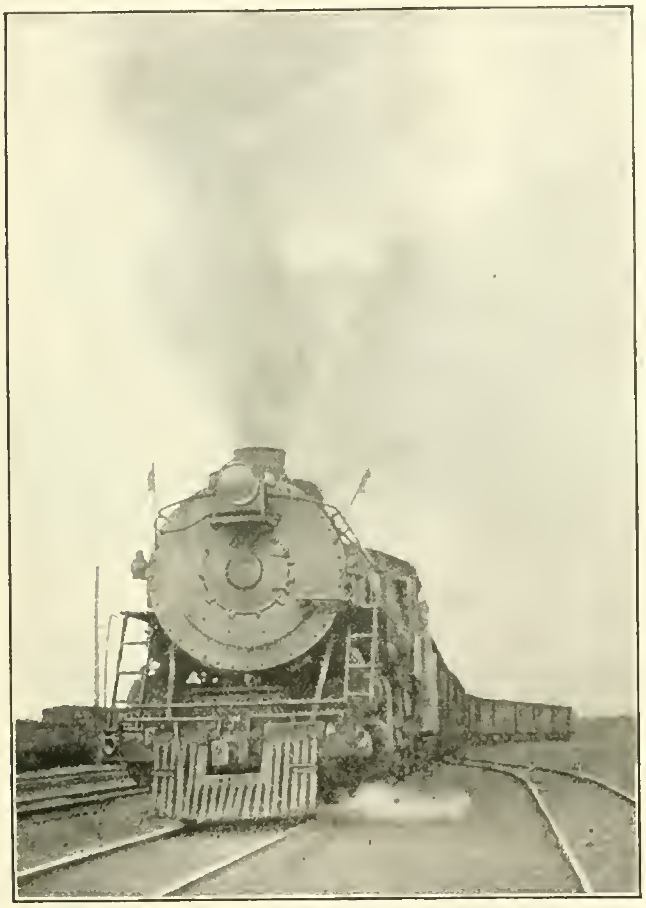
IN CANADA
MONTREAL - TORONTO

THE HOLDEN CO., LTD.

IN CANADA
WINNIPEG - VANCOUVER

BALDWIN

Mikado Type Locomotives in heavy freight service on the Burlington



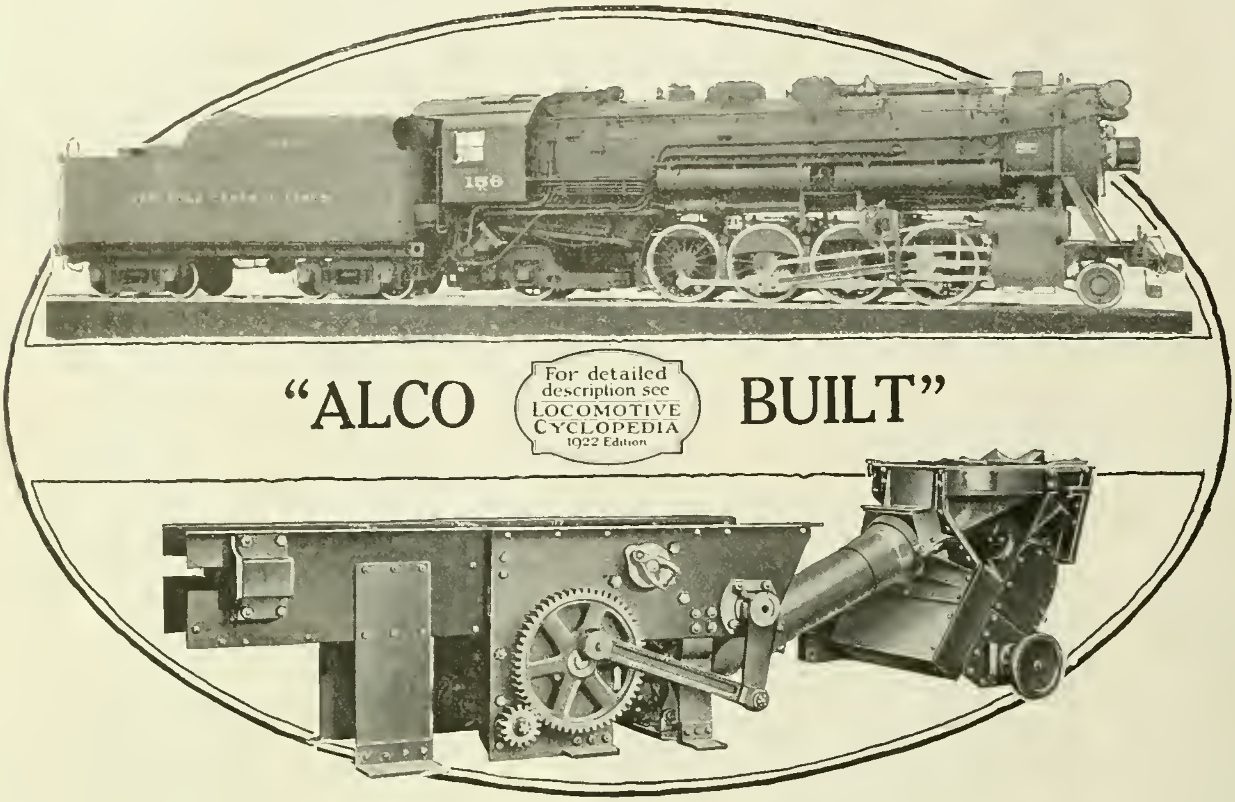
THE Chicago, Burlington and Quincy uses two classes of Baldwin Mikados in heavy freight traffic—O-1, with 27 x 30-inch cylinders, developing a tractive force of 52,300 pounds, and O-3, with 28 x 32-inch cylinders, developing a tractive force of 60,000 pounds. Both classes have 64-inch driving wheels, and are doing fine work in heavy drag service, as well as in handling perishable freight and live stock, a large amount of which is moved over this railroad.

West-bound from Chicago to Mendota, 83 miles, the Class O-3 locomotives handle 2700 tons as far as Aurora, 38 miles out, over a grade of 0.3 per cent 26 miles long. Between Aurora and Mendota, both East and West-bound, the rating for Class O-3 is 5,000 tons. The illustration shows one of the O-3 locomotives pulling out of the Chicago yards with a train of empty stock cars.

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

LOCOMOTIVES


"ALCO
For detailed description see LOCOMOTIVE CYCLOPEDIA 1922 Edition
BUILT"
156

ELVIN STOKERS

EVERY Elvin Stoker in operation is standing the test of service under all conditions and no better recommendation for their use as standard equipment could be made.

The ability of Elvin Stokers to reduce operating and maintenance costs to a reasonable ratio, while developing more gross ton miles is claiming more than the ordinary attention of railway officials—it is setting standards of stoker performance without duplication.

To install an Elvin Stoker on any locomotive is to prevent power loss—conserve fuel—increase revenue.

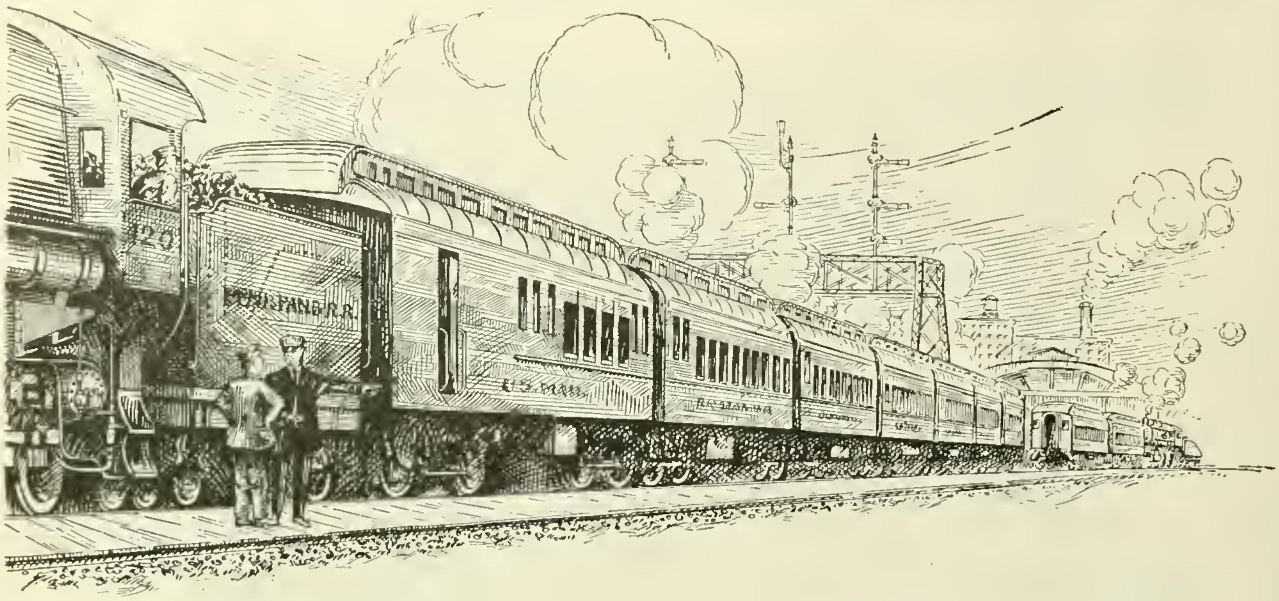
The Elvin Mechanical Stoker Company
50 Church Street New York City

Showing the Way

Three Cylinder Mohawk Type Locomotive
Built for New York Central Railroad

Three Cylinders—25 x 28 inches
Weight of Engine—367,000 pounds
Diameter of Driving Wheels—69 inches
Boiler Pressure—200 pounds
Tractive Power with Booster—75,700 pounds.

AMERICAN LOCOMOTIVE COMPANY
30 Church Street New York City

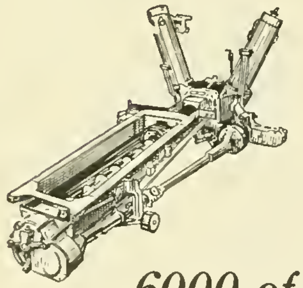


"AT ANY RATE, WE'VE GOT A DUPLEX STOKER"

And because he did have a Duplex Stoker, the engineer calmly watched them couple on the extra coaches which had been ordered at the last minute to accommodate an unexpected traffic rush, and which, to the railroad, meant extra revenue.

With ordinary hand-firing, additional coaches are apt to mean long, slow pulls and late arrival at destination, but Duplex Stokers provide the extra margin of power which makes it possible to handle extra tonnage and still adhere to schedules.

Large locomotives in either freight or passenger service *must* be stoker-fired to be operated economically.



Duplex Stokers will bring out full capacity of locomotive; will haul more tonnage per freight train; will make quicker trip with regular number of cars per train; will make up lost time; will make hard schedules on time; will take an extra car or two on heavy passenger trains without trouble; will enable passenger trains to make extra divisions without fire-cleaning; will carry thin, extra-hot fire; WILL INCREASE EARNING POWER OF ANY LARGE LOCOMOTIVE!

6000 of our Stokers in Service on 79 Railroads

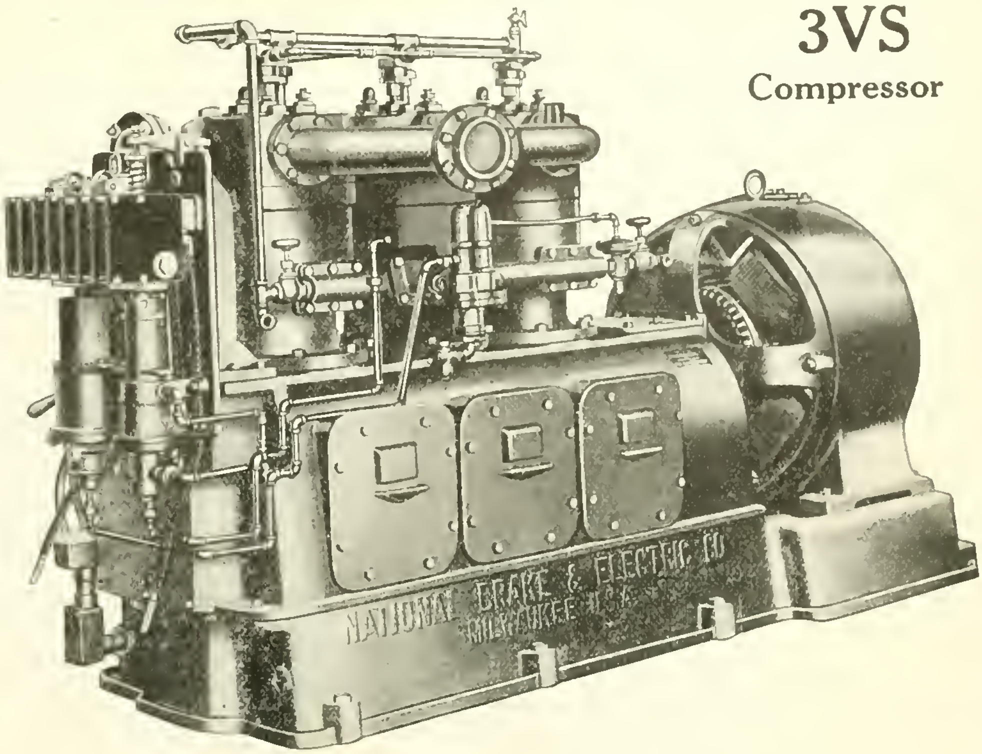
—"because the Promise has been Performed"

LOCOMOTIVE STOKER CO.

Main Office and Works—30 General Robinson St., West,
Northside, PITTSBURGH, PA.

Hudson Terminal Bldg. 50 Church St. NEW YORK	Munsey Bldg. 1329 "E" St., N. W. WASHINGTON	Railway Exchange Bldg. 80 E. Jackson Blvd. CHICAGO

3VS
Compressor



THIS PARTICULAR MACHINE—

is the justly famous 3VS Compressor which is found in so many railroad shops, roundhouses, power stations and signal plants. It is furnished in capacities ranging from 115 to 520 cu. ft. piston displacement, with either D.C. or A.C. motor. Note the HP Automatic Control indicated by the finger. This is an exclusive feature not found on any but Westinghouse Compressors.

Compressed Air Needs

The compressed air needs of many railroad shops and plants are efficiently taken care of by Westinghouse-National Air Compressors.

These machines are built especially for industrial use and offer so many important advantages that they have become known as the standard of quality and economy in the air compressor field.

Only on these compressors will you find the distinctive "HP" Automatic Control, which starts and stops the motor in exact accordance with your air requirements. No power is wasted and no special attention is required to insure satisfactory operation under all conditions.

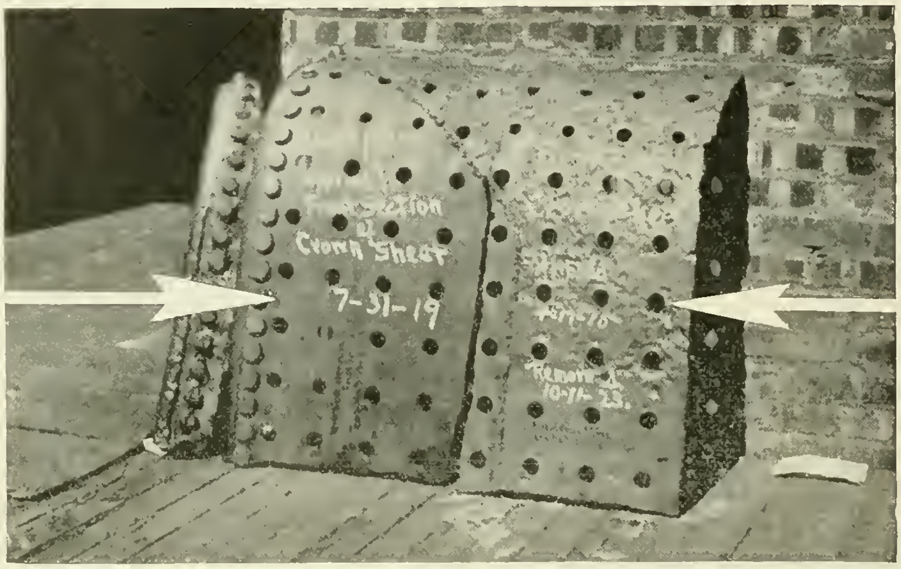
From our complete line you will be able to select a compressor for any specific need. Portable or stationary installations.

WRITE FOR THE WESTINGHOUSE-NATIONAL CATALOG

WESTINGHOUSE AIR BRAKE CO.

GENERAL OFFICES AND WORKS, WILMERDING, PA.
NEW YORK WASHINGTON CHICAGO ST. LOUIS SAN FRANCISCO

BOILER CORROSION ARRESTED



The use of
The Bird-Archer
Chemicals
did this

This condition
occurred previously to use of
The Bird-Archer
Chemicals

In above photographic reproduction, the stenciling reads as follows: "Original crown sheet applied 4-17-15. New piece applied to front section of crown sheet 7-31-19. Sheet removed 10-11-23."

A Southwestern line afflicted with corrosive conditions in its boilers decided to test the merits of The Bird-Archer Chemical treatment adapted to this condition.

A badly pitted fire-box was selected for the test and a crown sheet patch of sizable dimensions was welded into the old crown. The use of the chemicals was then started.

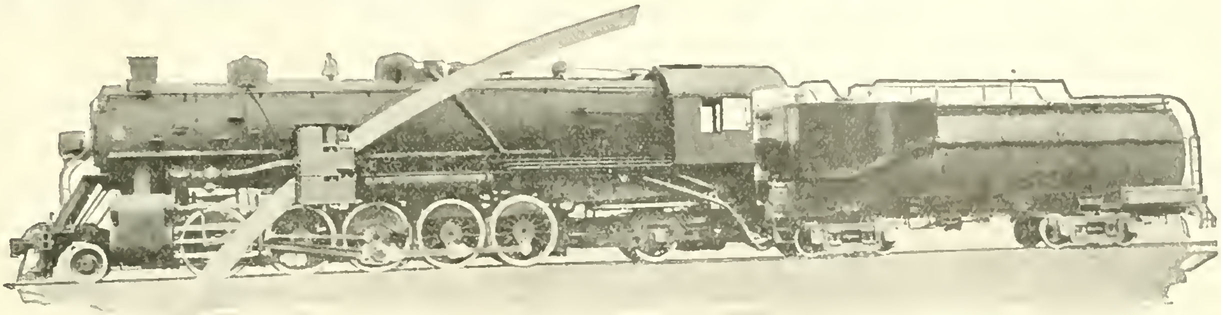
After something more than three years the entire crown sheet was removed for observation. The noted result as shown in the above photograph, was absolute evidence that the pitting was stopped.

The cost of the chemicals was almost negligible in view of the results obtained.

THE BIRD-ARCHER COMPANY

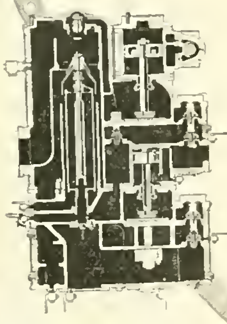
NEW YORK CHICAGO ST. LOUIS MONTREAL

Worthington Locomotive Feed Water Heater



1,355,022,222
B. T. U's
Saving per engine per month

Think of it! over a billion B. T. U's saved per engine per month. This is the figure resulting from data gathered on the performance of 30 locomotives, equipped with the Worthington heater. The records cover the 30 engines and their operation over one division for three months. The total fuel saved was 103 carloads or over three thousand tons.



Sectional view of the Worthington heater showing hot and cold water pump pistons at the right and heating chamber at the left.

WORTHINGTON PUMP AND MACHINERY CORPORATION

W-281.8

Executive Offices: 115 Broadway, New York City. Branch Offices in 24 Large Cities

WORTHINGTON

Deane Works, *Holyoke, Mass.*
Blake & Knowles Works
East Cambridge, Mass.
Worthington Works
Harrison, N. J.
Laidlaw Works, *Cincinnati, Ohio.*

Hazleton Works, *Hazleton, Pa.*

Gas Engine Works, *Cudahy, Wis.*
Power & Mining Works
Cudahy, Wis.
Snow-Holly Works
Buffalo, N. Y.
Epping-Carpenter, *Pittsburgh, Pa.*

U-LOY
STEELS

Help the Round House Foreman

The Round House Foreman's job is one of the hardest in the mechanical department of any railroad. Why add unnecessary troubles by using inferior steel in machinery parts, which cause failure and more headaches for the foreman?

U-LOY carbon vanadium steel, normalized, will reduce your failures to a minimum.

Take advantage of our consulting service. Our railroad men have picked up a lot of mighty valuable information in their travels which they will be glad to pass on to you.

UNITED ALLOY STEEL CORPORATION, CANTON, OHIO

New York
Syracuse
Cleveland

Chicago
Detroit
Pittsburgh

San Francisco
Indianapolis
Portland

U-LOY
STEELS

Special analysis and alloy steels made to your specification or ours for any required purpose.

TONCAN
METAL

Commercially pure iron alloyed with copper to obtain the greatest possible resistance to rust and corrosion.

MADE BY THE OLDEST AND LARGEST PRODUCERS OF HIGH-GRADE ALLOY STEEL.

UNITED ALLOY STEEL CORPORATION

Scientific Treatment of Boiler Feed Water

Dearborn

Leading the Way For 36 Years

For 36 years Dearborn has maintained that accurate analysis of the boiler feed water, proper reagents compounded for the injurious salts found and laboratory control of changing conditions, constitute the only effective method of water treatment.

While other propositions have been tried out from time to time through the years, none have withstood the test of actual service. The injurious salts in the water must be changed, and made harmless—so called "metal" or "protective" coatings, etc., are useless, otherwise, and "one formula compounds" cannot meet the problems presented by different supplies of varying character.

We keep constantly ahead of our subject—and give individual attention in our laboratory, engineering and manufacturing departments to each customer's need.

—With this result:

For 36 years we have gained and held an average of more than three new accounts daily.

Have you tried Dearborn Service? If not, will you talk over your feed water problems with the Dearborn Salesman next time he calls?

Dearborn Chemical Company

332 SOUTH MICHIGAN AVENUE
CHICAGO

299 BROADWAY
NEW YORK CITY

Only a Simple Heating and a Slow, Air Cooling

NORMALIZING, i. e., a single heating and slow cooling in still air, is the only treatment required with Carbon-Vanadium main and side rods, piston rods, axles and other forgings.

This simple alloy steel requires absolutely no quenching and tempering.

In its Normalized condition, a Carbon-Vanadium Forging will have minimum yield point of 60,000 pounds to the square inch, tensile strength of 90,000 pounds, elongation (in two inches) of 20%, and reduction of area, 40%.

In addition to the strength and toughness evidenced by its physical properties, Carbon-Vanadium possesses the characteristic shock-resisting and anti-fatigue qualities characteristic of all steels containing Vanadium.

Write for information about Carbon-Vanadium Forging Steel and the thousands of Carbon-Vanadium parts on the locomotives of many roads. Or, let us recommend steel makers and forging companies from whom you can get Carbon-Vanadium Forgings, Billets or Blooms.

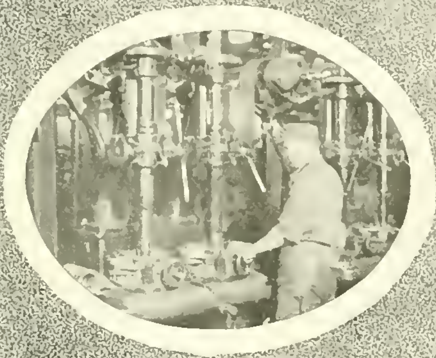
VANADIUM CORPORATION OF AMERICA

NEW YORK
120 Broadway

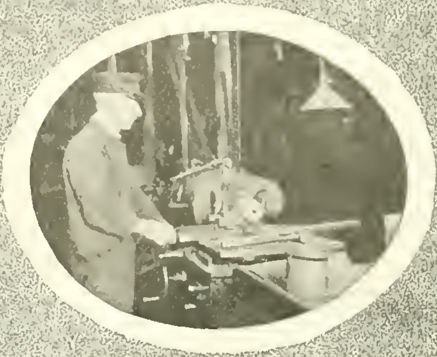
DETROIT
Book Bldg

VANADIUM STEELS

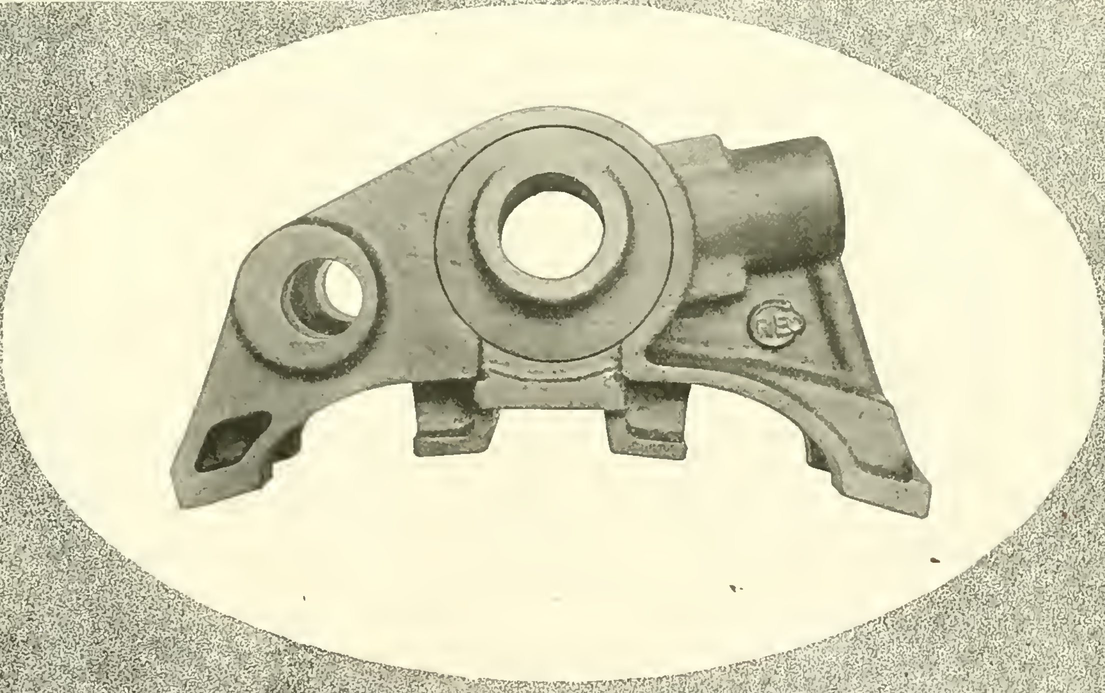
for Strength, Toughness and Durability



Boring Heads



Turning Sleeves



Creco Self Adjusting Brake Heads

When repairing Brake Beams, it should be borne in mind that they will be required to perform the same work as new beams. Creco parts are machined to fit.

Chicago Railway Equipment Co.

The tougher the test, the better Wood's show their superiority

Take a shovel from any one of the four standard grades of Wood's carbon steel shovels. Test it in comparison with any other shovel of similar grade. Grade for grade, shovel for shovel, Wood's readily prove their superiority.

Compare the wearing qualities of the blades. Compare the strength of their handles, the perfection of their welds, the toughness of their straps. Point for point, Wood's top them all.

Then you come to the H. K. Wood's Mo-*lyb*-den-um Steel Shovel. Comparisons cease. Stack a carbon steel shovel up against it and all you get is a contrast.

H. K. Wood's Mo-*lyb*-den-um Steel Shovels are harder, tougher and lighter for a given strength than any shovel made. The difference is overwhelming. They outwear other shovels two to six times. They easily stand abuse no other shovel could survive. Every conceivable test—thousands have been made—proves their absolute shovel supremacy.

If you want carbon steel shovels, buy Wood's. You can't get better. But if you want the finest shovel in the world, buy H. K. Wood's Mo-*lyb*-den-um Steel Shovel.

Let us give you complete information about the application of Wood's Shovels to all your needs.

THE WOOD SHOVEL & TOOL COMPANY
Piqua, Ohio, U. S. A.

Wood's Mo-lyb-den-um *The American Super Steel* **Shovels**

CRANE PROGRESS
SIX NEW LINES

of Valves and Fittings
For steam, water, oil and gas

Series
15
150 Steam
300 Water

Series
25
250 Steam
500 Water

Series
35
350 Steam
700 Water

WORKING PRESSURES

Series
50
300 Steam
1000 Water

Series
75
750 Steam
1500 Water

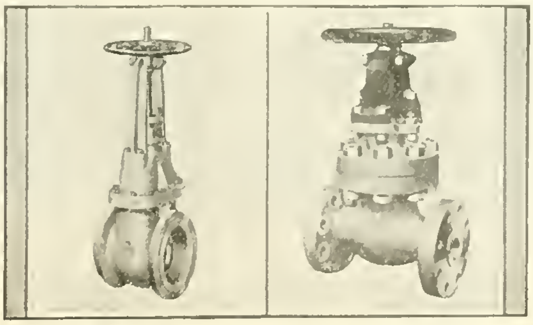
Series
150
1500 Steam
3000 Water

CRANE

GENERAL OFFICES: CRANE BUILDING, 836 S. MICHIGAN AVE., CHICAGO

Branches and Sales Offices in One Hundred and Forty Cities
National Exhibit Rooms: Chicago, New York, Atlantic City
Works: Chicago, Bridgeport, Birmingham, Chattanooga and Trenton

CRANE, LIMITED, MONTREAL. CRANE-BENNETT, Ltd., LONDON
CRANE EXPORT CORPORATION: NEW YORK, SAN FRANCISCO
Cie CRANE, PARIS

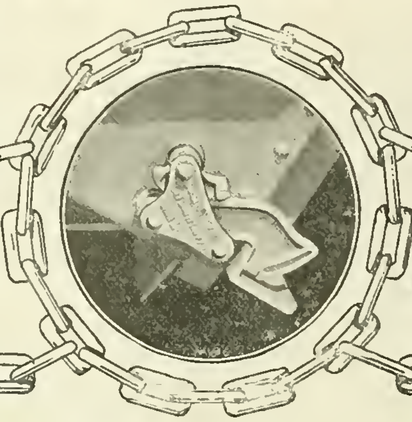


Gate Valve, 47-A
Series 15

Gate Valve, 3005-H
Series 150

WINE DOOR LOCKS

SAFETY **ECONOMY**



SIMPLICITY **DEPENDABILITY**

ELIMINATING all possibilities of danger to men unloading cars, is one of the cardinal features of the Wine Door Lock. Simple in construction it requires but a small hammer to knock out the dog, insuring safety to the operator.

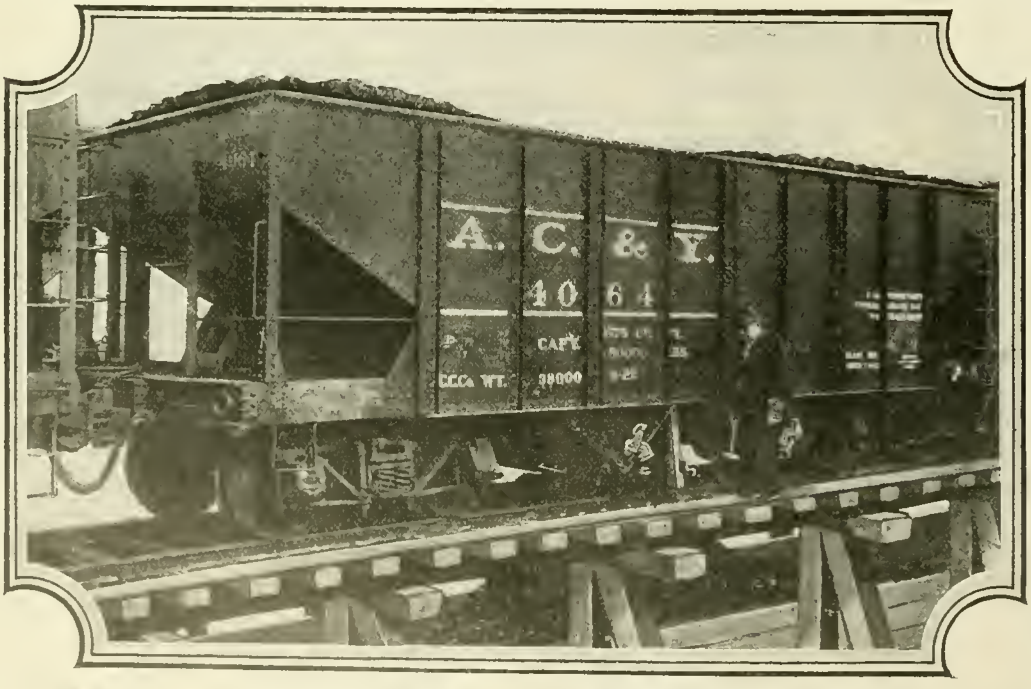
Designed with but three simple parts, they practically throw open the doors to economy by reducing first cost. The scrap material removed from old cars will pay for their installation. Naturally the few parts reduce maintenance costs to a minimum.

From 200 to 1200 lbs. reduction in the dead weight of the cars is an item in itself that requires no further discussion; and by reducing the unloading time and costs they also assist in maintaining desired car mileage.

Their dependability is positive, the greater the load, the tighter they grip, thereby preventing loss of loads, dropped in transit.

Facts and figures gladly furnished. Write for them today.

—For Detailed Description Locomotive Cyclopedia 1922



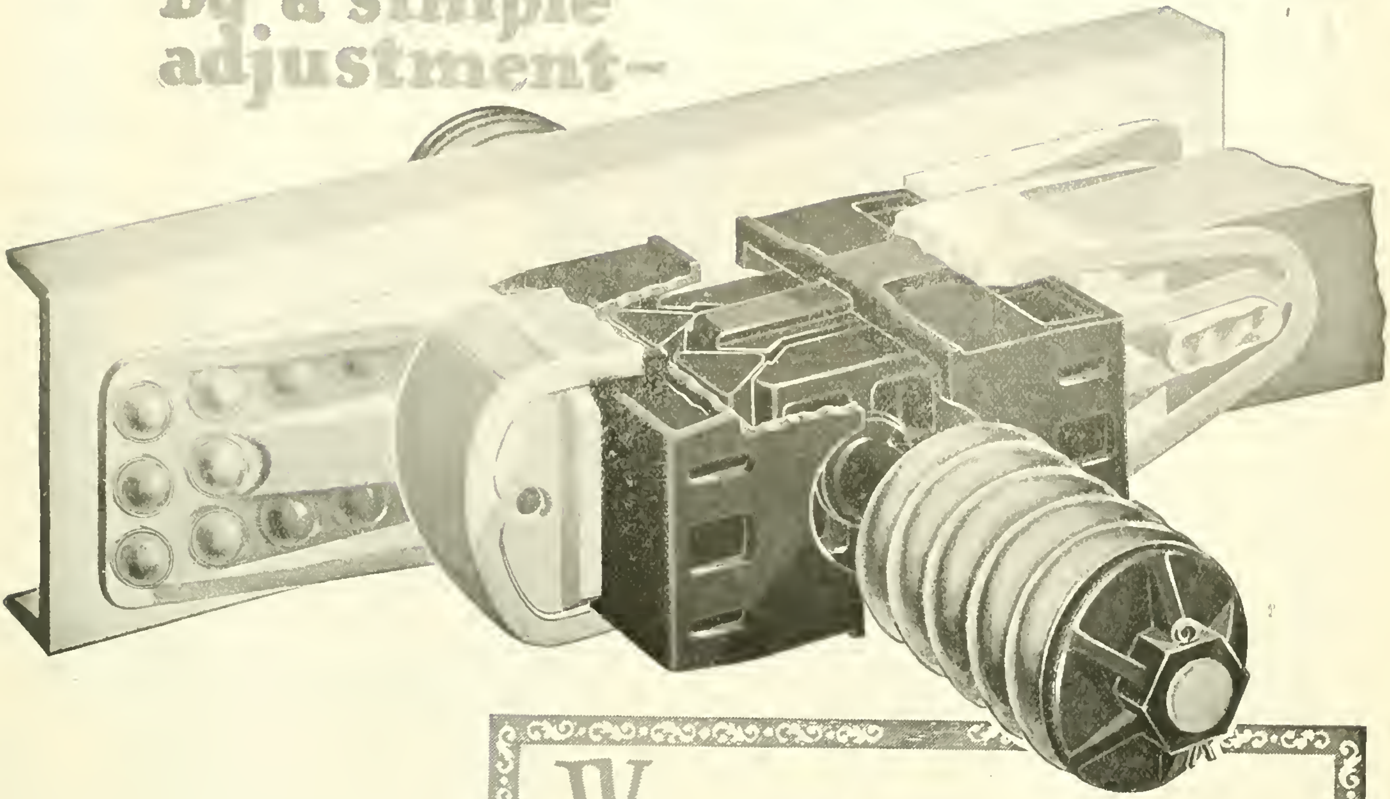
The Wine Railway Appliance Co.

Grand Central Terminal
New York

Toledo, Ohio

Peoples Gas Building
Chicago, Ill.

LIFE RESTORED
by a simple
adjustment—



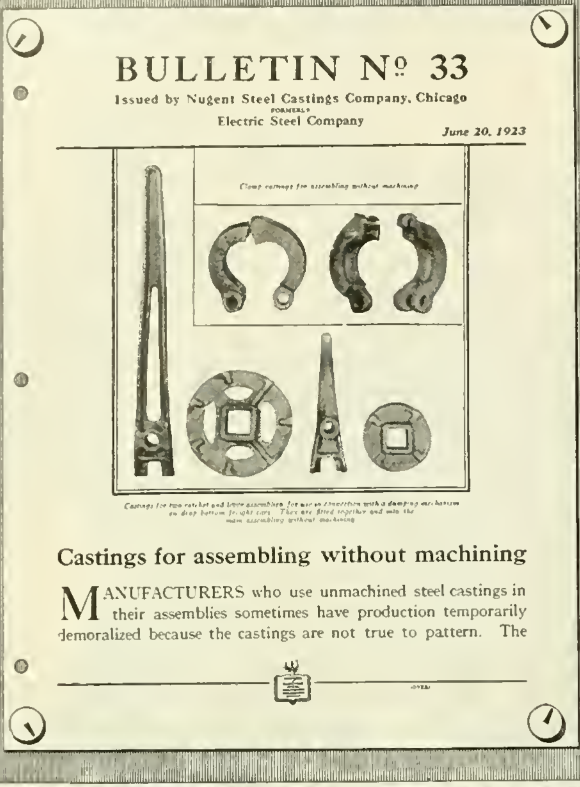
When other gears are being discarded because of wear on the friction parts, the Cardwell gear is restored to its initial efficiency by a simple quick adjustment.

It is then ready for another long period of severe service; after which a similar simple adjustment gives it still a third period of useful life

UNION DRAFT GEAR CO.

332 S. MICHIGAN AVE. CHICAGO, ILL.
TRANSPORTATION BLDG. MONTREAL, CAN.

For detailed description see
CAR AND LOCOMOTIVE
CYCLOPEDIAS
1922 Edition



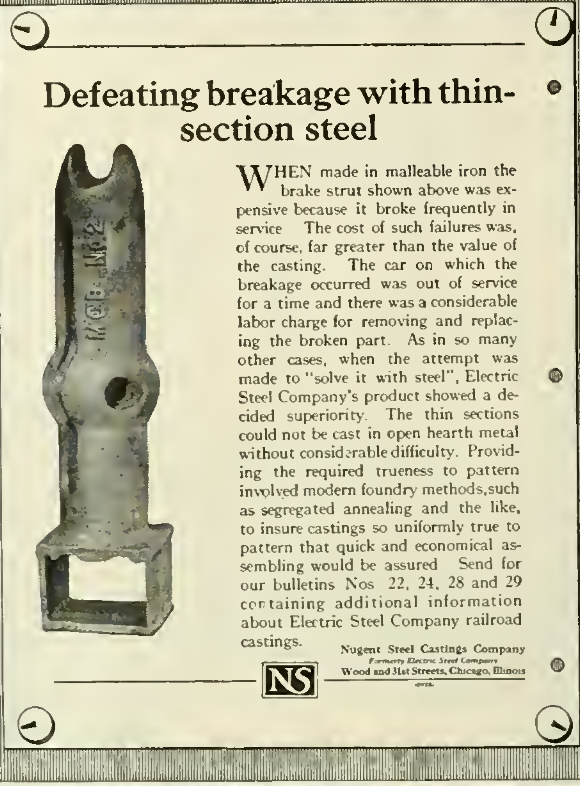
BULLETIN Nº 33

Issued by Nugent Steel Castings Company, Chicago
FORMERLY
Electric Steel Company

June 20, 1923

Castings for assembling without machining

MANUFACTURERS who use unmachined steel castings in their assemblies sometimes have production temporarily demoralized because the castings are not true to pattern. The



Defeating breakage with thin-section steel

WHEN made in malleable iron the brake strut shown above was expensive because it broke frequently in service. The cost of such failures was, of course, far greater than the value of the casting. The car on which the breakage occurred was out of service for a time and there was a considerable labor charge for removing and replacing the broken part. As in so many other cases, when the attempt was made to "solve it with steel", Electric Steel Company's product showed a decided superiority. The thin sections could not be cast in open hearth metal without considerable difficulty. Providing the required trueness to pattern involved modern foundry methods, such as segregated annealing and the like, to insure castings so uniformly true to pattern that quick and economical assembling would be assured. Send for our bulletins Nos. 22, 24, 28 and 29 containing additional information about Electric Steel Company railroad castings.

Nugent Steel Castings Company
Formerly Electric Steel Company
Wood and 31st Streets, Chicago, Illinois

Keeping cars off the "rip" track and lowering car-repair costs

Solving it with steel

DURING the last three years, over a dozen railroads with headquarters in the middle west have resolutely attacked the problem of lowering repair costs on freight cars by using steel castings.

Their attack resolved itself into two principal elements.

The first consisted of studying the parts that failed, to find out whether or not the number of failures could be reduced.

Parts that failed frequently

Parts such as the brake strut shown above, brake wheels, truck columns, door guides, brake head castings and many others that failed frequently in service were studied first.

Reducing casting costs

In every case we were able to produce repair parts of steel—so strong and serviceable that they helped materially in diminishing the number of cars on the "rip" tracks.

In many cases we were able to reduce even the first cost of the castings.

Reducing assembly costs

Second, the attack was concentrated on getting steel parts—intended for assembling without being machined—so true to pattern that the usual difficulties and costs due to off-size castings would be eliminated.

In every case Nugent Steel Castings proved so uniformly true to pattern that they did away with the machining, chipping and grinding so frequently necessary when ordinary castings were used.

Bulletins sent on request

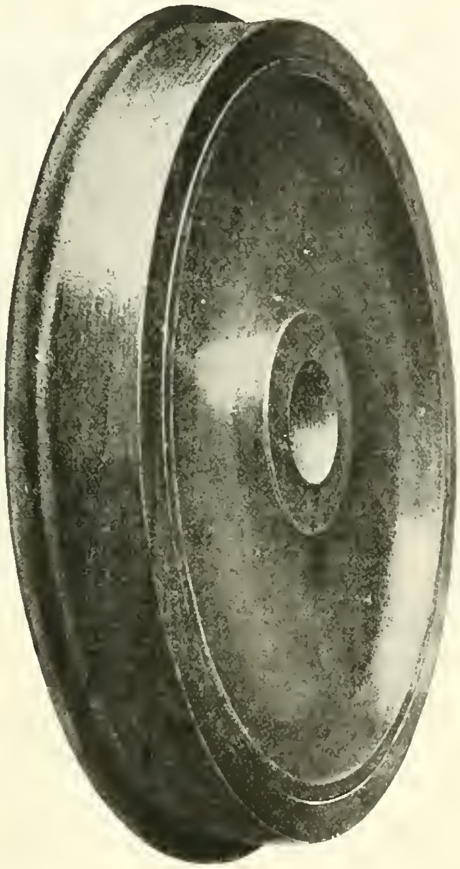
A description of the founding methods used to achieve these results is contained in our A series of 41 bulletins.

A complete set is sent free on request to anyone writing on business stationery.

Nugent Steel Castings Company, *formerly* Electric Steel Company
31st and Wood Streets, Chicago

NUGENT STEEL NS

'CARNEGIE'

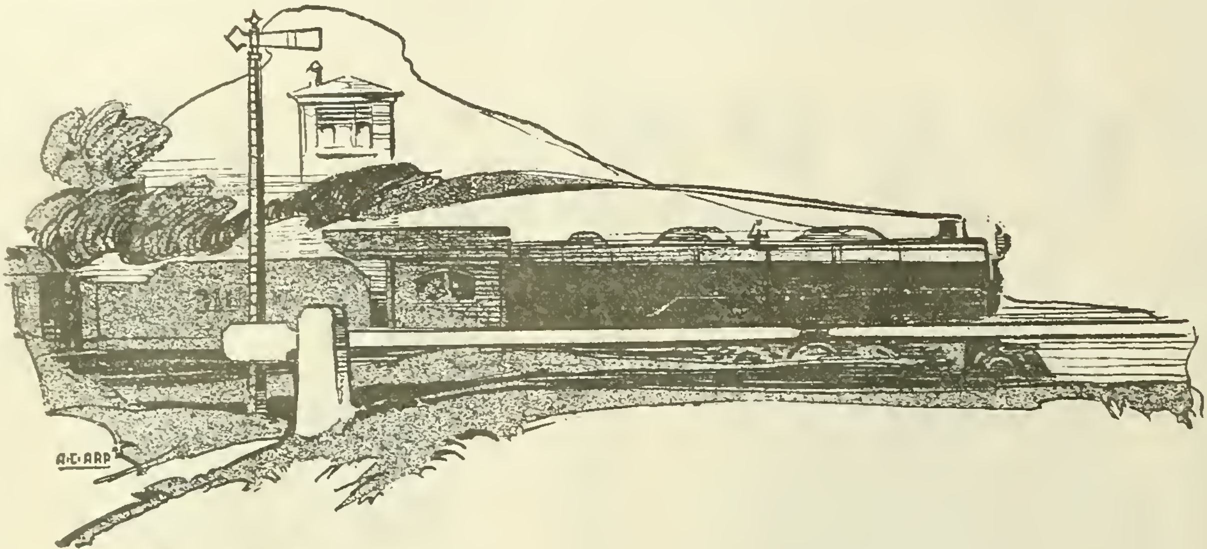


—the name
that guarantees
Service
to users
of Wheels

'The Proof is in the Wearing'

Carnegie Steel Company
GENERAL OFFICES: CARNEGIE BUILDING 434 FIFTH AVENUE PITTSBURGH, PA.

1661



Millions for Safety

Safety First is far more than a sentiment, or watchword with the railroads—IT'S a principle of action that underlies the whole structure of railroad efficiency and service.

Reputation and patronage are built on it. Millions of dollars yearly are spent for it. Equipment of highest merit is none too good to make it a living, practicable, thing of action.

Therefore, over a long term of years many railroads have found it desirable to clinch one big item in the sum total of railway safety by specifying

Goodrich

"LOCOMOTIVE FIRE HOSE"

"Best in the Long Run"

Built for the hardest kind of use

LUKENS

1810 ~ 1923

FOR one hundred and thirteen years every achievement of Lukens has been the result, not of mere "happening" but of determined purpose.

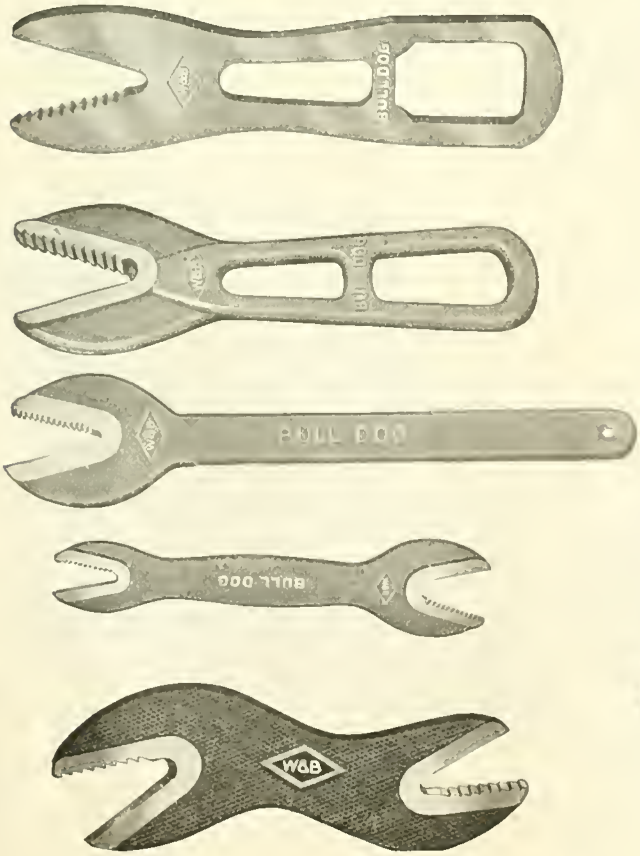
Persistence — ability — resourcefulness have combined to develop in Lukens steel matchless quality.

Foresight has created capacity to deliver the **World's Largest Steel Plates**—making possible **One Piece Crown and Side Sheets.** In boiler design this means no seams—less rivets—greater strength—lower construction and maintenance cost.

LUKENS STEEL COMPANY

Coatesville Pennsylvania

The World's Largest Plate Mill



"Invaluable in Tight Places"

In tight awkward places where a positive grip is necessary Williams "Bull Dog" Wrenches are indispensable, after their first trial.

Their jaws grip! Round, square, hexagon—in fact, any and every shape that will fit between their tough, oil tempered jaws, as these wrenches are drop-forged from a specially fine grade of high carbon steel and carefully tempered in oil. They are solid, dependable tools that are practically indestructible.

Their simplicity, strength, efficiency and ease of operation is appealing especially for railroad work.

Would you like a copy of our latest catalog?

J. H. WILLIAMS & CO.

Brooklyn Buffalo Chicago

WILLIAMS

SUPERIOR DROP-FORGED TOOLS

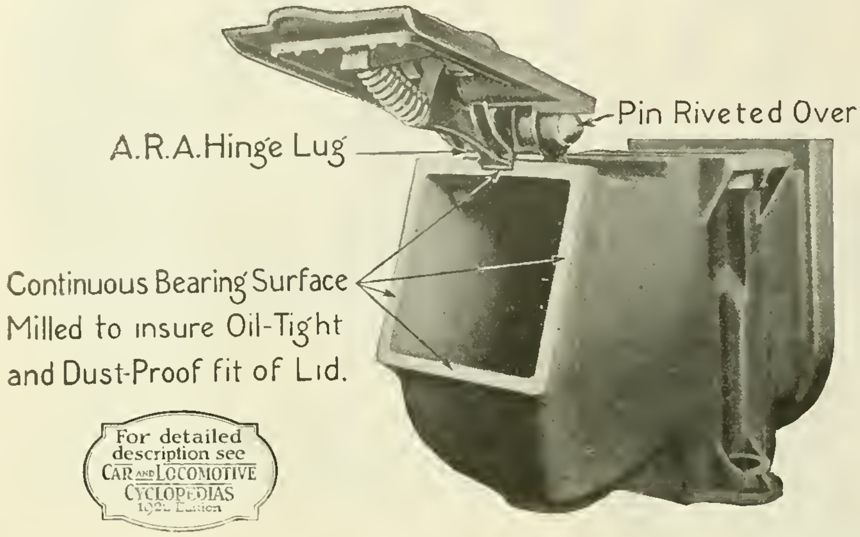
DROP-FORGED

"BULL-DOG"

WRENCHES

The National Coiled Spring Journal Box

THE NMCo


Pin Riveted Over
A.R.A. Hinge Lug
Continuous Bearing Surface Milled to insure Oil-Tight and Dust-Proof fit of Lid.

Meets all the requirements of the American Railroad Association for the maximum protection of Car Journals.

Write for Information

For detailed description see
CAR AND LOCOMOTIVE CYCLOPEDIAS
1922 Edition

THE NATIONAL MALLEABLE CASTINGS CO.

CLEVELAND CHICAGO INDIANAPOLIS TOLEDO
SHARON, PA. MELROSE PARK, ILL. EAST ST. LOUIS, ILL.

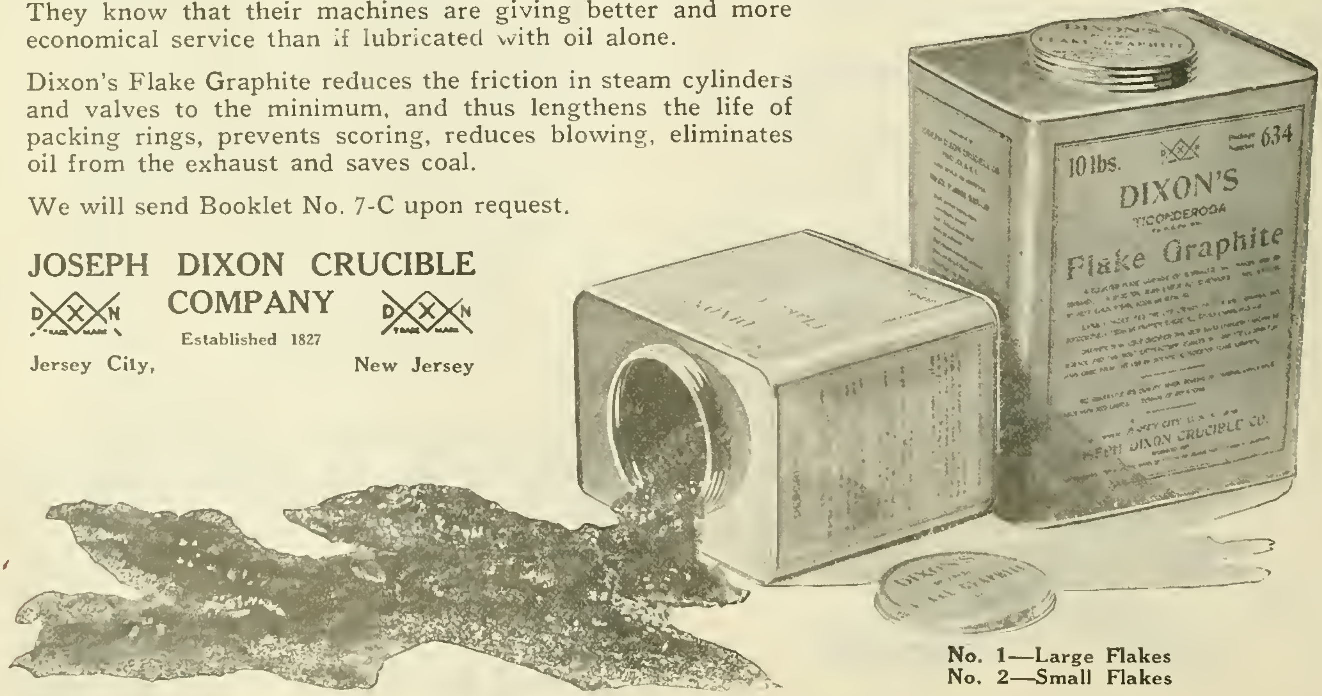
Dixon's Flake Graphite

Engineers who use Dixon's Flake Graphite regularly as a lubricant do not worry about hot boxes or scored cylinders. They know that their machines are giving better and more economical service than if lubricated with oil alone.

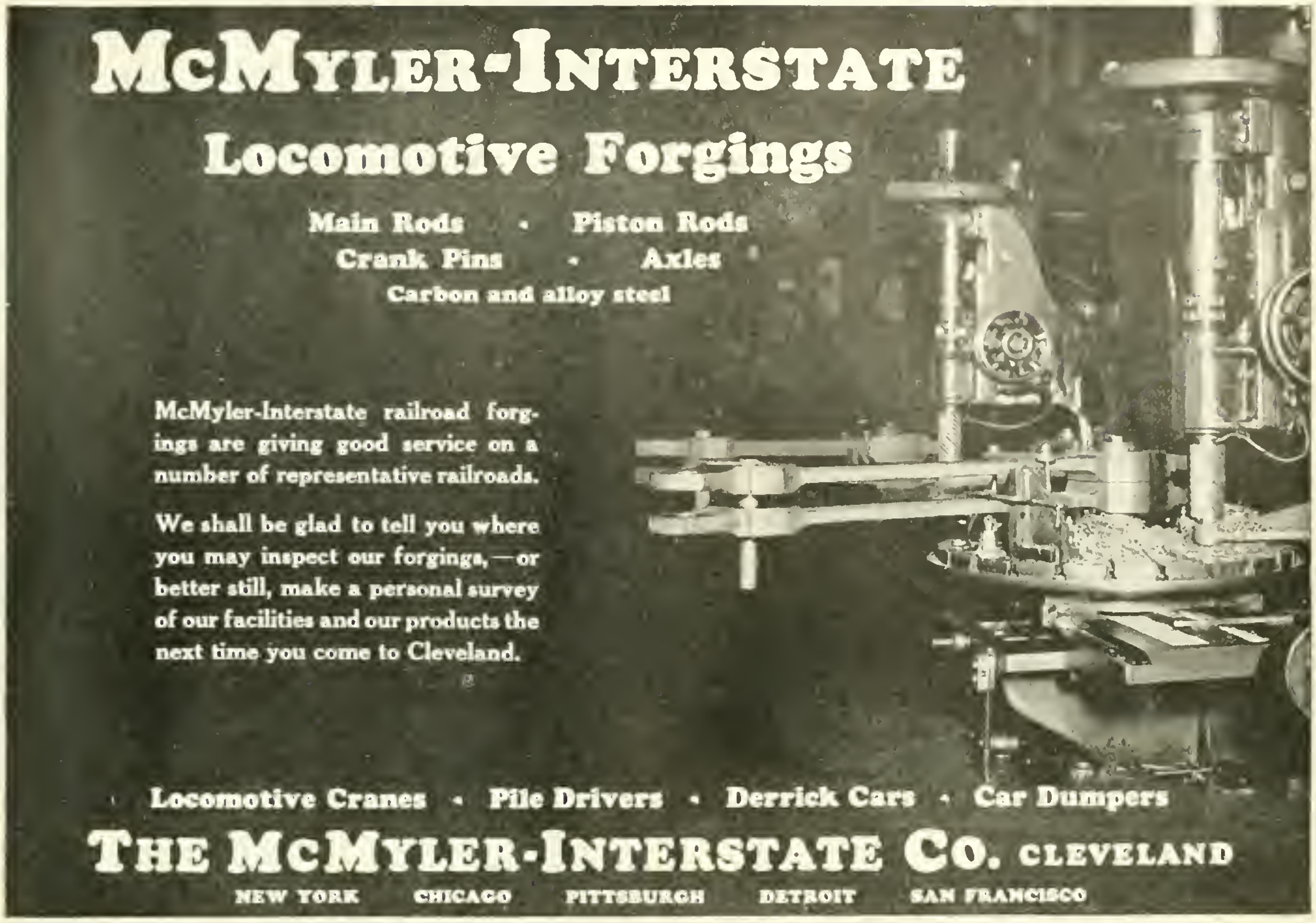
Dixon's Flake Graphite reduces the friction in steam cylinders and valves to the minimum, and thus lengthens the life of packing rings, prevents scoring, reduces blowing, eliminates oil from the exhaust and saves coal.

We will send Booklet No. 7-C upon request.

JOSEPH DIXON CRUCIBLE
COMPANY
Established 1827
Jersey City, New Jersey



No. 1—Large Flakes
No. 2—Small Flakes



McMyler-Interstate
Locomotive Forgings
Main Rods • Piston Rods
Crank Pins • Axles
Carbon and alloy steel

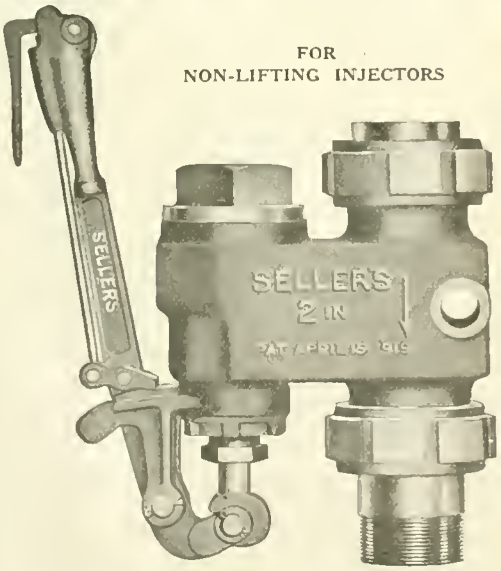
McMyler-Interstate railroad forgings are giving good service on a number of representative railroads.

We shall be glad to tell you where you may inspect our forgings,—or better still, make a personal survey of our facilities and our products the next time you come to Cleveland.

Locomotive Cranes • Pile Drivers • Derrick Cars • Car Dumpers
The McMyler-Interstate Co. Cleveland
New York Chicago Pittsburgh Detroit San Francisco

William Sellers & Co., Incorp.
1600 Hamilton St., PHILADELPHIA PA.

FOR NON-LIFTING INJECTORS



BALANCED STARTING VALVE
STYLE V-C
A RADICAL AND SUCCESSFUL DEPARTURE FROM FORMER MODELS

It remains STEAM-TIGHT IN SERVICE
It cannot jar open
MAIN AND PILOT VALVES ARE VERTICAL STEAM CHECKS, LOOSELY FITTED TO STEM AND SELF-GRINDING
It can be used as a heater
It can be placed inside or outside of cab

Simplest Design, No Unnecessary Parts

For detailed description —see— CAR BUILDERS CYCLOPEDIA 1922 Edition

LABOR-SAVING MACHINE TOOLS DRILL GRINDERS SHAFTING
TOOL-GRINDERS INJECTORS

PROOF

Commonwealth Devices Pay For Themselves

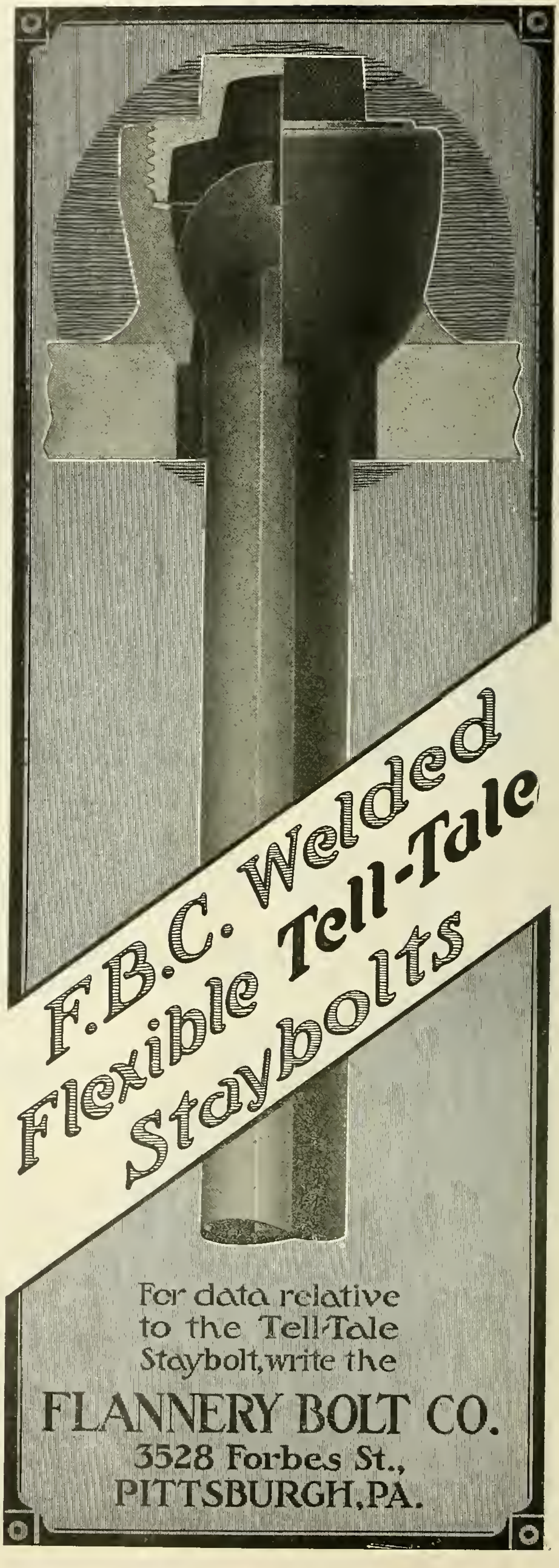
Recently one of our engineers had occasion to inspect a baggage car built several years ago and equipped with Commonwealth Trucks with pedestals cast integral.

They were in good condition after constant service running into hundreds of thousands of miles.

The Car Foremen and various others of whom inquiry was made, did not recall that these Trucks ever required any attention, except changing of the wheels, or renewing the removable wearing faces of the pedestals.

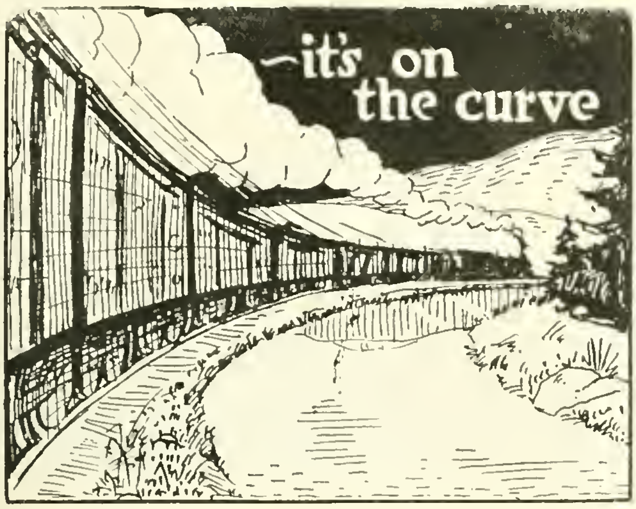
The pedestals were in perfect condition, proving that years ago we were successful in making Cast Steel Truck Frames with integral pedestals.

Commonwealth Steel Company
St. Louis



For data relative
to the Tell-Tale
Staybolt, write the

FLANNERY BOLT CO.
3528 Forbes St.,
PITTSBURGH, PA.



Boyden Co-ordinating Six Wheel Truck

On straight line travel these trucks give added smoothness, equalizing any vertical inequalities of the track, but It's On the Curves that they perform as no other truck can—here is where the wheels roll without drag or binding, and respond to every ounce of steam, saving real dollars.

(Patented and Patents Pending.)

BOYDEN STEEL CORPORATION
BALTIMORE, MD.

Q & C
Devices for Railroads

- Derails
- Rail Saws
- Skid Shoes
- Rail Braces
- Samson Rail Benders
- Guard Rail Clamps
- Electric Snow Melters
- Piston Rod Lubricators
- Rolled Steel Step Joints
- Bonzano-Thomson Rail Joints
- Century Steel Fence Posts
- Car and Engine Replacers
- Switch and Target Stands
- Universal and Gilman-Brown Emergency Knuckles

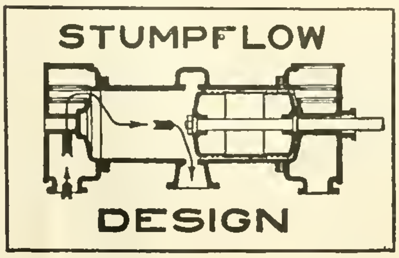
The Q & C Company, 90 West St., N. Y
CHICAGO SAN FRANCISCO ST. LOUIS
BANK & GOODELL St. Paul
SHERBURNE & COMPANY Boston
The General Supply Co. of Canada, Ltd., Ottawa

THE UNA-FLOW STEAM ENGINE

By Prof. Stumpf

contains a chapter on Locomotives — 25 pages of practical data illustrated by numerous cuts and pointing the way to improvements in locomotive design.

Send $4.00 to



STUMPF UNA-FLOW ENGINE CO.
INC.
206 E. Genesee St.
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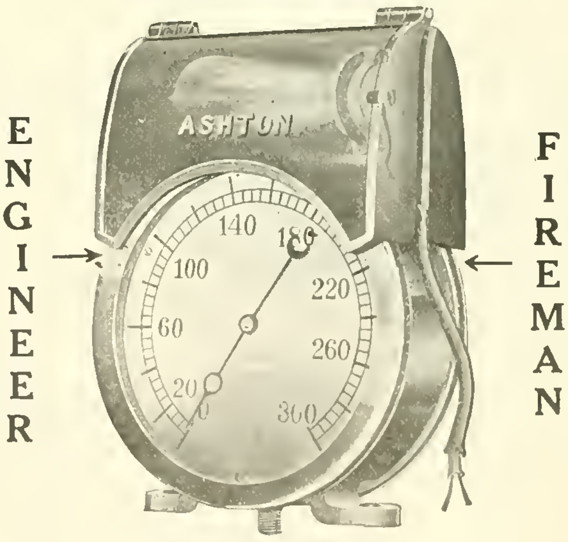
N. Y.



A Dial for Each

THE ASHTON DOUBLE DIAL STEAM GAGE is particularly designed for use on large oil burning locomotives and those having large fire boxes which extend far into the cab.

No duplication of steam pipes and lighting facilities is required. The convenience and economy effected by this gage is obvious. Engineer and fireman read the gage from their respective sides.

Please send for Circular No. 52-D.

THE ASHTON VALVE CO.
BOSTON, MASS. 161-179 First St., Cambridge 41
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NEW YORK 126 Liberty St.

ELESCO

THE VALUE OF
SUPERHEATERS
FEED WATER HEATERS
EXHAUST STEAM INJECTORS

on any locomotive is measured by the difference in the cost of operating locomotives with them and without them.

THE SUPERHEATER COMPANY
General Offices: 17 E. 42nd St., New York
Chicago: Peoples Gas Bldg.
For Canada: THE SUPERHEATER CO., Ltd., Montreal

For detailed description see Locomotive Cyclopedia, 1922 Edition

SUPERHEATERS

ARRIVING

What Is the Engineer's Report?

Train—*Extra* U. S. R. R. Engine—*2842*
Arriving time—*2:20 P. M.* Delay *2 hrs. 20 min.*
Cause of delay—*Both valves blowing. Necessary to give up train.* Engineer—*J. Jones.*

Bad engine failure, is it not? To eliminate such failures and reduce valve maintenance costs with maximum fuel conservation, use

THE AMERICAN SEMI-PLUG VALVES

Makers of American Semi-Plug Piston Valves, "Jack Wilson" High Pressure Valves, Valve and Piston Packing Rings

C. C. YOUNG
Successor to
AMERICAN BALANCE VALVE COMPANY
JERSEY SHORE, PENNSYLVANIA

GLOBE
insure perfect air conditions
VENTILATORS

IT is the actual every day performance year after year for 30 years on the buildings and cars of the great railway systems that has built Globe reputation—made passengers comfortable and shop men active.

Perfect ventilation at the lowest cost to install—no cost to operate.

Simple, strong, stormproof, they are effective in any position producing a continual exhaust, irrespective of weather conditions and without draft.

Blue prints sent on application.

GLOBE VENTILATOR COMPANY TROY, N.Y.

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KNOBBLED
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Works and General Offices:
WASHINGTON :: PENNSYLVANIA

The
Railway
Materials
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Steel Back
Brake Shoes

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NEW YORK
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FERGUSON FURNACE COMPANY

Head Office
TOLEDO, OHIO

STANDARD IN RAILWAY AND LOCOMOTIVE SHOPS
WILL REDUCE FUEL AND LABOR COSTS

Robert M. Lucas Co.
1955 West 31st St. CHICAGO.
Creators and Makers
— of —
LUCAS
CEMENT
·EST. 1912·

As a protective coating for car roofs, under frames, and all places of contact, etc., the equal of Lucas Cement does not exist.

A. R. A. Standard "D" Coupler
Penn Coupler Pitt Coupler
for Cars and Locomotives

Pitt Pivoted Coupler
designed especially for Passenger Equipment Cars

Steel Castings, Forging Billets and Ingots, and Rolled Steel Bars

For
detailed
description
— see —
CAR AND LOCOMOTIVE
CYCLOPEDIAS
1922
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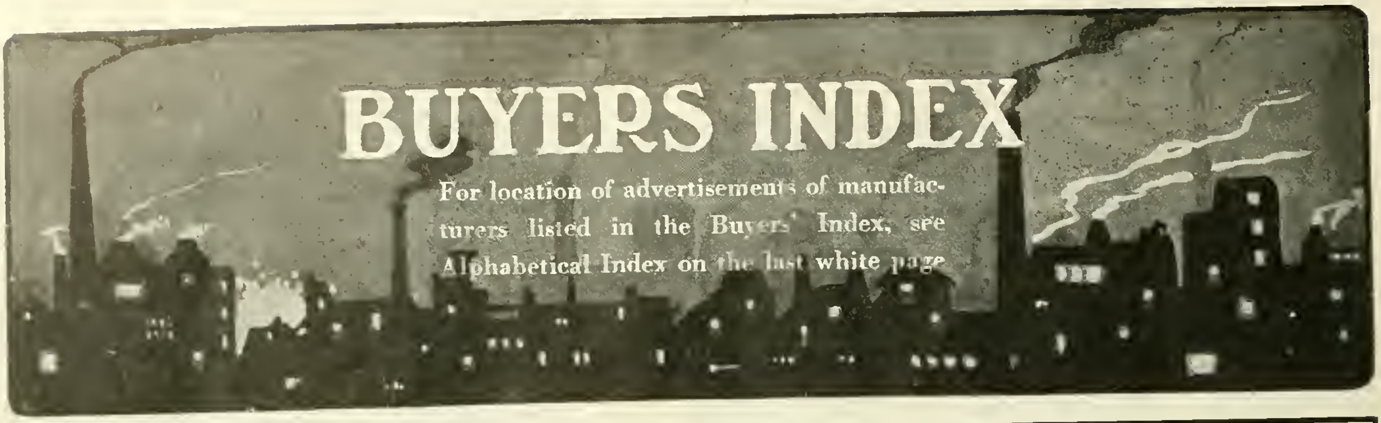
THE McCONWAY & TORLEY COMPANY
48th Street and A. V. Railway, Arsenal Station
PITTSBURGH, PA.



BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers' Index, see Alphabetical Index on the last white page

Accumulators, Hydraulic.
Chambersburg Engineering Co.
Hydraulic Press Mfg. Co.
Niles-Bement-Pond Co.
Southwark Fdry. & Mach. Co.
United Engineering & Fdy. Co.
Watson-Stillman Co., The.

Acetylene, Dissolved.
Air Reduction Co.
Prest-o-Lite Co., Inc.

Acetylene, Gas.
Prest-o-Lite Co., Inc.

Acetylene Welding Rods and Wire.
See Welding Rods and Wire.

Air Compressors—(See Compressors, Air).

Air Drills—(See Drilling Machines, Portable Pneumatic).

Air Hammers — (See Hammers, Pneumatic).

Air Hoists—(See Hoists, Air).

Air Hose—(See Hose, Air).

Air Lifts.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Air Reservoir Joints — (See Joints, Air Reservoir).

Arbor Press — (See Presses Arbor).

Arbors and Mandrels, Expanding.
Commonwealth Supply Co.
Nicholson & Co., W. H.

Arbors and Mandrels, Solid.
Brown & Sharpe Mfg. Co.
Cleveland Twist Drill Co.
Ingersoll Milling Machine Co., The.
Nicholson & Co., W. H.

Arch, Locomotive Brick.
American Arch Co.

Arch Tube Cleaners — (See Tube Cleaners).

Arch Tubes.
National Tube Co.
Parkesburg Iron Co.

Architectural Iron.
Page Steel & Wire Co.

Arrestors, Electric.
General Electric Co.

Asbestos Sheet Paper.
Air Reduction Sales Co.

Ash Pans, Cast Steel.
Commonwealth Steel Co.

Automatic Chucking and Turning Machines — (See Lathes, Automatic Chucking and Turning).

Automatic Connectors — (See Connectors, Automatic).

Automatic Lever Chucks — (See Chucks, Quick Action).

Automatic Milling Machines —(See Milling Machines, Automatic).

Automatic Screw Machines—(See Screw Machines, Automatic).

Band Saws.
American Saw Mill Machinery Co.

Banding Presses, Hydraulic—(See Presses, Banding).

Bars, Boring — (See Boring Bars).

Bars, Concrete, Reinforcing.
Carnegie Steel Co.
Ryerson & Son, Jos. T.

Bars, Iron and Steel—(See also Steel, Tool).
Carnegie Steel Co.
McConway & Torley Co., The.
Ryerson & Son, Jos. T.
United Alloy Steel Corp.

Bars, Refined Iron.
Ryerson & Son, Jos. T.

Batteries, Storage.
Prest-o-Lite Co., Inc.

Bearings, Center.
American Steel Foundries.
Chicago Ry. Equipment Co.
National Malleable Castings Co.
Nugent Steel Castings Co.

Bearings, Driving Box.
Gill Railway Supply Co.

Bearings, Side.
American Steel Foundries.
Chicago Ry. Equipment Co.
Nugent Steel Castings Co.
Wine Railway Appliance Co.

Belt Dressing.
Dixon Crucible Co., Jos.

Belts.
Goodrich Rubber Co., The B. F.

Belt Shifters, Mechanical.
Greaves, Klusman Tool Co.

Belting, Silent Chain — (See Chain Drive).

Bench Legs.
Brown & Sharpe Mfg. Co.

Bending Machines, Hand and Power.
Buffalo Forge Co.
Niles-Bement-Pond Co.
Pels & Co., Henry.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Southwark Fdry. & Mach. Co.
Underwood Corp., H. B.
Watson-Stillman Co., The

Bending Machines, Hydraulic.
Chambersburg Engineering Co.
Hydraulic Press Mfg. Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Southwark Fdry. & Mach. Co.
Watson-Stillman Co., The.

Bending Rolls — (See Rolls, Bending and Straightening).

Billets, Steel.
Carnegie Steel Co.
McConway & Torley Co., The.
Ryerson & Son, Jos. T.

Bits, Track and Bonding—(See Drills, Track and Bonding).

Bits, Machine Tool—(See Tool Holder Bits—High Speed Steel).

Blocks, Chain — (See Hoists, Chain).

Blooms, Steel.
Carnegie Steel Co.

Blowers.
Buffalo Forge Co.
Johnston Mfg. Co.

Blower Fitting Automatic Smoke Box.
Barco Mfg. Co.

Boiler Chemicals.
Dearborn Chemical Co.

Boiler Compounds—(See Compounds, Boiler).

Boiler Tube Cleaners—(See Tube Cleaners).

Boiler Washers and Testers.
Sellers & Co., Inc., Wm.

Boilers, Locomotive.
American Locomotive Co.
Baldwin Locomotive Works, The.

Bonding Outfits, Rail.
Ingersoll-Rand Co.

Bolsters, Car.
American Steel Foundries.

Bolsters, Steel.
Commonwealth Steel Co.

Bolt Cutters — (See Thread Cutting Machines, Bolt).

Bolt and Nut Machinery.
Acme Machinery Co.
Ajax Manufacturing Co.
Foote-Burt Co.
Landis Machine Co., Inc.
National Mchy. Co., The.
Niles-Bement-Pond Co.
Williams Tool Corp.

Bolts, Patch.
Ryerson & Son, Jos. T.

Bolts and Nuts.
National Acme Co.
Ryerson & Son, Jos. T.
United Alloy Steel Corp.

Bond Wires.
Page Steel & Wire Co.

Books—Railway.
Simmons-Boardman Pub. Co.

Boosters.
Franklin Ry. Supply Co.

Boring Bars.
Davis Boring Tool Co.
Gisholt Machine Co.
Ingersoll Milling Machine Co., The.
Williams & Co., J. H.

Boring Bars, Expansion.
Davis Boring Tool Co.

Boring Bars, Loco. Cylinder —(See Boring Machines Portable).

Boring and Drilling Machines, Horizontal.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Gisholt Machine Co.
Ingersoll Milling Machine Co., The.
Lucas Machine Tool Co.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.

Boring and Drilling Machines, Vertical.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Colburn Mach. Tool Plant of Consolidated Mach. Tool Corp. of America.
Foote-Burt Co.
Gisholt Machine Co.
Greenfield Tap & Die Corp.
Ingersoll Milling Machine Co., The.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.
Universal Boring Machine Co.

Boring, Drilling and Milling Machines, Horizontal.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Gisholt Machine Co.
Ingersoll Milling Machine Co., The.
Lucas Machine Tool Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.
Universal Boring Machine Co.

Boring Machines, Car Wheel.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Ingersoll Milling Machine Co., The.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

Boring Machines, Cylinder.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Niles-Bement-Pond Co.
Newton Machine Tool Plant of Consolidated Mach. Tool Corp. of America.
Sellers & Co., Inc., Wm.

Boring Machines, Portable (for Loco. Cylinder and Valve Chambers).
Rooksby, E. J., & Co.
Underwood Corp., H. B.

Boring Machines, Rod Boring, Duplex.
Ingersoll Milling Mach. Co.
Niles-Bement-Pond Co.
Newton Machine Tool Plant of Consolidated Machine Tool Corp. of America.

Boring Machines, Tire.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.
Universal Boring Machine Co.

Boring and Turning Mills, Vertical.
Betts Machine Plant of Consolidated Mach. Tool Corp. of America.
Bullard Machine Tool Co.
Cincinnati Planer Co.
Colburn Machine Tool Plant of Consolidated Machine Tool Corp. of America.
Gisholt Machine Co.
Niles-Bement-Pond Co.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

Boring Tools.
Davis Boring Tool Co.
Gisholt Machine Co.
Morris Tool Co., Inc.
Williams & Co., J. H.

Boring Tools, Expansion.
Davis Boring Tool Co.

Boxes, Cast Iron Packing for Use with Hardening and Annealing Furnaces.
Brown & Sharpe Mfg. Co.

Brake Beams.
American Steel Foundries.
Chicago Ry. Equipment Co.

Brake Beam Supports.
Chicago Ry. Equipment Co.

Brake Heads.
American Steel Foundries.
Chicago Ry. Equipment Co.
Nugent Steel Castings Co.

Brake Levers.
National Malleable Castings Co.
Westinghouse Air Brake Co.

Brake Pins.
Westinghouse Air Brake Co.

Brake Shoes.
Chicago Ry. Equipment Co.
Railway Materials Co.

Brake Wheels.
National Malleable Castings Co.
Nugent Steel Castings Co.

Brakes, Air.
Westinghouse Air Brake Co.

Brakes, Electric.
Westinghouse Air Brake Co.

Brakes, Hand.
Wine Railway Appliance Co.

Brakes, Press.
Wine Railway Appliance Co.

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Brick, Locomotive Arch.
American Arch Co.

Brushes, Dynamo and Motor.
Dixon Crucible Co., Jos.
Westinghouse Electric & Manufacturing Co.

Buffers, Electric.
Bridgeport Safety Emery Wheel Co.
U. S. Electrical Tool Co., The.

Buffers, Friction.
Westinghouse Air Brake Co.

PANTASOTE
TRADE MARK

THE National Standard for car curtains and car upholstery. Twenty years' service tests have established its superiority to any other curtain material.

AGASOTE
TRADE MARK

FOR car headlinings and interior trim. A homogeneous waterproof board of great density and tensile strength. It will not warp, blister or separate.

NON-CONDUCTIVE qualities of heat and cold make it peculiarly well adapted for headlining and interior trim for steel fireproof passenger cars, entirely eliminating the disadvantage of steel for interior trim and giving the appearance of wood finish.

THE PANTASOTE COMPANY

11 Broadway, New York
Peoples Gas Building, Chicago
797 Monadnock Building, San Francisco

BUYERS INDEX

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Ingersoll-Rand Co.
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Westinghouse Electric & Manufacturing Co.

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Drills, Ratchet.
Whitman & Barnes Mfg. Co.

Drills, Rock.
Chicago Pneumatic Tool Co.
Greenfield Tap & Die Corp.
Ingersoll-Rand Co.

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YOU will be surprised, perhaps, to find the web of the CLE-FORGE Drill just as true and as accurately centered as the finest milled drill made.

Because the CLE-FORGE High Speed Drill is forged you will also find in it that toughness, stamina—or whatever you want to call that quality which resists drill breakage and reduces drill cost to the minimum—which, hitherto, has been the peculiar (and exclusive) advantage of the ordinary forged drill.

By combining into one drill these two out-standing features, CLE-FORGE offers you an entirely new experience in the use of High Speed Drills for increasing your production.

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CLEVELAND
NEW YORK CHICAGO LONDON
TRADE MARK REG U S PAT OFF.

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Gould & Eberhardt Co.
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Greenfield Tap & Die Corp.
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Landis Tool Co.
Modern Tool Plant, of Consolidated Mach. Tool Corp. of America.

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Landis Tool Co.
Modern Tool Plant, of Consolidated Mach. Tool Corp. of America.

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Little Giant Co.
Ryerson & Sons, Jos. T.

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Niles-Bement-Pond Co.
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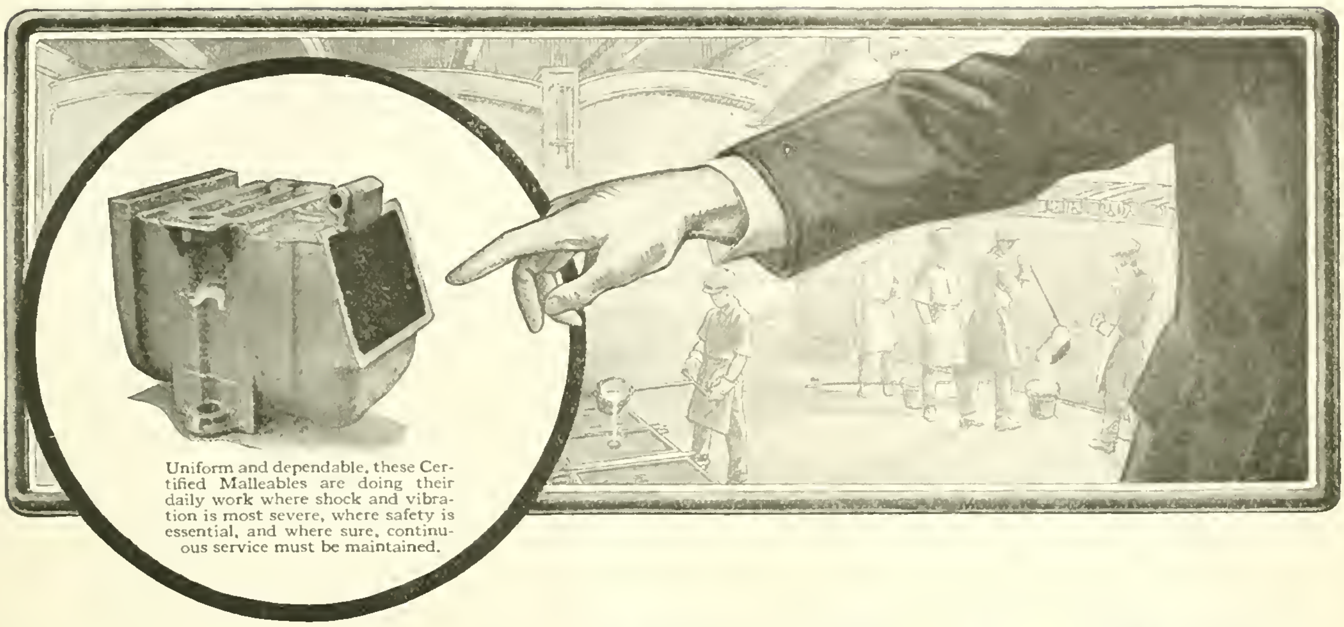
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Whiting Corp.



Uniform and dependable, these Certified Malleables are doing their daily work where shock and vibration is most severe, where safety is essential, and where sure, continuous service must be maintained.

Why is This Part Called "Certified Malleable?"

"Certified", in the Malleable Castings business, means the same as sterling applied to silverware.

"Certified Malleable" is the product of those companies who receive quarterly certificates of merit from the Association's consulting engineer; declaring that their product for the quarter indicated met his exacting tests and plant inspections.

Buyers of castings should know that the product of every foundry must show the highest quality before the name of that company can appear on this page, as a maker of Certified Malleable Castings. Companies have striven for years to get their names on this list, even going to the expense of rebuilding their plants and revamping their equipment and foundry practice in their efforts to meet the Association's requirements for Certified Malleable Castings.

The American Malleable Castings Association has been a leader in the matter of establishing higher quality standards at which its members could aim—a principle now so strongly urged by the United States Department of Commerce. This guardianship of consumers' interests can be likened to the Trade Guild activities of the middle ages.

THE AMERICAN MALLEABLE CASTINGS ASSN.
The 1900 Euclid Building Cleveland, Ohio

MAKERS OF CERTIFIED MALLEABLE CASTINGS

Certificate Holders for the Quarter Ending September 30th, 1923

Albany Malleable Iron Co	Voorheesville N. Y.
Albion Malleable Iron Co.	Albion, Mich.
American Chain Co.	Bridgeport, Conn.
American Malleable Castings Co	Marion, O.
American Malleables Co	Lancaster, N. Y., and Owosso, Mich.
Badger Malleable & Mfg. Co.	South Milwaukee, Wis.
Baltimore Malleable Iron & Steel Casting Co	Baltimore, Md.
Belle City Malleable Iron Co.	Racine, Wis.
Chain Belt Co.	Milwaukee, Wis.
Chicago Malleable Castings Co	West Pullman Chicago, Ill.
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CERTIFIED-MALLEABLE CASTINGS

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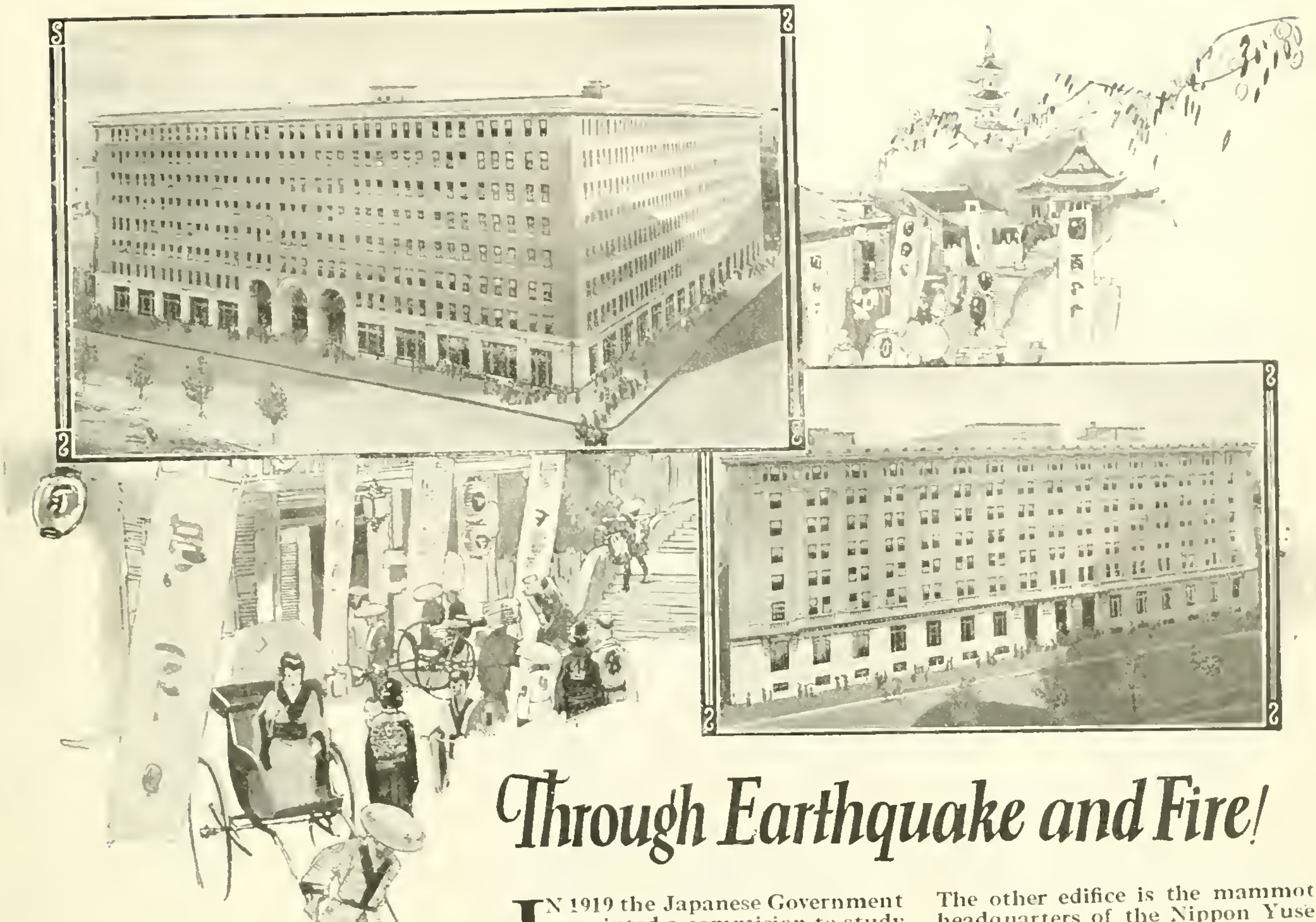

Through Earthquake and Fire!

In 1919 the Japanese Government appointed a commision to study European and American building methods. The commission was so favorably impressed with American buildings, that a New York firm was invited to organize the Geo. A. Fuller Co. of the Orient, Ltd., their first work being the erection, in Tokio, of the two giant structures illustrated above.

These buildings were nearing completion when the disastrous earthquake and fire occurred. American building methods scored their crowning triumph when these structures emerged with amazingly small damage from the most terrible catastrophe in recorded history.

The larger of these buildings, the Marunouchi Building, now stands amidst devastation and ruin, a modern office building of gigantic proportions, a typical American steel frame structure.

The other edifice is the mammoth headquarters of the Nippon Yusen Kaisha. Both of these buildings contain all modern conveniences and safeguards to life and property, such as passenger elevators, electric light, plumbing, heating and other pipe systems. These latter include a number of services found only in the best equipped American business buildings, namely:

Heating System	*Byers Pipe*
Cold Water Supply Lines	*Byers Pipe*
Hot Water Supply Lines .	*Byers Pipe*
Fire Lines	*Byers Pipe*
Sprinkler System	*Byers Pipe*
Refrigeration System .	*Byers Pipe*
Drinking Water Lines and Other Services . .	*Byers Pipe*
Vacuum Sweeper Lines.	*Byers Pipe*

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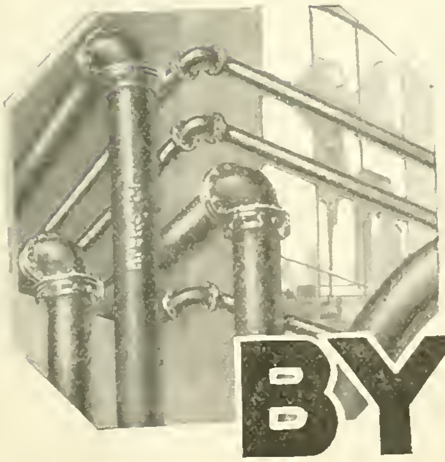

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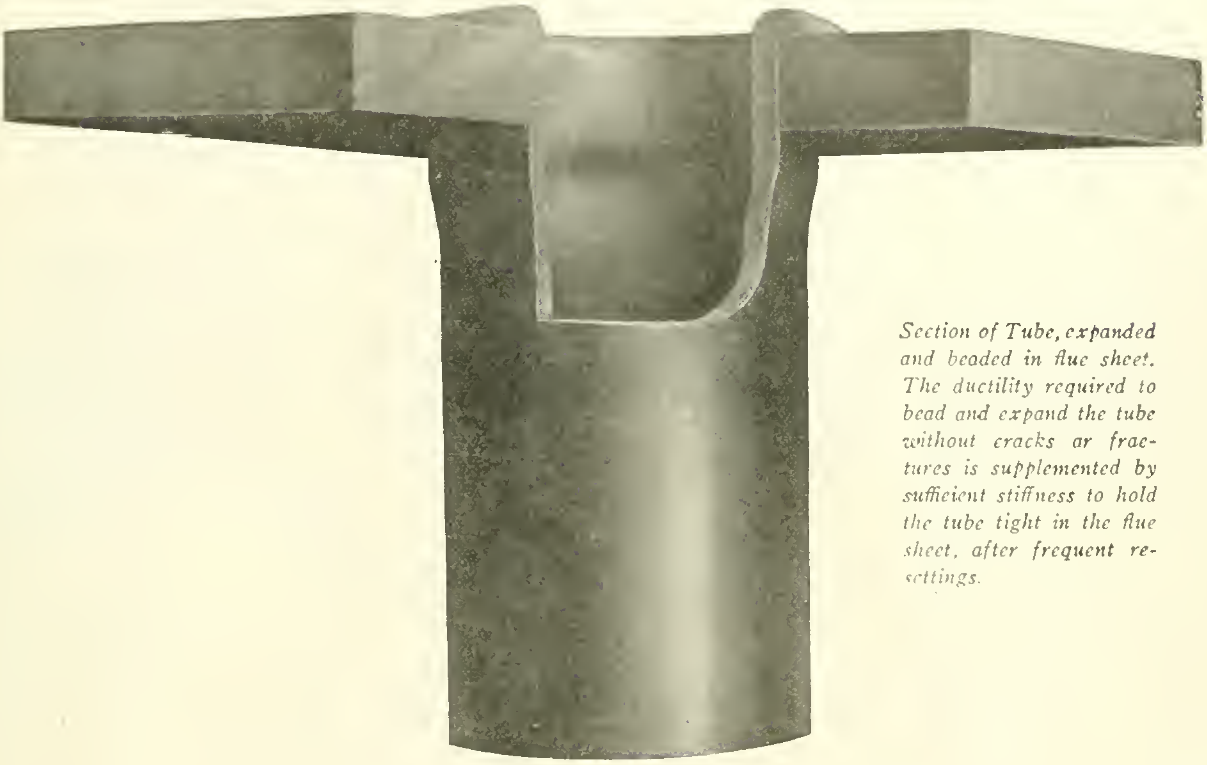

Section of Tube, expanded and beaded in flue sheet. The ductility required to bead and expand the tube without cracks ar fractures is supplemented by sufficient stiffness to hold the tube tight in the flue sheet, after frequent resettings.

THE constant search for and the thorough development of opportunities for improving the product has always been a basic principle underlying the manufacture of "SHELBY" Seamless Steel Boiler Tubes. Constantly, the aim has been to make the tubes better, then better, then better.

As new and higher standards of boiler construction have been adopted and pressures increased, it has been the endeavor of National Tube Company by careful study and experiment, not only to keep pace with but actually anticipate, the needs and demands of boiler tube service. So that today, with modern blast furnaces, open hearth steel works, rolling mills and manufacturing plants, especially designed and expertly supervised, the modern steel tube is better than it has ever been before and particularly adapted to the requirements of modern power generation.

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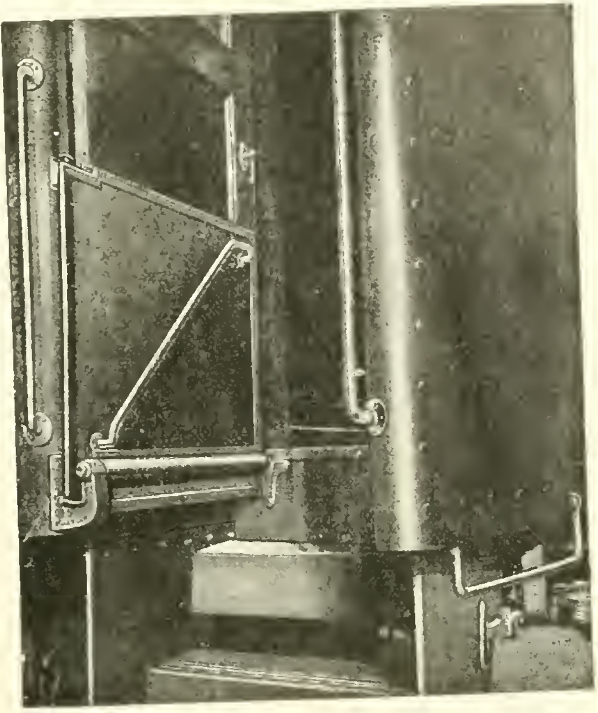

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SYRACUSE, N. Y.
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LEADERS SINCE 1887

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